QUEEN MARY'S COLLEGE (A), CHENNAI-4

PG & RESEARCH DEPARTMENT OF CHEMISTRY

M.Sc. CHEMISTRY

CO-K, PO – CO MAPPED SYLLABUS

2021-22 onwards

QUEEN MARY'S COLLEGE (A), CHENNAI – 4

PG AND RESEARCH DEPARTMENT OF CHEMISTRY

BOARD OF STUDIES 2021-22

MINUTES OF THE BOARD MEETING HELD ON 31.03.2021

REVISION OF PG SYLLABI

The meeting of the Board of Studies was held on 31.03.2021. The proposed new syllabi were presented before the board.

The following changes were made:

1. In Semester- I, Paper- II -Organic Applications of spectroscopy title has been renamed as "Spectroscopic application in Organic Chemistry".

2. All eight-ester hydrolysis mechanisms have been included in UNIT- I- Organic Chemistry-I, since they enlighten student's understandings.

3. In Organic Chemistry-II, UNIT-V- topics have been enhanced with finer details that will aid the students for easy understanding.

4. In Organic Chemistry-IV UNIT-IV-Biomolecules topic has been subdivided into Carbohydrate, Proteins and Nucleic acids.

The copy of the syllabi after carrying out the suggestions was submitted for approval.

QUEEN MARY'S COLLEGE (A), CHENNAI – 4

PG AND RESEARCH DEPARTMENT OF CHEMISTRY

BOARD OF STUDIES 2021-22

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PG and Research Department of Chemistry

Queen Mary's College (A), Chennai – 4

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15.	Mrs. K. Bharathi	- Assistant Professor.
16.	Mrs. K. Jayanthi	- Assistant Professor.
17.	Dr. N.Vijayashree	- Assistant Professor.
18.	Dr.R. Komalavalli	- Assistant Professor.

CONTENTS

List of Papers with Credits for the proposed new syllabi (PG)

S.No	Sem	C/E	Code No.	Title	No. of Credits	Int. Marks	Ext. Marks
SEMESTER - I							
1.	I	C	PC5341	Organic Chemistry –I	4	25	75
2.	I	C	PC5342	Spectroscopic application in Organic Chemistry	4	25	75
3.	I	C	PC5343	Quantum Chemistry and Chemical Kinetics	4	25	75
4.	I	C	PC5344	Inorganic Chemistry-I	4	25	75
5.	I	C	PC5345	Inorganic Chemistry Practicals-I	4	25	75
SEMESTER - II							
6.	II	C	PC5346	Organic Chemistry –II	4	25	75
7.	II	C	PC5347	Inorganic Chemistry-II	4	25	75
8.	II	C	PC5348	Organic Chemistry Practicals-II	4	25	75
9.	II	E	PE5317	Elective-I- Electro Chemistry	3	25	75
10.	II	E	PE5318	Elective-II- Nanochemistry	3	25	75
11.	II	E(other discipline)	PD5308	EDE- I- Food Chemistry	3	25	75
SEMESTER - III							
12.	III	C	PC5349	Organic Chemistry – III	4	25	75
13.	III	C	PC5350	Group Theory, Surface Phenomena and Thermodynamics	4	25	75
14.	III	C	PC5351	Physical chemistry practicals-III	4	25	75
15.	III	E	PE5319	Elective-III- Problem Solving in Chemistry	3	25	75
16.	III	E	PE5320	Elective-IV- Inorganic Chemistry-III	3	25	75
17.	III	E(other discipline)	PD5309	EDE- II- Chemistry of Engineering Materials	3	25	75
SEMESTER - IV							
18.	IV	C	PC5352	Organic Chemistry-IV	4	25	75
19.	IV	C	PC5353	Physical Methods and Analytical Techniques	4	25	75
20.	IV	C	PC5354	Spectroscopic Methods in Inorganic Chemistry	4	25	75
21.	IV	C	PC5355	Analytical Chemistry Practicals -IV	4	25	75
22.	IV	E	PE5321	Elective-V- Dissertation and Viva- Voce	3	25	75

C- Core; E- Elective; EDE – Other Department Elective

SOFT SKILL SUBJECTS

S.No	Sem	Code No.	Title	No. of Credits	Int. Marks	Ext. Marks
1.	I		Soft Skill-I- Language Lab	2	25	75
2.	II		Soft skill-II- Personal Skills	2	25	75
3.	III		Soft skill III Social skills	2	25	75
4.	IV		Soft skill IV Employability skills	2	25	75
			INTERNSHIP			
1	II		INTERNSHIP		25	75

CHOICE BASED CREDIT SYSTEM FOR PG- 2021-22

Total No of Courses : 27 Total Credits: 91

Type of Course	No. of Course	Credits Per Course	Credits
Core	15	4	60
Core Elective	5	3	15
Other Department Elective	2	3	6
Soft Skill	4	2	8
Internship	1	2	2

- Out of 7 elective Courses 5 elective Courses will be offered by parent department (II, III and IV Semester)
- The remaining 2 elective Courses will be offered to all Other PG students in the college (II and III Semester)

S. No	Core/Elective	Hrs/Week*	No. of Weeks*	Total Hours/ Semester
1	Core	06	15	90
2	Elective	04	15	60

- ***Week - 6 working day order Semester – 15 such weeks**
- Number of Units in the syllabus of core Courses 05
- Number of Units in the syllabus of elective Courses 05
- Maximum marks per Course 100
- **Total marks 2200**

QUANTIFICATION : END SEMESTER EXAMINATION

QUESTION PAPER PATTERN - M. Sc. CHEMISTRY

(EFFECTIVE FROM ACADEMIC YEAR 2021-2022)

CORE AND ELECTIVE COURSES

Maximum Marks: 100 (Internal Assessment: 25, External Valuation: 75)

Part – A	Part – B	Part - C
5 x 2 = 10 marks	**5 x 4 = 20 marks**	**3 x 15 = 45 marks**
Answer all the questions	**Answer all the questions**	**Answer any 3 questions**

Question	Unit
1	I
2	II
3	III
4	IV
5	V

Question	Unit
6(a) or 6(b)	I
7(a) or 7(b)	II
8(a) or 8(b)	III
9(a) or 9(b)	IV
10(a) or 10(b)	V

Question	Unit
11	I
12	II
13	III
14	IV
15	V

INTERNAL EVALUATION METHODOLOGY FOR ALL PROGRAMS

- Quiz programme
- Periodic class tests
- MCQ type assignments
- Assignments on problem solving (Individual/group)
- Seminars using powerpoint and chemdraw
- Group discussions/Debate/Interactive sessions
- Oral presentation on current topics of interest

QUANTIFICATION OF INTERNAL EVALUATION - PG THEORY

- Minimum 2 Internal tests – Average of 2 Test
- Minimum 3 assignments – Average of 2 best assignments
- Seminar
- Model Examination for 75 marks reduced to 10 marks

TEST	ASSIGNMENT	SEMINAR	MODEL EXAM	TOTAL	CONTINUOUS INTERNAL ASSESSMENT
10	10	5	75	100	-
Reduced To					
5	5	5	10		25

PRACTICALS

Maximum Marks : 100

Internal Assessment : 25 **External Valuation: 75**

Model test for 75 marks reduced to 10 marks

Attendance	Observation	Record	Model	Total
5	5	5	10	25

Practical End Semester Exam
75

Passing minimum

University Examination 50%
Aggregate (CIA+UE) 50%
Grade Points and Cumulative Grade Point Average are awarded in the mark sheet

TEACHING METHODOLOGIES ADOPTED FOR THE PROGRAMME

1. CHALK TALK
2. TEXT BOOK LEARNING
3. DIGITAL LEARNING- ONLINE PPT - LECTURE NOTES
4. VIDEO LECTURE – ONLINE – YOU TUBE – GOOGLE MEET - CLASSROOM
5. INTERACTIVE SESSIONS
6. STUDENT SEMINAR
7. LECTURE BY EXPERTS IN FIELD – INVITED TALKS
8. PARTICIPATORY LEARNING – LECTURES IN OTHER INSTITUTIONS

Programme Educational Objective (PEO)

The objective of M.Sc. Chemistry programme is to empower students with requisite skill sets to

- be experts in the subject, eloquent communicators and eminent academicians (PE01)
- be a competent resource with analytical skills and take up key roles in industry (PE02)
- make significant contribution in the field of research (PE03)

Programme Specific Outcome (PSO)

After completing the M.Sc. Chemistry programme, the students will have

1. in depth knowledge on advanced concepts in chemistry which will enable them to have careers in industry and research (PSO1 : PO1)
2. competence in handling digital tools to broaden their domain knowledge (PSO2 : PO7)

3. problem solving skills essential for providing solutions to research problems as well as to excel in competitive examinations (PSO3 : PO3)
4. curiosity to analyse the concepts in chemistry (PSO4 : PO4)
5. capability to work in teams to achieve a common goal (PSO5 : PO5)
6. communication skills and can take active participation in group discussions (PSO6 : PO2)
7. exposure to current national and international developments in the field of chemistry (PSO7 : PO9)

Programme Outcome (PO)

The aim of the PG program in Chemistry is to hone the analytical, problem solving and communication skills of students, thereby, making significant contribution to the talent pool in chemistry.

While pursuing the program, there will be abundant scope for students to gain strong foundation in fundamental as well as advanced concepts (**PO1**), improve communication skills (**PO2**), strengthen the problem solving skills (**PO3**), develop sense of enquiry (**PO4**), imbibe team spirit by working in groups (**PO5**), gain leadership attributes (**PO6**), enhance digital skills (**PO7**), reinforce ethical values (**PO8**), broaden their domain knowledge (**PO9**), develop aptitude for lifelong learning (**PO10**). The total correlation of skills for the program is arrived at by assessing the skill levels for each unit on a scale of 3 in which the value of 1, 2, and 3 correspond to low, moderate and strong correlation, respectively. Skill levels below 30 % are not correlated and left blank.

Graduate Attributes for M.Sc. Chemistry Programme

PO1. Disciplinary knowledge and skills : Capability to demonstrate deep knowledge in (i). stereochemistry, reaction mechanisms, reagents for functional group transformations and strategies in asymmetric synthesis and retrosynthesis, heterocyclic compounds, biomolecules, green chemistry, natural products, coordination chemistry, bioinorganic chemistry, organometallic chemistry, main group chemistry, nuclear chemistry, supramolecular chemistry, quantum mechanics, group theory, statistical thermodynamics, polymer and macromolecular chemistry, electroanalytical techniques, electrochemistry, chemical kinetics, solid state chemistry, nanochemistry and problem solving in chemistry. (ii). elucidating structure of organic and inorganic compounds using various spectroscopic techniques. (**PSO1**).

PO2. Skilled Communicator: Ability to express important concepts in a lucid manner through seminars using power point presentations and report writing by applying the methodologies learnt in soft skill courses. (**PSO6**).

PO3. Critical thinker and problem solver: Aptitude, gained through rigorous problem solving sessions in Course titled “Problem solving in chemistry” as well as assignments and quiz programmes, to solve problems and find solutions by critical analysis of concepts. (**PSO3**).

PO4. Sense of inquiry: Skill to put forward inquisitive questions in group discussions and seminars. (**PSO4**).

PO5. Team player/worker: Ability to undertake team assignments/work through the experience gained in internship and competitions (**PSO5**).

PO6. Skilled project Manager: Competence to conceive ideas, plan and execute experimental protocols utilising skills acquired during project work.

PO7. Digitally Efficient: Proficiency in using softwares for theoretical calculations in chemistry and drawing structures of compounds (chemdraw), a skill learnt in internship and CLP programmes (**PSO2**).

PO8. Ethical awareness / reasoning : Commitment to reinforce ethical and moral standards while practicing science by not resorting to manipulation, fabrication and plagiarism. Consciousness adherence to norms for copy right as well as intellectual property right. These attributes are instilled through course on value education.

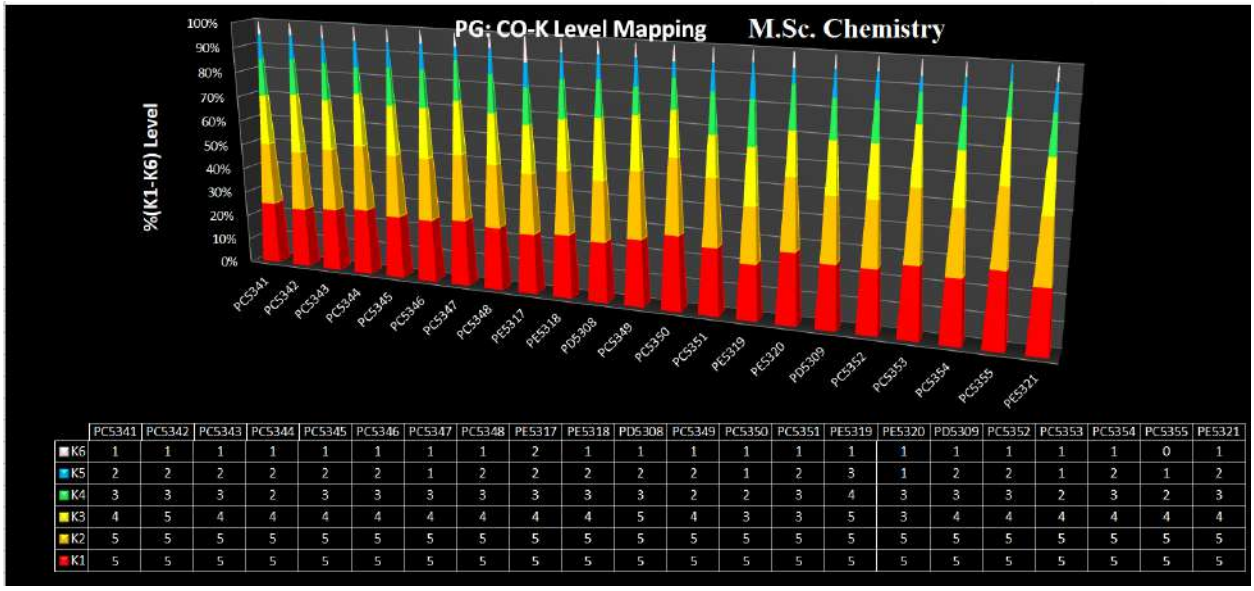
PO9. National and international perspective: Quest to stay updated about current developments in various concepts learnt during the course and in the field of research. Referring e Resources from institutions with national and international reputation, effective usage of INFLIBNET and participation in seminars ensures this attribute (**PSO7**).

PO10. Lifelong learners: Inclination to pursue a career in the field of chemistry makes students to continuously replenish their domain knowledge

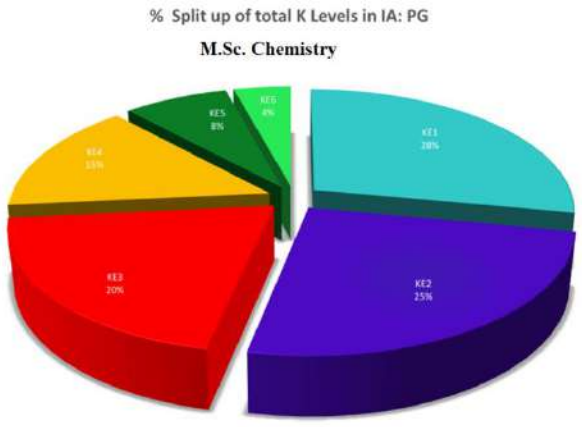
PG Course Outcome (CO) :

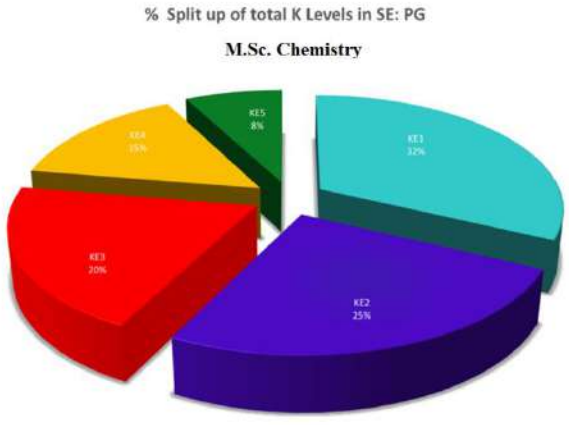
The PG Chemistry curriculum has been designed to impart skills corresponding to 6 knowledge levels, viz., K1, K2, K3, K4, K5 and K6, advocated by Bloom's taxonomy. The curriculum enables students to acquire clear understanding of core concepts in chemistry. The evaluation method comprising of both internal and external assessment ensures the student's ability to apply and analyse advanced concepts. Creative skills are imparted through project work. The knowledge levels are mapped to check their presence or absence.

CO-K Mapping

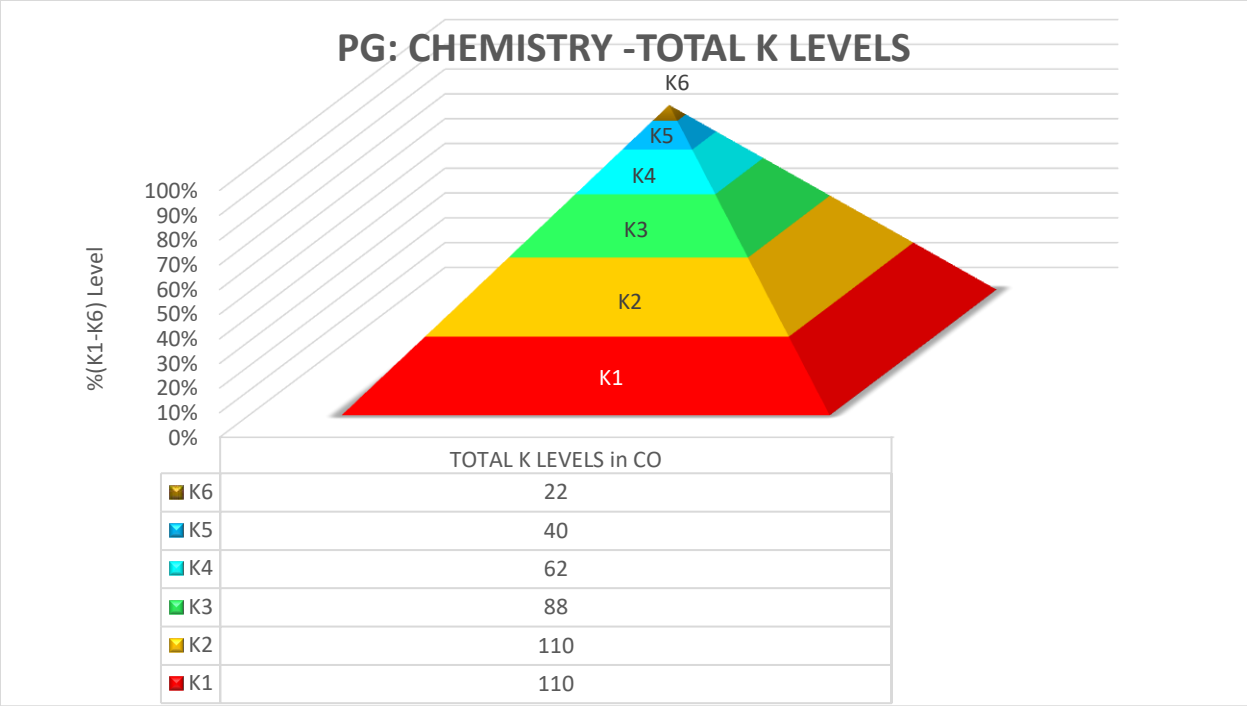


	PC5341	PC5342	PC5343	PC5344	PC5345	PC5346	PC5347	PC5348	PE5317	PE5318	PD5308	PC5349	PC5350	PC5351	PE5319	PE5320	PD5309	PC5352	PC5353	PC5354	PC5355	PE5321
K6	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	0	1
K5	2	2	2	2	2	2	1	2	2	2	2	2	1	2	3	1	2	2	1	2	1	2
K4	3	3	3	2	3	3	3	3	3	3	3	2	2	3	4	3	3	3	2	3	2	3
K3	4	5	4	4	4	4	4	4	4	4	5	4	3	3	5	3	4	4	4	4	4	4
K2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
K1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

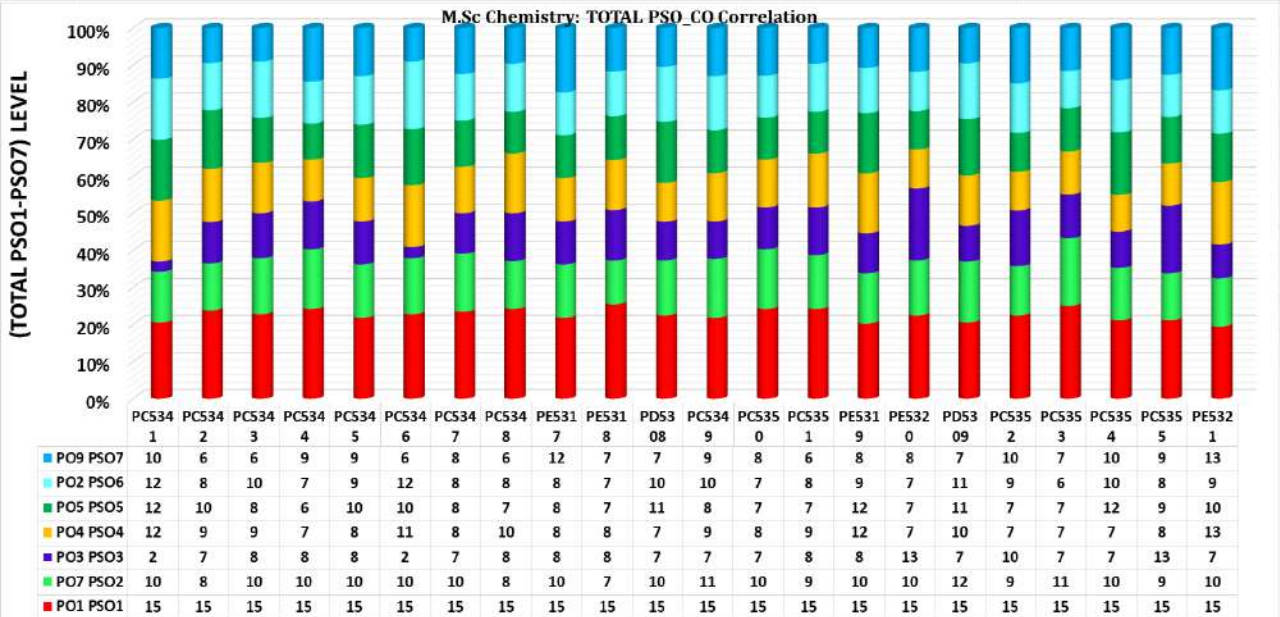




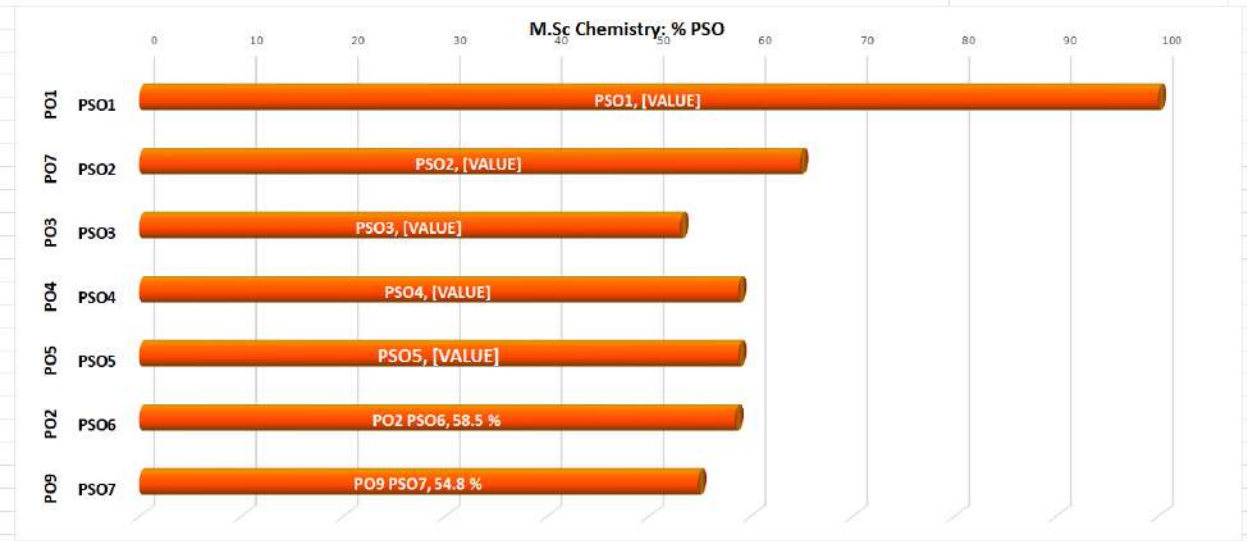
Note : Kindly refer Appendix for mapping and correlation details of all courses of the program.



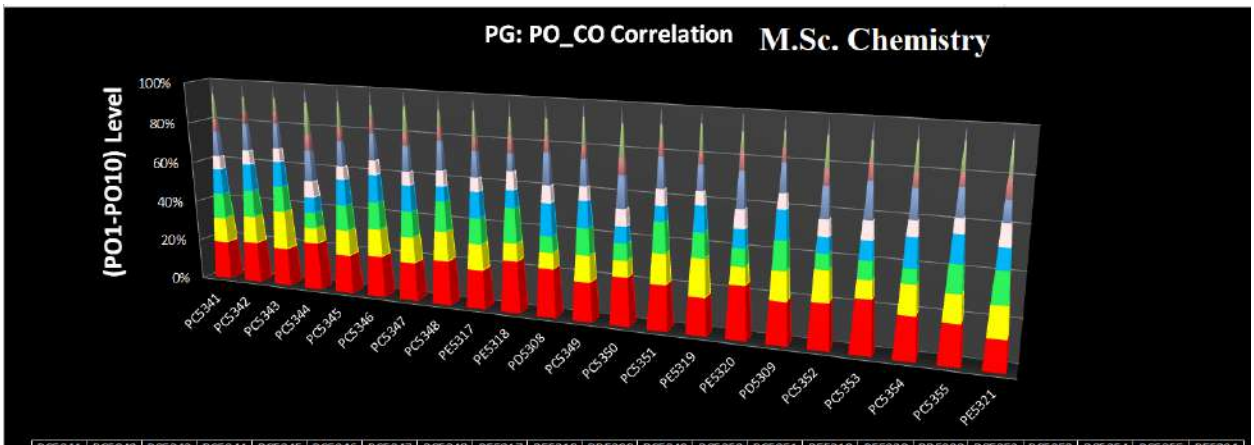
	TOTAL K LEVELS in CO
K6	22
K5	40
K4	62
K3	88
K2	110
K1	110



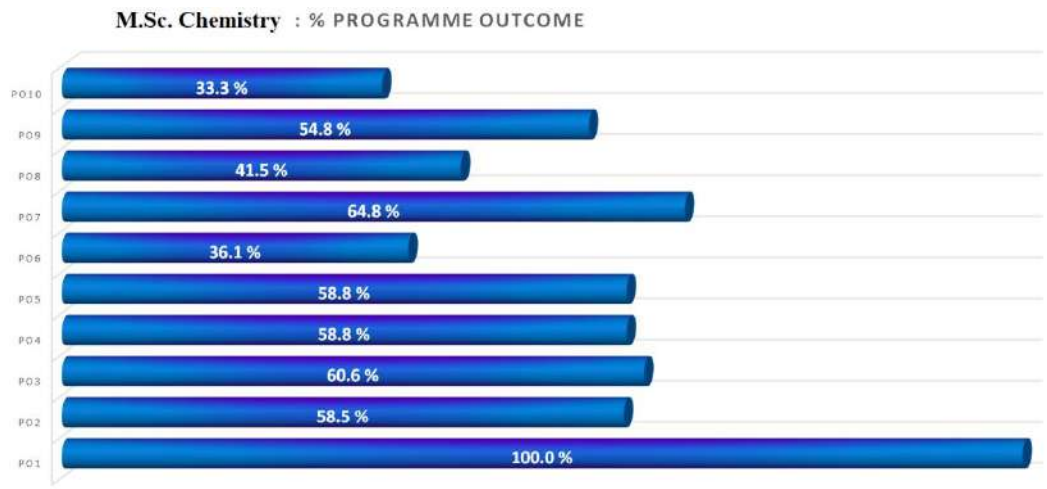
	PC534 1	PC534 2	PC534 3	PC534 4	PC534 5	PC534 6	PC534 7	PC534 8	PE531 7	PE531 8	PD53 08	PC534 9	PC535 0	PC535 1	PE531 9	PE532 0	PD53 09	PC535 2	PC535 3	PC535 4	PC535 5	PE532 1
PO9 PSO7	10	6	6	9	9	6	8	6	12	7	7	9	8	6	8	8	7	10	7	10	9	13
PO2 PSO6	12	8	10	7	9	12	8	8	8	7	10	10	7	8	9	7	11	9	6	10	8	9
PO5 PSO5	12	10	8	6	10	10	8	7	8	7	11	8	7	7	12	7	11	7	7	12	9	10
PO4 PSO4	12	9	9	7	8	11	8	10	8	8	7	9	8	9	12	7	10	7	7	7	8	13
PO3 PSO3	2	7	8	8	8	2	7	8	8	8	7	7	7	8	8	13	7	10	7	7	13	7
PO7 PSO2	10	8	10	10	10	10	10	8	10	7	10	11	10	9	10	10	12	9	11	10	9	10
PO1 PSO1	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15



PO-CO Mapping



	PC5341	PC5342	PC5343	PC5344	PC5345	PC5346	PC5347	PC5348	PE5317	PE5318	PD5308	PC5349	PC5350	PC5351	PE5319	PE5320	PD5309	PC5352	PC5353	PC5354	PC5355	PE5321
010	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
09	2	1	1	2	2	1	2	1	2	1	1	2	2	1	2	1	1	2	1	2	2	3
08	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
07	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2
06	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
05	2	2	2	1	2	2	2	1	2	1	2	2	1	1	2	1	2	1	1	2	2	2
04	2	2	2	1	2	2	2	2	2	2	1	2	1	2	2	1	2	1	1	1	2	3
03	2	2	3	1	2	2	2	2	2	1	1	2	1	2	3	1	2	2	1	2	2	3
01	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3


M.Sc. Chemistry : % PROGRAMME OUTCOME
PO10
PO9
PO8
PO7
PO6
PO5
PO4
PO3
PO2
PO1
33.3 %
54.8 %
41.5 %
64.8 %
36.1 %
58.8 %
58.8 %
60.6 %
58.5 %
100.0 %

QUEEN MARY'S COLLEGE (AUTONOMOUS) CHENNAI – 4

M.Sc. CHEMISTRY

ORGANIC CHEMISTRY – I (Core)

Semester-I

Course No. : I **Max Marks: 75**
Code: PC5341 **Credits: 4**

Learning Objectives : The aim of the course is to give

1. Understanding about the nature and reactivity of reactive intermediates.
2. Knowledge about the mechanism of substitution reactions involving NGP, enolates, asymmetric alkylation and addition reactions, and hence will be able to optimise the yield of a reaction and control the regiochemical as well as the stereochemical outcome of chemical reactions.
3. Awareness about methods available to determine the mechanism of chemical reactions.
4. Knowledge about stereochemistry and conformational analysis of organic molecules
5. Understanding about aromatic, non aromatic and antiaromatic nature of organic compounds.

COURSE OUTCOMES:

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluation, K6 – Create

CO Number	Course outcome	POs addressed
CO1	**Reactive intermediates** **recall** characteristics of carbocations, carbanions, nitrenes, arynes. **analyse** factors controlling rates of aliphatic nucleophilic substitution reactions **explain** mechanism of ester hydrolysis **predict** the outcomes of finkelstein and wurtz coupling reactions. **https://www.vedantu.com/chemistry/finkelstein-reaction** **https://byjus.com/chemistry/wurtz-reaction/**	K1 K4 K2 K3
CO2	**METHODS OF DETERMINING REACTION MECHANISMS** **define** kinetic and non-kinetic methods of determining reaction mechanisms. **classify** conditions for kinetic and thermodynamic control of product	K1 K4 K3 K2

	formation **use** thermodynamic and kinetic aspects of reactions. **relate** structure and activity of set of compounds using hamett and taft equations. **Compile** substituent and reactant constants using Hamett and Taft equations **Activities** Seminar:kinetic and thermodynamic controlled reactions.Transition state vs intermediate **eResources** Nonkinetic Methods for the Elucidation of Reaction Mechanisms - ScienceDirect **https://www.chemistryworld.com/opinion/hammett-equation/4011006.article** **https://www.slideshare.net/BebetoGNair/methods-of-determining-reaction-mechanisms-andria-dsouza**	K6
CO3	**Stereochemistry** **predict** molecular symmetry and chirality of organic molecules. **define** diastereomers, constitutionally symmetrical and unsymmetrical chiral molecules. **illustrate** axial, planar, and helical chirality **compare** enantiotopic and diastereotopic ligands **Activity** **e quiz**:chirality,R S notation **eResources** Three-Dimensional Representations: Sawhorse Projections (chemeddl.org) **http://www.chem.ucalgary.ca/courses/351/Carey5th/Ch07/ch7-6.html** **https://www.youtube.com/watch?v=-Lu_vxcZ4ps**	K2 K1 K3 K5
CO4	**Conformational Analysis** **recognize** the relationship between conformation and reactivity of organic compounds. **summarise** the outcomes of curtin-hammett principle **connect** stability of acyclic and cyclic systems with conformations. **compile** stable conformations of cis and trans decalins and 9-methyl decalin **eResources** **https://www.masterorganicchemistry.com/2014/08/05/fused-rings/** **https://www.metallacycle.com/chemistry/organic/asymmetric-synthesis/pdfs/03%20Conformational%20Analysis.pdf** **https://www.metallacycle.com/chemistry/organic/asymmetric-synthesis/pdfs/03%20Conformational%20Analysis.pdf**	K1 K2 K4 K5
CO5	**Aromaticity** **recognize** characteristics of aromatic compounds and **describe** their stability. **apply** NMR spectrum to characterize aromatic and antiaromatic	K1 K2 K3

	compounds. **Activity** **Debate** on the correlation between aromticity and stability (**PO2**) **Seminar:** electron occupancy in MOs,Problems in finding out aromaticity https://madoverchemistry.com/2019/04/23/110-aromaticity3-huckel-molecular-theory-hm https://www.youtube.com/watch?v=FN0G_V_4cgA	

CO/PO	PO									
	1 Disciplinary knowledge and skills	2 skilled communicator	3 critical thinker and problem solver	4 sense of inquiry	5 Team player / worker	6 skilled project manager	7 Digitally efficient	8 Ethical awareness and reasoning	9 National and international Perspective	10 Lifelong learners
CO1	3	3	3	2	3	1	3	1	2	1
CO2	3	2	2	2	2	1	2	2	2	1
CO3	3	2	2	3	2	1	2	2	2	1
CO4	3	2	1	3	2	1	1	1	2	1
CO5	3	3	2	2	3	1	2	1	2	1
Average PC 5341	3	2	2	2	2	1	2	1	2	1
TOTAL PC 5341	15	12	10	12	12	5	10	7	10	5

Course Outline

UNIT I **(18 hrs)**

REACTIVE INTERMEDIATES

Carbocations, carbanions, radicals, carbenes, nitrenes, arynes – generation, stabilities, identification, trapping and structure.

ALIPHATIC NUCLEOPHILIC SUBSTITUTION

Neighbouring group participation, Substitution at carbonyl, vinylic and bridgehead system. Substitution with ambident nucleophiles. "O" Vs"C"- alkylation of ketones through enamines, lithium enolates, and silyl enol ether. Role of LDA, crown ethers and phase transfer catalyst (PTC) in nucleophilic substitution reactions.

Generation of enolates, enolates selectivity (kinetics Vs thermodynamics), alkylation of enolates and stereochemistry of enolate alkylation. Classification of the eight mechanism for ester hydrolysis and formation- $A_{AC}1$, $A_{AC}2$, $A_{AL}1$,$A_{AL}2$,$B_{AC}1$,$B_{AC}2$,$B_{AL}2$ and $B_{AL}2$. Alkylation of active methylene compounds. Asymmetric alkylation (Evans, Enders and Meyers procedure). Preparation and synthetic utility of enamines, Finkelstein reaction-Wurtz coupling.

UNIT - II **(18hrs)**

METHODS OF DETERMINING REACTION MECHANISMS

Kinetic and non-kinetic methods of determining reaction mechanisms-Thermodynamic and kinetic aspects-spectroscopic studies - isotope effects – energy profile diagrams – intermediate *vs* transition state – product analysis and its importance – cross over experiments. Relationship between thermodynamic stability and rates of reactions - kinetic versus thermodynamic control of product formation – Hammond postulate - kinetic isotope effects with examples

Quantitative treatment of structure and reactivity – Hamett and Taft equations – Classification of solvents (protic and aprotic), solvent effects in organic chemistry – solute –solvent interactions.

UNIT III **(18 hrs)**

STEREOCHEMISTRY

Introduction to molecular symmetry and chirality; axis, plane, center, alternating axis of symmetry; Configuration and conformational stereoisomers; enantiomers – racemic modifications - R and S nomenclature using Cahn-Ingold-Prelog rules – molecules with a chiral center and C_n – molecules with more than one center of chirality; definition of diastereoisomers;

constitutionally symmetrical and unsymmetrical chiral molecules; erythro, threo nomenclature; Fischer, Sawhorse and Newmann Projections and their interconversion.

Axial, planar and helical chirality – examples – stereochemistry and absolute configuration of allenes, biphenyls and binaphthyls, ansa and cyclophanic compounds, spiranes, exo-cyclic alkylidenecycloalkanes.

Topicity and prostereoisomerism – topicity of ligands and faces, and their nomenclature – NMR distinction of enantiotopic/diastereotopic ligands.

UNIT IV (18 hrs)

CONFORMATIONAL ANALYSIS

Conformational analysis of acyclic and cyclic systems : 1,2 disubstituted ethane derivatives, cyclohexane and its disubstituted derivatives, cyclo hexanols –conformation and reactivity – oxidation, acylation, hydrolysis and esterification – chemical consequence of conformational equilibrium - Curtin-Hammett principle. Conformation and stereochemistry of cis and trans decalins and 9-methyl decalin

UNIT V (18 hrs)

AROMATICITY

Huckel's theory of aromaticity – electron occupancy in MOs – Systems with $(4n+2)\ \pi$ electrons and $4n\pi$ electrons – Alternant and Non-alternant hydrocarbons – aromatic systems with 2, 4, 8, and 10 electrons – Systems of more than 10 electrons (Annulenes) – Aromaticity in Sydnones and fullerenes – Concept of homoaromaticity – Heteroaromatic molecules. NMR concept of aromaticity and antiaromaticity – compounds with aromatic sextets: Five, six, seven, and eight membered ring and other systems

COURSE OUTCOME

The student

1 can have understanding about the nature and reactivity of reactive intermediates.
2 can determine the mechanism of chemical reactions.
3 will have thorough knowledge about the mechanism of substitution involving NGP, enolates, asymmetric alkylation and addition reactions, and hence will be able to optimise the yield of a reaction and control the regiochemical as well as the stereochemical outcome of chemical reactions.
4 can find out whether the compound is chiral or not

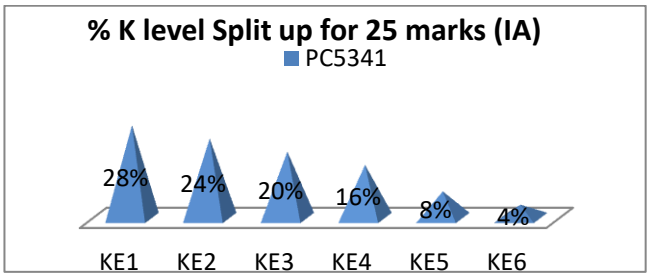
5 can determine the configuration, conformation and topicity of organic compounds, an essential skill in drug development.

Reference Books

1. J. March, Advanced Organic Chemistry; Reactions, Mechanisms and Structure, 6th Ed., Wiley interscience, 2007.
2. J. Clayden, N. Greeves, S. Warren and P. Wothers, Organic Chemistry, Oxford University Press, 1st Ed., 2000.
3. F. A. Carey and R. J. Sundberg, Advanced Organic Chem., parts A and B. 5th Ed., Springer, 2007.
4. Paul Wyatt.Stuart Warren Organic Synthesis- Strategy and Control, Wiley publications,2013.
5. E.L. Eliel, S. H. Wilen, L. N. Mander, Stereochemistry of Organic Compounds, John Wiley & Sons, Inc., 2005.
6. P. S. Kalsi, Stereochemistry, Conformation and Mechanism, New Age International, 6th Ed., 2006.
7. D.Nasipuri, Stereochemistry of Organic compounds, Principles and Applications, 3rd edn, New Age Publishers, 2012.

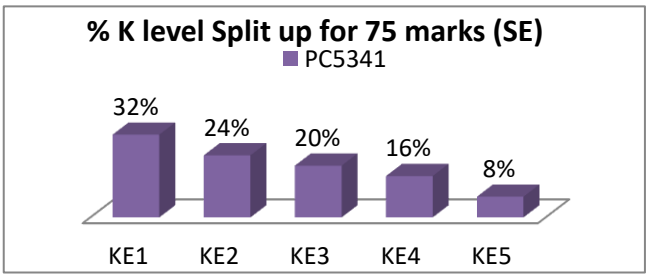
CIE-Continuous Internal Evaluation (25 Marks)

PC5341				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	1	1	2	3
Understand (6)	1	0	1	4
Apply (5)	2	2	0	1
Analyse (4)	0	1	1	2
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

PC5341	
Bloom's Taxonomy	**Weightage %**
Remember	32%
Understand	24%
Apply	20%
Analyze	16%
Evaluate	8%



QUEEN MARY'S COLLEGE (AUTONOMOUS) CHENNAI – 4

M. Sc. CHEMISTRY

SPECTROSCOPIC APPLICATIONS IN ORGANIC CHEMISTRY (CORE)
Semester-I

Course: II **Max Marks: 75**
Code: PC5342 **Credits: 4**

Learning Objectives. The objectives of the course is to

1 learn quantization of energy and interaction of electromagnetic radiation with matter.

2 understand the fundamentals of different branches of spectroscopy.

3 elucidate the structures of organic molecules using different spectral techniques

Course outcomes

K1- Remember K2-understand K3- Apply K4- Analyze K5- Evaluation K6- Create

CO No.	Course outcomes Upon completion of the course, students will be able to	POs addressed
CO-1	IR Spectroscopy: **Tabulate** the Skeletal vibrations and finger print regions – **Identify** the characteristic vibrational frequencies-**Interpret** structure of organic compounds by combined use of Raman and IR spectra	**K1** **K2** **K3**
CO-2	UV Spectroscopy**:** **Describe** the types of transitions – **Predict** λ_{max} using Woodward-Fieser rules – **Differentiate** geometrical isomers and position isomers **Explain** ORD and CD, **Relate** axial halo ketone rule and cotton effect.	**K1** **K2** **K3**
CO-3	^{1}H NMR Spectroscopy **Tabulate** chemical shift values of various chemically non-equivalent protons- **Classify** the protons bonded to carbon and protons bonded to other nuclei -**Explain** the types of coupling- **Simplify** complex spectra-**Interpret** the structure of organic compounds by ^{1}H NMR spectra **e-quiz** on NMR problems. **(e-resources PO9)** https://freevideolectures.com/course/4883/nptel-principles-applications-nmr-spectroscopy/1 https://freevideolectures.com/course/4140/nptel-nmr-spectroscopy-chemists-biologists	**K1** **K2** **K3** **K4** **K5**

CO-4	Mass Spectrometry **Recall** the basic principle, nomenclature and instrumentation- **outline** common functional groups- **identify** unknown compounds **Analyze** the mass spectrum –-**Seminar on mass spectral fragmentation of organic compounds using PPT(PO2, PO7)**	**K1** **K2** **K3** **K4**
CO-5	**^{13}C and 2D NMR Spectroscopy** ^{13}C NMR Spectroscopy: **Describe** isotopic abundance, **Summarize** Chemical shift, **Interpret** DEPT spectrum 2D NMR Spectroscopy: Introduction, **Compare** Homo COSY, C, H-HETCOR and NOESY for simple molecules**. Predict** the structure of simple moleules by 2D NMR spectra **Combine** IR, NMR, and Mass spectroscopy for structure elucidation of organic compounds. **Assignment** on structure elucidation of organic compounds using various spectral techniques followed by **group discussion on** latest developments in spectroscopy **(PO1, PO3, PO4, PO7)** **e-resources (PO9, PO10)** https://freevideolectures.com/course/4272/nptel-multidimensional-nmr-spectroscopy-structural-studies-biomolecules/9	**K1** **K2** **K3** **K4** **K5** **K6**

CO/PO	PO									
	1 Disciplinary knowledge and skills	2 Skilled communicator	3 Critical thinker and problem solver	4 Sense of inquiry	5 Team player/worker	6 Skilled project manager	7 Digitally efficient	8 Ethical awareness and reasoning	9 National and international perspective	10 Lifelong learners
CO 1	3	1	2	1	2	1	2	1	1	1
CO 2	3	2	1	2	2	1	2	2	1	1
CO 3	3	1	2	2	2	1	1	1	2	1
CO 4	3	2	2	2	2	1	1	2	1	1
CO 5	3	2	2	2	2	2	2	1	1	1
PC5342-AVG	3	2	2	2	2	1	2	1	1	1
PC5342-Total	15	8	9	9	10	6	8	7	6	5

Course Outline

UNIT - I **(18 hrs)**

IR and Raman Spectroscopy

IR Spectroscopy : Skeletal vibrations and finger print regions – characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines, carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds) - Effect of Hydrogen bonding and solvent effect on vibrational frequencies – extension to various organic molecules for structural assignment. Vibrational frequency chart for various functional frequencies.

Raman Spectroscopy: Application in organic chemistry – Benzene: ortho, para, meta isomers- cis, trans isomers – structure determination by combined use of Raman and IR spectra

UNIT - II **(18 hrs)**

UV Spectroscopy

Types of transitions – Woodward Fieser rules for calculating λmax in conjugated dienes and α,β -unsaturated carbonyl compounds- differentiation of geometrical isomers and position isomers (disubstituted benzene derivatives, nitrophenols) conjugated cyclic ketones, acetophenones, esters – study of steric effect in aromatic compounds – steric inhibition of resonance. Solvent effects.

Introduction: ORD and CD, axial halo ketone rule, cotton effect.

UNIT - III **(18 hrs)**

^{1}H NMR Spectroscopy

Nuclear Magnetic Resonance Spectroscopy: Approximate chemical shift values of various chemically non-equivalent protons and correlation to protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic), Protons bonded to other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides, SH), effect of deuteration, complex spin-spin interaction between two, three, and four interacting nuclei (first order spectra), Complex interaction, virtual coupling, stereochemically hindered rotation, Karplus curve, variation of coupling constant with dihedral angle, simplification of complex spectra using shift reagents, nuclear magnetic double resonance and Nuclear Overhauser Effect (NOE).

Unit - IV **(18 hrs)**

Mass Spectrometry

Basic principle, instrumentation, nomenclature, Mass spectral fragmentation of organic compounds – common functional groups – molecular ion peaks – meta stable peak – McLafferty rearrangement – general rules for interpretation of the spectrum – molecular weight, isotope effect, nitrogen rule, ring rule – examples of mass spectral fragmentation of organic compounds with respect to their structure determination, identification of unknown compounds, characterization of polymers based on mass spectrometry.

UNIT - V **(18 hrs)**

^{13}C and 2D NMR Spectroscopy

13C NMR Spectroscopy: isotopic abundance, Chemical shift, Structural problems by a combination of spectroscopic methods like IR, 1 H NMR, 13 C NMR,DEPT and Mass spectrometry.

2D NMR Spectroscopy: Introduction, Homo COSY, C, H-HETCOR and NOESY for simple molecules.

COURSE OUTCOME

The student will have a sound knowledge in various spectroscopy principles and to analyse any spectral data of organic molecules.

Reference Books

1. R. M. Silverstein, F. X. Webster, and D. Kiemle, Spectroscopic Identification of Organic Compounds, 7th Ed., John Wiley & Sons, 2005.
2. R. S. Macomber, A complete introd. to modern nmr spectroscopy, John Wiley & Sons, 1998.
3. E. D. Becker, High resolution NMR, 3rd Ed., Academic Press, 1999.
4. D. L. Pavia et al., Introduction of spectroscopy, 4th Ed., Brooks Cole, 2008.
5. W. Kemp, Organic Spectroscopy, 3rd Ed., McMillan Press Ltd., 1991.
6. D. H. Williams & I. Fleming, Spectroscopic Methods in Organic Chemistry, 5th Ed., Tata McGraw Hill, 2004.
7. C. N. Banwell & E. M. McCash, Fundamentals of Molecular Spectroscopy, Tata McGraw-Hill, New Delhi, 2006.
8. D. Pasto, C.Johnson & M.Miller, Experiments and Techniques in Organic Chemistry, Prentice Hall Inc., New Jersey, 1992
9. Barrow, Molecular Spectroscopy, McGraw Hill Book Co., 1962.

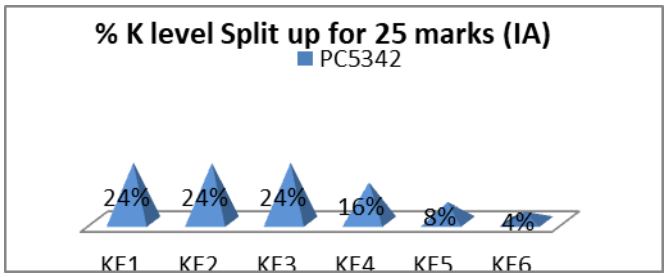
10. D. N. Sathyanarayana, Vibrational spectroscopy – Theory and Applications, Ist Ed., New Age International Ltd., New Delhi.

Web References and e-learning sources:

1. https://freevideolectures.com/course/4883/nptel-principles-applications-nmr-spectroscopy/1
2. https://freevideolectures.com/course/4140/nptel-nmr-spectroscopy-chemists-biologists
3. https://freevideolectures.com/course/4272/nptel-multidimensional-nmr-spectroscopy-structural-studies-biomolecules/9

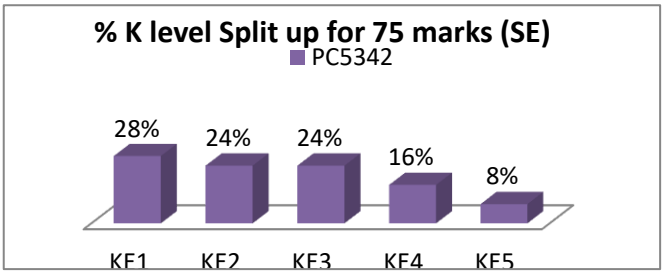
CIE-Continuous Internal Evaluation (25 Marks)

PC5342				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (6)	1	1	2	2
Understand (6)	1	0	1	4
Apply (6)	2	2	0	2
Analyse (4)	0	1	1	2
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

PC5342	
Bloom's Taxonomy	**Weightage %**
Remember	28%
Understand	24%
Apply	24%
Analyze	16%
Evaluate	8%



QUEEN MARYS COLLEGE (AUTONOMOUS), CHENNAI – 4
M.Sc. CHEMISTRY
QUANTUM CHEMISTRY AND CHEMICAL KINETICS – (Core)
Semester-I

Course: III **Max Marks: 75**
Code: PC5343 **Credits: 4**

Learning Objectives: To enable the students to

- understand the need and basics of quantum chemistry
- acquire knowledge about operators and their use in quantum mechanics
- know about the wave nature of particles, Schrodinger equation and is applications
- learn the experimental methods of monitoring reaction kinetics.

Course Outcomes:
At the end of the Course, students will be able to:

CO1	**Recall** the basic mathematical concepts and **extend** it to the postulates of quantum mechanics; **Summarize** the breakdown of classical theory and the dawn of quantum theory; **construct** different types of operators; **solve** Schrodinger wave equation for a particle in a 1D box and **illustrate** the energy levels and wave functions; **extend** it to 3D box systems and **examine** for degeneracy; **list** the experimental evidences for quantum tunneling. **Activity** **Make use of** a visual platform as an alternative way of learning the particle in a box problem. www.shaziyatambawala.com/particleinabox . **[PO1]**	**K1,** **K2,** **K3,** **K4,** **K5**
CO2	**Solve** the Schrodinger wave equation for actual chemical systems and **relate** rotational constant with bond lengths, force constant with stiffness of a bond, **analyze** rotational transitions and different modes of vibration; **compare and contrast** classical with quantum mechanical results; **classify** L-S and j-j coupling. **Activity** Lecture videos with discussion. http://nptel.ac.in/courses/115/101/115101107 **[PO7]**	**K1,** **K2,** **K3,** **K4**
CO3	**Outline** the variation method of approximation to **solve** He atom wavefunctions; **compare** valence bond theory and LCAO-MO theory for hydrogen molecule; **apply** Huckel MO theory to ethylene and 1,3-butadiene. **Construct** HMO diagram for few other conjugated linear polyenes and **evaluate** their delocalization energy. https://youtu.be/y_uNDXATy9c **[PO2,PO9].** http://antoine.frostburg.edu/chem/senese/101/quantum/index.shtml	**K1,K2, K3** **K5, K6**
CO4	**Apply** spectrophotometric technique to monitor the progress of a chemical reaction; **Summarize** the flow methods of kinetic measurements; **explain and distinguish** flash photolysis with relaxation method for various gas phase and liquid phase reaction kinetics; **solve** numerical on temperature dependence of specific reaction rate, Arrhenius parameter and relaxation time for different types of reactions. **[PO3]**	**K1,K2, K3**

CO5	**Distinguish** elementary and complex reactions; **define** consecutive reactions and derive the kinetics; **outline** the mechanism of steady state approximation and **extend** it to M-M mechanism; **examine** the advantages of RRK theory over L-H theory; **interpret** the kinetics of termolecular reactions. **Activity** **seminar with interactive question session** and **e-Quiz session** using www.menti.com and www.kohoot.com using a code.**[PO4]**	**K1, K2, K4**

CO/PO	**PO**									
	1 Disciplinary knowledge and skills	**2 skilled communicator**	**3 critical thinker and problem solver**	**4 sense of inquiry**	**5 Team player / worker**	**6 skilled project manager**	**7 Digitally efficient**	**8 Ethical awareness and reasoning**	**9 National and international Perspective**	**10 Lifelong learners**
CO1	3	1	3	2	1	1	2	1	1	1
CO2	3	2	2	2	2	1	3	2	1	1
CO3	3	3	3	1	3	1	1	2	2	1
CO4	3	1	3	1	2	1	3	1	1	1
CO5	3	3	2	3	2	1	1	1	1	1
AVERAGE PC5343	3	2	3	2	2	1	2	1	1	1
TOTAL PC5343	15	10	13	9	8	5	10	7	6	5

Course Outline

UNIT - I **(18 hrs)**

Review of essential mathematical concepts, Origin of the Quantum theory. Postulates of quantum mechanics,

Operators: Linear, differential, Hermitian and Hamiltonian operators. Eigen functions and Eigen values – time-dependent and time independent Schrodinger wave equations. Particle in a box (1D, 2D & 3D); degeneracy, QM tunneling.

UNIT - II **(18 hrs)**

Rigid rotator wave equation and solution, calculation of rotational constants and bond length. Harmonic Oscillator: Wave equation and solution, anharmonicity force constant and its significance. Angular momentum - spin coupling and spin-orbit coupling.

UNIT - III **(18 hrs)**

Approximation method - Variation method . Application to the helium atom. Slater determinantal wave functions, Born – Oppenheimer approximation. LCAO – MO and VB treatments of hydrogen molecule. Huckel pi-electron theory and its application to ethylene and butadiene.

UNIT - IV **(18 hrs)**

EMPRICAL CHEMICAL KINETICS - I

Experimental techniques – Monitoring the progress of a reaction spectrophotometry – application of the techniques; Fast reactions – flow method – flash photolysis; The rates of reactions – Temperature dependence of reaction rate – Arrhenius parameters – Temperature jump – relaxation methods.

UNIT - V **(18 hrs)**

EMPRICAL CHEMICAL KINETICS – II

Elementary reactions – unimolecular – bimolecular – consecutive elementary reactions – variation of concentration with time – Rate determining step – steady state approximation – Third order reactions – Michaelis – Menton's mechanism – Lindemann – Hinshelwood mechanism – Rice Ramsperger – Kassel theory.

REFERENCE BOOKS:

1. Levine, Quantum Chemistry, 4th Ed., Allyn & Bacon Inc., 1983.
2. R. K. Prasad, Quantum Chemistry, New Age International Publishers, New Delhi. 1997.
3. R. P. Rastogi and V.K. Srivastava, An Introduction to Quantum Mechanics of Chemical Systems. Oxford & IBH Publishing Co., New Delhi, 1986,
4. D. A. McQuarrie, Quantum chemistry, Viva Books Pvt. Ltd., New Delhi, 2007.
5. P.W.Atkins, Physical chemistry, Oxford university press, 1978.
6. K.L.Kapoor, A textbook of Physical chemistry, (volumes-2 and 3) Macmillan India Ltd, 1994.
7. K.J. Laidler, Chemical Kinetics, 3rd Ed., Harper and Row Publishers. New York, 1987.

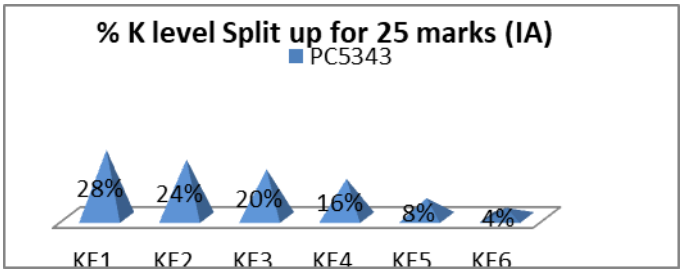
8. J.Rajaram and J.C.Kuriokose, Kinetics and Mechanisms of chemical transformation, 1st Ed., Macmilland India Ltd, Delhi, 1993.
9. A.A.Frost and R.G.Pearosn, Kinetics and Mechanism, 2nd Ed., John Wiley and Sons, 1963.
10. K.B. Ytsimiriski, Kinetic Methods of Analysis, Pergamon press, 1996.
11. .A.K. Chandra, Indtroductory Quantum Chemistry, 3rd edition, Tata – Mc.Graw – Hill Publishing Company Limited, New Delhi.
12. James E.House, 2nd edition, Fundametals of Quantum chemistry, Elsevier Academic Press, 2008.

Web References and e-learning sources:

1. http://myeclss.academy/mod/resource/view.php?id=21372
2. http://nptel.ac.in
3. http://www.slideshare.net/
4. http://epgp.inflibnet.ac.in/
5. http://antoine.frostburg.edu/chem/senese/101/quantum/index.shtml

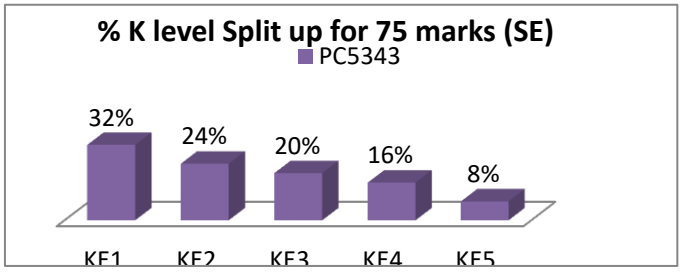
CIE- Continuous Internal Evaluation (25 Marks)

PC5343				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	1	1	2	3
Understand (6)	1	0	1	4
Apply (5)	2	2	0	1
Analyse (4)	0	1	1	2
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage %)

PC5343	
Bloom's Taxonomy	**Weightage %**
Remember	32%
Understand	24%
Apply	20%
Analyze	16%
Evaluate	8%



QUEEN MARYS COLLEGE (AUTONOMOUS), CHENNAI – 4

M.Sc. CHEMISTRY

INORGANIC CHEMISTRY-I- (Core)
Semester –I

Course: IV **Max Marks: 75**
Code: PC5344 **Credits: 4**

LEARNING OBJECTIVES

1 To understand the need for non aqueous solvents and the fundamental concepts of hard and soft acids and bases.
2 To gain thorough knowledge about the crystal field and molecular orbital theories of Coordination complexes.
3 To facilitate an in depth study about the stereochemical aspects of Inorganic complexes.
4 To acquire knowledge about photochemical reactions in Inorganic complexes and the role of photocatalysts.

Course Outcomes

K1 – Remember,K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluation, K6 - Create

CO No.	Course outcomes Upon completion of the course, students will be able to	POs addressed
CO-1	**Attain** knowledge about various non aqueous solvents. **Understand** the relation of electronegativity of acids and bases with their hardness and softness **Differentiate** acids and bases based on HSAB concept. **Activity** e-quiz on HSAB concept and non aqueous solvents.(**PO3,PO4**) Assignment given in identify the hard & soft acids and bases and group discussion is conducted to assess the understanding of HSAB concept. (**PO7**) https://www.slideshare.net/sirodjudin908/hsab-theory-53408419 (**PO9**)	K1 K2 K3
CO-2	K**now** about the magnetic properties of transition metals, actinides and lanthanides. E**xplain** the magnetic susceptibility of complexes. **Compare** the different types of magnetic behaviour of coordination complexes. **Interpretation** of charge transfer spectra based on spectrochemical series and nephelauxetic series **Hypothesise** the nature of complexes based on magnetic behaviour. **Activity** **Seminar** on CFSE applications, spectrochemical series and related problems followed by **group discussion** to assess capability of solving problems	K1 K2 K3 K5 K6

	(PO1, PO3, PO4, PO5, PO7) https://www.slideshare.net/chemsant/coordination-chemistry-cft https://www.slideshare.net/chemsant/electronic-spectra-of-metal-complexes1 nephlauxtic series **(PO9)**	
CO-3	**Recall** the basic concepts of coordination complexes **Explain** MOT of Oh, Td and square planar complexes C**ompare** of VBT, CFT, LFT and MOT of bonding in Oh complexes **Calculate** CFSE E resources https://www.scribd.com/presentation/382956365/Inorganic-Chemistry-VBT-and-CFT-and-MOT-theories https://www.slideshare.net/kelemuhonja/1-organometallic-chemistry(PO9)	K1 K2 K3 K5
CO-4	C**alculate** the stability constant of the complexes **Explain** factors influencing stability of complexes K**now** about the macrocyclic ligand C**ompare** the relative stablility complexes E resources https://www.slideshare.net/abudardazilli/schiff-base-ligand schiff base stability of complexes https://www.slideshare.net/SekharDas6/crown-ether-and-cryptand (PO9)	K1 K2 K3 K4
CO-5	D**escribe** various photochemical reactions C**lassify** the photochemical reactions and chemical reactions. E**xplain** the applications of various photocatalysts **Assignment** given in various applications of photochemical reactions**(PO1)** **Activity** **E resources** Thermal and photochemical reactions of methanol on nanocrystalline anatase TiO_2 thin films† David A. Bennett,[a] Matteo Cargnello,‡[b] Thomas R. Gordon,[b] Christopher B. Murray[bc] and John M. Vohs*[a] **https://doi.org/10.1039/C5CP02307F** **(PO9)**	K1 K2 K4

CO/PO	PO									
	1 Disciplinary knowledge and skills	2 skilled communicator	3 critical thinker and problem solver	4 sense of inquiry	5 Team player / worker	6 skilled project manager	7 Digitally efficient	8 Ethical awareness and reasoning	9 National and international Perspective	10 Lifelong learners
CO1	3	2	2	2	1	1	2	1	1	1
CO2	3	2	2	2	2	1	2	1	2	1
CO3	3	1	1	1	1	1	2	1	2	1
CO4	3	1	1	1	1	1	2	1	2	1
CO5	3	1	1	1	1	1	2	1	2	1
PC5344-AVG	3	1	1	1	1	1	2	1	2	1
PC5344-TOTAL	15	7	7	7	6	5	10	5	9	5

Course Outline

UNIT – I **(18hrs)**

NON-AQUEOUS SOLVENTS:

Factors justifying the need for non aqueous solution Chemistry and failure of water as a Solvent. Solution chemistry of Sulphuric acid: Physical properties, Ionic self dehydration in H_2SO_4, high electrical conductance in spite of high viscosity, Chemistry of H_2SO_4 as an acid, as a dehydrating agent, as an oxidizing agent, as a medium to carry out acid-base neutralization reaction and as a differentiating solvent. Liquid BrF_3: Physical properties, solubilities in BrF_3, self ionization, acid base neutralization reactions, solvolytic reactions and formation of transition metal fluorides. Chemistry of Molten salts as Non-Aqueous Solvents: Solvent properties, solution of metals, complex formation, Unreactivity of molten salts, Low temperature molten salts.

HSAB concept of acids and bases -acid, base strength and hardness and softness - symbiosis – Relation of electronegativity of acids and bases with their hardness and softness.

UNIT – II **(18hrs)**

COORDINATION CHEMISTRY – I

Crystal field theory and its application to explain magnetic properties of coordination complexes, octahedral vs tetrahedral complexes, Jahn-Teller effect, Interpretation of electronic spectra including charge transfer spectra: spectrochemical series, nephelauxetic series: magnetic properties of lanthanides and actinides and splitting of d-orbitals in octahedral field.

Magnetic properties and Electronic structure of Transition Metal Complexes: Brief review of different types of magnetic behavior, spin-orbit coupling, quenching or orbital angular momenta, temperature-independent paramagnetism, measurement of magnetic susceptibility using Guoy and Faraday methods..

UNIT – III **(18 hrs)**

COORDINATION CHEMISTRY – II

MOT: MOT σ – bonding and π- bonding in Oh complexes effect of π– bonding on the value of 10 Dq of Oh complexes spectrochemical series 18 e- rule in terms of MOT, MOT for the square planar (16 e- rule) and Td (18 e- rule)complexes –comparison of VBT, CFT, LFT and MOT of bonding in Oh complexes.

UNIT- IV **(18 hrs)**

STABILITY OF COMPLEXES

Stability and Stereo chemical Aspects Stability of complexes - thermodynamic aspects of complex formation, factors affecting stability, stability correlations, statistical and chelate effects; Determination of stability constants - polarographic, photometric and potentiometric methods. Stereochemistry of coordination complexes - stereoisomerism in inorganic complexes, isomerism arising out of ligand distribution and ligand conformation, chirality. Macrocyclic ligand types - porphyrins, corrins, Schiff bases, crown ethers, cryptates and catenands. (simple complexes).

UNIT-V **(18 hrs)**

PHOTOCHEMICAL REACTIONS:

Photochemical excitation – prompt and delayed reaction photochemical reactions of metal carbonyls, Co(III) complexes, Cr(III) complexes – photolysis of $[M(CN)_8]^{3-}$ and $[M(CN)_8]^{4-}$ (M = Mo, W) in aqueous solution – oxalate complexes $[M(OX)_3]^{3-}$ (M = Fe, Mn, Co), photochemical reactions of Fe(II) and Fe(III) complexes – photochemical substitution process in Pt(IV). Photochemistry of $[Ru(bpy)_3]^{2+}$ photochemical splitting of H_2O - TiO_2 as a green photocatalyst in removing air and water pollutants – photochemical reactions of nitrogen.

COURSE OUTCOME

1 The syllabus offers a complete knowledge about core concepts of inorganic chemistry like the demand for non aqeous solvents, theories of hard and soft acids and bases.
2 It provides indepth knowledge about the interpretation of electronic spectra of complexes and their magnetic properties.
3 A clear picture of photochemical inorganic reactions are taught which will help the student understand the mechanism of these reactions in detail.

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3. Purcell, K. F.; Kotz, J. C. Inorganic Chemistry; Saunders: Philadelphia, 1976.
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13. Asim. K. Das and Mahua Das, Fundamentals concepts of Inorganic chemistry, CBS publishers & Distributors private Ltd.

14. Ajai Kumar, Coordination Chemistry, Aaryush Educations,2nd Edition

Web References and e-learning sources:

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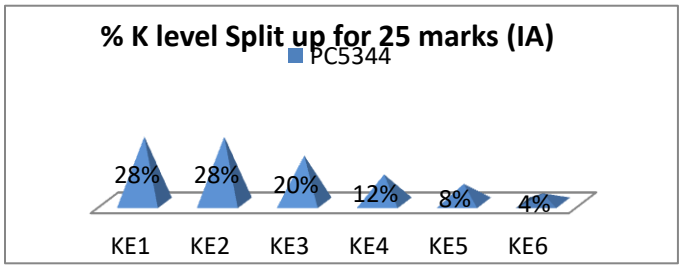
2. https://www.slideshare.net/sirodjudin908/hsab-theory-53408419
3. https://www.slideshare.net/chemsant/coordination-chemistry-cft
4. https://www.slideshare.net/chemsant/electronic-spectra-of-metal-complexes1
5. https://www.slideshare.net/kelemuhonja/1-organometallic-chemistry

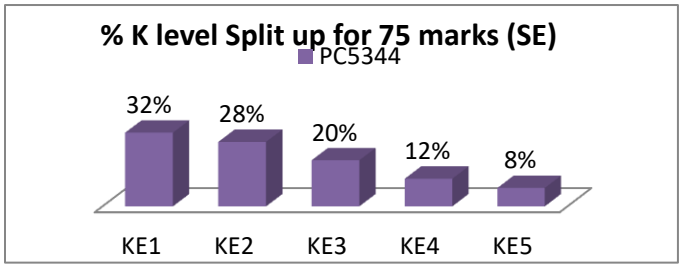
CIE-Continuous Internal Evaluation (25 Marks)

PC5344				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	1	1	2	3
Understand (7)	1	0	1	5
Apply (5)	2	2	0	1
Analyse (3)	0	1	1	1
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

PC5344	
Bloom's Taxonomy	**Weightage %**
Remember	32%
Understand	28%
Apply	20%
Analyze	12%
Evaluate	8%



QUEEN MARY'S COLLEGE (AUTONOMOUS) CHENNAI-4

M. Sc. CHEMISTRY

INORGANIC CHEMISTRY PRACTICAL –I (Core)

Semester-I

Course-V **Max. Marks: 75**

Code: PC5345 **Credits: 4**

LEARNING OBJECTIVES

1 To impart the skill in preparations of metal complexes.

2 To identify the methodology to estimate a metal ion in the presence of another metal ion.

3 To improve the skill in the qualitative analysis of rare metal ions in different groups.

4 To identify the methodology to analyse a metal ion in the presence of another metal ion.

5 To enable the students in interpreting the spectra of inorganic complexes.

Course Outcomes

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluation, K6 - Create

CO No.	Course outcomes Upon completion of the course, students will be able to	POs addressed
CO-1	**Demonstrate** and **describe** the preparation of various inorganic complexes. **Duplicate** any known procedure. **Webresources** https://www.academia.edu/RegisterToDownload/BulkDownload https://youtu.be/49z5-Adw9QA (Courtesy) https://youtu.be/r5nehqcvVFk (Courtesy) https://vdocuments.mx/preparation-of-tristhiourea-copper.html	K3, K2 K1
CO-2	**Identify** the nature of metals. **Select** a suitable procedure to separate them. **Demonstrate** the procedure to separate iron and nickel in given solution using volumetric and gravimetric **estimation**. **Compare** their result with peer group and improvise their skill. **Viva(PO3, PO4)** **Assessment** based on her skill and results produced in the laboratory **Webresources** https://byjus.com/chemistry/gravimetric-analysis/ https://www.khanacademy.org/science/ap-chemistry/stoichiometry-and-molecular-composition-ap/limiting-reagent-stoichiometry-ap/a/gravimetric-analysis-and-precipitation-gravimetry	K1 K2 K3, K5 K4

CO-3	**Identify** the nature of metals. **Select** a suitable procedure to separate copper and nickel in the given solution by volumetric and gravimetric **estimation**. https://youtu.be/mG273lCRijw	K1 K2
CO-4	**Identify** the nature of cations present in the inorganic mixture by **applying** semi micro qualitative analysis. **Understand** the principle behind qualitative analysis. **Infer** the nature of cations present in the mixture by carrying out group separation analysis **Webresources** https://science-blogs.ucoz.com/resources/notes/msc/pract1/CationGuide.pdf	K1 K3 K2 K4
CO-5	**Identify** the groups present in the inorganic compounds by **interpreting** their spectra. **Predict** the spectral features **Examine** the spectra of any unknown compound. **Compile** spectral data and **propose** its structure. **Group Activity (PO5)** Elucidating **(PO3, PO4)** the structure of inorganic compounds by analysing sets of spectra for each compound through group discussion and presenting the results through written format. **Viva (PO3,PO4)** **Web resources (PO9,PO10)** https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Book%3A_Introduction_to_Organometallic_Chemistry_(Ghosh_and_Balakrishna)/12%3A_Physical_Methods_in_Organometallic_Chemistry/12.01%3A_Characterization_of_Organometallic_Complexes	K1, K2 K3 K4 K5, K6

CO/PO	PO									
	1 Disciplinary knowledge and skills	2 skilled communicator	3 critical thinker and problem solver	4 sense of inquiry	5 Team player / worker	6 skilled project manager	7 Digitally efficient	8 Ethical awareness and reasoning	9 National and international Perspective	10 Lifelong learners
CO1	3	1	1	1	2	1	2	1	3	1
CO2	3	2	3	2	2	1	2	2	3	1
CO3	3	1	1	1	2	1	1	1	1	1
CO4	3	3	2	2	2	1	3	2	1	1
CO5	3	2	2	2	2	1	2	1	1	1
PC5345-AVG	3	2	2	2	2	1	2	1	2	1
PC5345-TOTAL	15	9	9	8	10	5	10	7	9	5

Course Outline

1. Inorganic Preparations

1. Preparation of Tris(thiourea) copper(I) sulphatedihyrade
2. Preparation of hexammine nickel(II) chloride
3. Preparation of cis-potassium bis(oxalato) diaquochromate(III)
4. Preparation of trans-potassium bis(oxalate) diaquochromate(II)
5. Preparation of sodium hexanitrocobaltate(III)
6. Preparation of Bis(acetylacetonato) copper(II)

***2. Inorganic Estimations.**

1. Estimation of iron volumetrically and nickel gravimetrically
2. Estimation of iron volumetrically and magnesium gravimetrically

3. Semi micro qualitative analysis

Analysis of cations containing less familiar elements- tungsten. Selenium, tellurium. Molybdenum, cerium, thorium, zirconium, vanadium, uranium and lithium.

4. Identification of inorganic compounds from spectral data

*Experiments only for Internal assessment

COURSE OUTCOME

The students

1 Will have a sound knowledge in preparation of inorganic complexes which is useful in their research field.
2 Will possess the ability to separate and analyse mixture of ions either gravimetrically or by using volumetric methods.
3 Can able to resolve any spectral data of inorganic compounds which is essential in their research as well as in any analytical field.
4 Can analyse and identity the less common elements if present in a sample, in a laboratory.

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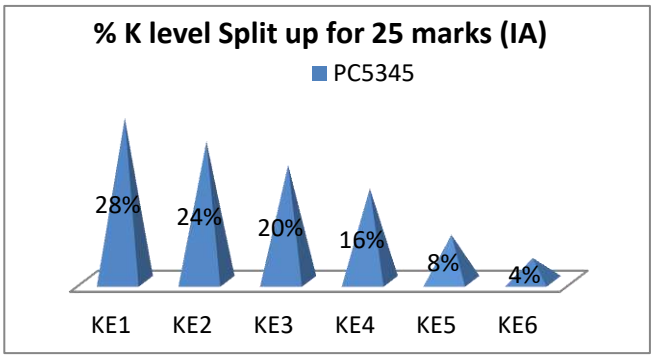
3. https://www.khanacademy.org/science/ap-chemistry/stoichiometry-and-molecular-composition-ap/limiting-reagent-stoichiometry-ap/a/gravimetric-analysis-and-precipitation-gravimetry
4. https://science-blogs.ucoz.com/resources/notes/msc/pract1/CationGuide.pdf

https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Book%3A_Introduction_to_Organometallic_Chemistry_(Ghosh_and_Balakrishna)/12%3A_Physical_Methods_in_Organometallic_Chemistry/12.01%3A_Characterization_of_Organometallic_Complexes CIE-Continuous

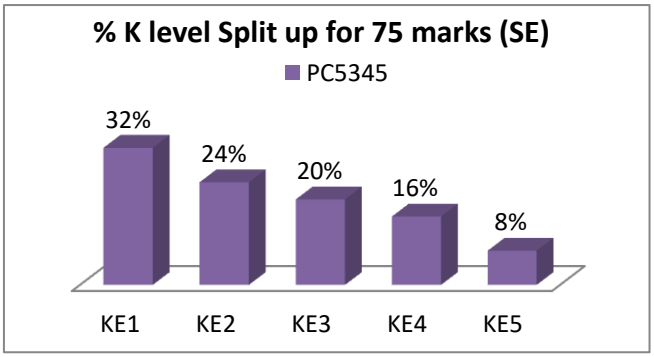
Internal Evaluation (25 Marks)

PC5345				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	1	1	2	3
Understand (6)	1	0	1	4
Apply (5)	2	2	0	1
Analyse (4)	0	1	1	2
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

PC5345	
Bloom's Taxonomy	**Weightage %**
Remember	32%
Understand	24%
Apply	20%
Analyze	16%
Evaluate	8%



QUEEN MARY'S COLLEGE (AUTONOMOUS) CHENNAI – 4

M.Sc. CHEMISTRY-

ORGANIC CHEMISTRY – II
SEMESTER- II

Course No. : VI **Max Marks: 75**
Code: PC5346 **Credits: 4**

LEARNING OBJECTIVES

1. To understand the mechanism of organic chemical reactions.
2. To appreciate the concept of substitution, elimination and rearrangement reactions and their reaction mechanisms.
3. To acquire a sound knowledge in the reagents employed for oxidation and reduction reactions.

COURSE OUTCOMES:K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluation, K6 - Create

CO. No	COURSE OUTCOME Upon completion of course, student will be able to know to	POs Addressed
CO 1	**Addition reactions** **illustrate** mechanism of electrophilic, nucleophilic and free radical addition reactions. **identify** the orientation and reactivity of ring opening reactions of cyclopropanes. **infer** stereochemical aspects of addition reactions. **propose** reaction conditions for selective 1,2 and 1,4 –addition reactions	K2 K1 K4 K5
CO 2	**Elimination reactions** **classify** structural and Stereochemical factors governing E1, E2 and E1cb reactions. **define** Hoffmann and Zaitsev's rules **explain** stereochemical outcomes of chelotropic elimination reactions **apply** Bredt's rule to elimination reactions of bicyclic compounds **Seminar:** Stereo chemical orientation, addition to cyclopropane rings http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/organic_chemistry_iii/07.nucleophilic_and_free_radical_addition_reactions_of_alkenes/et/4811_et_et.pdf https://www.organic-chemistry.org/namedreactions/michael-addition.shtm	K1 K2 K3 K4
CO 3	**Reagents for oxidation** **list** reagents for conversion of alcohols to carbonyl compounds **use** suitable reagents for epoxidation and **predict** the stereochemistry of products in asymmetric epoxidation reactions .	K1 K2 K3

CO 4	**Reagents for reduction** **recall** reagents for catalytic hydrogenation of carbon carbon multiple bonds **explain** regioselectivity of Heterogeneous and Homogeneous hydrogenation reactions. **interpret** and **compare** the outcomes of Birch reduction reactions. **recommend** reagents for selective reduction of carbonyl compounds **construct** multistep schemes for synthesis of organic compounds incorporating various reducing agents **Power point presentation: Birch reduction, Lindlar's catalyst and samarium reagents** https://pubs.rsc.org/en/content/articlelanding/2020/cs/d0cs00835d	K1 K2 K4 K3 K5 K6
CO5	**Heterocyclic reactions** **Identify** the five, six, fused heterocyclic compounds **Compare** the properties of five membered ring compounds with 2 or more heteroatoms **Choose** appropriate method for the preparation of six membered ring compounds with 2 or more heteroatoms and fused heterocyclic containing one or more heteroatoms **Seminar** on synthesis and reactions of various heterocyclic compounds like Quinoline, Indole, Pyrimidine, Purine , Imidazoles using **PPT (PO2, PO7)** followed by **group discussion (PO5)** **Web Resource** **https://drive.google.com/file/d/0B2G5XQYeBUFNendhUm8zRXBZNEk/view?usp=sharing** **https://drive.google.com/file/d/1YMnYElzKRGhD7cyF0MybWbWr1usmhBUS/view?usp=sharing**	K1 K2 K3

Strongly correlated - 3 **Moderately correlated -2** **Weakly correlated -1**

CO/PO	PO									
	1 Disciplinary knowledge and skills	**2 skilled communicator**	**3 critical thinker and problem solver**	**4 sense of inquiry**	**5 Team player / worker**	**6 skilled project manager**	**7 Digitally efficient**	**8 Ethical awareness and reasoning**	**9 National and international Perspective**	**10 Lifelong learners**
CO1	3	3	1	2	3	1	2	1	1	1
CO2	3	2	2	2	2	1	2	2	2	1
CO3	3	2	2	2	1	1	2	1	1	1
CO4	3	2	2	2	2	1	2	1	1	1
CO5	3	3	1	3	2	1	2	1	1	1
AVG PC5346	3	2	2	2	2	1	2	1	1	1
TOTAL PC5346	15	12	8	11	10	5	10	6	6	5

Course outline

UNIT I **(18 hrs)**

ADDITION REACTION

Addition to Carbon-Carbon Multiple Bonds

Mechanism: Electrophilic, nucleophilic and free radical addition

Orientation and reactivity : Stereochemical orientation, addition to cyclopropane rings.

Reactions of alkenes :

Addition of hydrogen – heats of hydrogenation, stereochemistry of alkene hydrogenation.

Addition of halogen and **Addition of halogen** in presence of water – stereochemistry

Addition of hydrogen halides – Regioselectivity of HX addition; carbocation rearrangement.

Addition of water – Acid catalyzed hydration; hydroboration & oxidation – stereochemistry and regiochemistry; Oxymercuration & demercuration – stereochemistry and regiochemistry.

Conjugate addition of nucleophiles to α, β – unsaturated carbonyl compounds (Michael Addition)

- Factors governing regioselectivity : conditions of reaction - kinetic and thermodynamic control; nature of α, β – unsaturated carbonyl; nature of nucleophile - hard and soft nucleophiles; Organolithium, Organomagnesium (with and without copper) and Organocopper reagents. Stereochemical aspects of each reaction.

UNIT- II **(18 hrs)**

ELIMINATION REACTION

Structural and Stereochemical factors governing E1, E2 and E1cb reactions, Reactivity, Orientation of the double bond: Hoffmann, Zaitsev's and Bredt's rule, Mechanisms and orientation in pyrolytic elimination. Chelotropic elimination, Decomposition of cyclic azo compounds, β-eliminations involving cyclic transition states such as sulfoxides, selenoxides, N-oxides, acetates, xanthates eliminations.

UNIT - III **(18 hrs)**

REAGENTS FOR OXIDATION

Alcohols to carbonyls: Chromium based reagents - CrO_3 in H_2SO_4, Jone's reagent, PCC, PDC, and Collin's reagent; Manganese based reagent - MnO_2; Ruthenium based reagents -TPAP, NMO; Hypervalent iodine reagents - DMP and IBX; Silver based reagents - Fetizon's reagent; DMSO based reagents - Swern, Pfitzner Moffatt oxidation; TEMPO.

Alkenes to epoxides: mCPBA, Sharpless asymmetric epoxidation, Jacobsen epoxidation, Shi epoxidation.

Alkenes to diols – $KMnO_4$, OsO_4, Sharpless asymmetric dihydroxylation, Prevost reaction and Woodward modification,

Alkenes to carbonyls with bond cleavage - $KMnO_4$, OsO_4 & $NaIO_4$, Ozonolysis

Alkenes to alcohols/carbonyls without bond cleavage - Wacker oxidation, SeO_2 based allylic oxidation.

Ketones to ester/lactones - Baeyer-Villiger

UNIT - IV **(18hrs)**

REAGENTS FOR REDUCTION

(1) Catalytic hydrogenation Heterogeneous: Palladium/Platinum/Rhodium/Nickel etc; Homogeneous: Wilkinson

(2) Metal based reductions Birch reduction, Lindlar's Catalyst, and Samarium reagents.

(3) Hydride transfer reagents from Group III and Group IV in reductions : $LiAlH_4$, $LiAlH(OR)_3$, Red-Al and DIBAL-H; $NaBH_4$, $LiBH_4$, $Zn(BH_4)_2$, L-selectride, K-selectride, $NaBH_3CN$, $NaBH_3CN$ & NH_2NHTs, Luche reduction, and Bu_3SnH.

UNIT V **(18 hrs)**

HETEROCYCLIC COMPOUNDS

Five-membered ring compounds with 2 or more heteroatoms- Occurrence, nomenclature, synthesis, properties- aromaticity, spectral properties and applications of Imidazoles, Oxazoles, thiazoles, isooxazole; Six-membered ring compounds with 2 or more heteroatoms: pyrimidines, purines, triazines. Fused heterocycles containing one or more heteroatoms: indoles, benzofurans, benzothiophene, benzopyrones.

COURSE OUTCOME

The student

1 Will have thorough knowledge about the mechanism of electrophilic substitution reactions involving Arenium ion mechanism and elimination reactions and hence will be able to optimise the yield of a reaction and control the regiochemical as well as the stereochemical outcome of chemical reactions.

2 Can suggest ways to transform functional groups through rearrangements and by employing reagents for oxidation and reduction.

Reference Books

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2. **https://drive.google.com/file/d/1YMnYElzKRGhD7cyF0MybWbWr1usmhBUS/view?usp=sharing**

CIE-Continuous Internal Evaluation (25 Marks)

PC5346				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	1	1	2	3
Understand (6)	1	0	1	4
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Evaluate (2)	1	0	1	0
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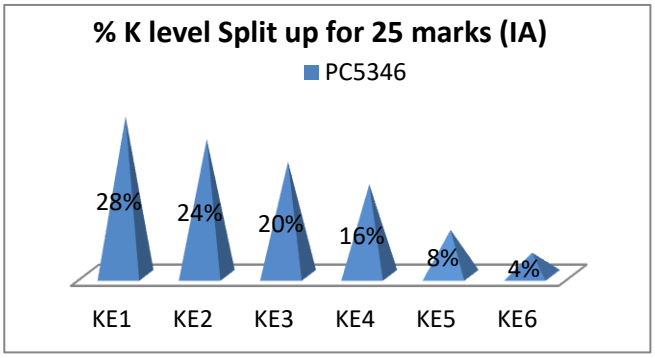

ESE- End Semester Examination (75 Marks; Weightage 75 %)

PC5346	
Bloom's Taxonomy	**Weightage %**
Remember	32%
Understand	24%
Apply	20%
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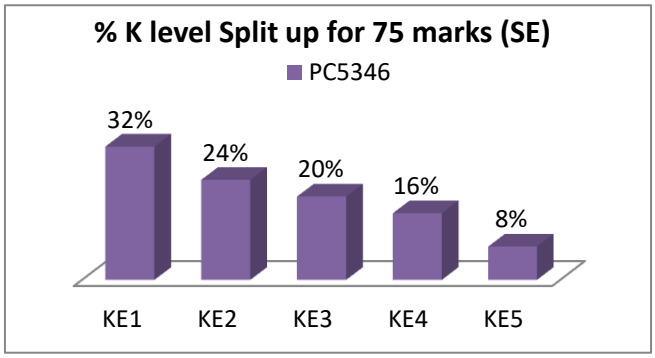
Evaluate	8%



QUEEN MARY'S COLLEGE (AUTONOMOUS) CHENNAI-4

M. Sc. CHEMISTRY

INORGANIC CHEMISTRY - II

SEMESTER II

Course No. : VII **Max Marks: 75**
Code: PC5347 **Credits: 4**

LEARNING OBJECTIVES

1. To study in detail about the reaction mechanism in reactions involving transition metal complexes.
2. To provide knowledge on different types of electron transfer reactions and their importance.
3. To impart knowledge about the fundamentals of Organometallic compounds and the different types of ligands.
4. To provide an exposure to organo metallic complexes involving sigma and pi bonded ligands and a knowledge of metallocenes.
5. To make students aware of the revolution created by transition metal complexes in the field of catalysis.

Course Outcomes

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluation, K6 - Create

CO No.	Course outcomes Upon completion of the course, students will be able to	POs addressed
CO-1	**Define and Compare** hydrolysis and anation reaction, Labile and inert reaction. **Illustrate** the mechanism of substitution reactions. **Choose** the correct route to synthesise the substituted square planar complex with the help of trans effect. **Assignment** on preparation of cis and trans square planar complex using trans effect. **(PO1, PO2, PO3, PO4)** **e-Resouce: (PO9)** https://nptel.ac.in/courses/104/105/104105033/ https://chem.yonsei.ac.kr/chem/upload/CHE3103-01/122447755644547.pdf https://authors.library.caltech.edu/25028/1/Langford_Lsp.pdf	K1 K2 K3 K5
CO-2	**Describe** the complementary and non- complementary reactions. **Discuss** and **Differentiate** the electron transfer mechanism.	K1 K2
CO-3	**Recognize** the type of ligands and Organometallic compounds and **Discuss (K2)** their synthetical applications. **Explain** the effect of solvents and steric effect on the substitution reaction. **Distinguish** Fisher and Schrock carbenes and carbynes. **e-Resouce: (PO9)** https://nptel.ac.in/content/storage2/courses/104106064/lectures.pdf https://nptel.ac.in/courses/104/108/104108062/ https://www.sscasc.in/wp-content/uploads/downloads/Chemistry/Inorganic-Chemistry.pdf	K1 K2 K3 K4
CO-4	**State and** the pi bound ligands in organometallic compounds.	K1

	Discuss the reactivity and uses of metallocenes. **Illustrate and Distinguish** insertion and deinsertion reaction, carbonylation and decarbonylation. **eQuiz** – Organometallic compounds **(PO3, PO4, PO7)**	K2 K3 K4
CO-5	**Define** Catalyst and catalysis. **Discuss** the mechanistic steps in the catalyzed reactions. **Use** of Organometallic catalyst in the Industry. **Compare** the role of OMC catalyst with the others. **Develop** a catalyst which is useful for the production of organic compounds from easily available sources **Seminar** on the basic reactions involved and some basic catalyst. (**PO2,PO7)** **e-Resource: (PO9)** https://www.ias.ac.in/public/Volumes/reso/004/09/0063-0081.pdf https://nptel.ac.in/content/storage2/courses/104103022/download/module11.pdf	K1 K2 K3 K4 K6

CO/PO	**PO**									
	1 Disciplinary knowledge and skills	**2 skilled communicator**	**3 critical thinker and problem solver**	**4 sense of inquiry**	**5 Team player / worker**	**6 skilled project manager**	**7 Digitally efficient**	**8 Ethical awareness and reasoning**	**9 National and international Perspective**	**10 Lifelong learners**
CO1	3	2	2	1	2	1	2	1	2	1
CO2	3	1	1	2	1	1	1	1	1	1
CO3	3	2	1	1	1	1	1	1	2	1
CO4	3	1	2	2	2	1	3	1	1	1
CO5	3	2	2	2	2	1	3	1	2	1
PC5347-AVG	3	2	2	2	2	1	2	1	2	1
PC5347-TOTAL	15	8	8	8	8	5	10	5	8	5

Course outline

UNIT- I **(18 hrs)**

INORGANIC REACTIONS AND MECHANISM:

Substitution reactions in octahedral complexes- general mechanism, discussion of A, D, IA, ID and DCB mechanism, replacement of coordinated water, acid hydrolysis reactions, base hydrolysis and anation reactions, substitution reaction, reactions occurring without rupture of

metal-ligand bond. Substitution reactions of square planar complexes. Theories of trans-effect, labile and inert complexes. Mechanism of redox reactions.

UNIT-II **(18 hrs)**

ELECTRON TRANSFER REACTIONS

Inner sphere (ISET) and outer sphere (OSET) electron transfer reactions – OSET: steps of OSET – electron transfer and Frank Condon principle – potential energy diagram for ET process – the Marcus eqn for OS cross – reaction nature of donors and receptors MO in OSET process – important factors to control the rate constants of OSET reactions – effect of external ions as ET rate in OSET process.

ISET: Steps of ISET process – rate law for the ISET process – effect of the nature (HOMO) of donor and (LUMO) of the receptor orbitals in the ISET process Comparison of reaction rates for the reduction of Co(III) complexes by $[Cr(OH)_6]^{2+}$ through the OSET and ISET processes – types of ISET – effect of the nature of HOMO of the reductant and LUMO of the oxidant on the rate of 1S reaction – role of bridging ligand with ISET reaction – tunneling transfer, resonance transfer – multiple bridging in the activated complex in the ISET process – effect of the non-bridging ligand on the rate of ISET & OSET processes – ligand replacement reactions through ET – non-complementary ET reaction.

UNIT – III **(18hrs)**

ORGANOMETALLIC CHEMISTRY - I

Transition Metal Alkyls and Aryls: α, β-elimination - Stable alkyl formation - Related *σ*-Bonded Ligands in group 12,13,14,15,16 and 17- Metal Hydride Complexes-reaction of metal Hydrides - Hydricity - Bending hydrides- *σ* - *c*omplexes, Bond Strengths for Classical *σ*-Bonding Ligands- Supramolecular interaction.

Metal Carbonyls, Phosphine complexes and ligand substitution reactions- Structure and stability of carbonyls- Reactions of carbonyls: Electrophilic Nucleophilic and migratory insertion.- Bridging carbonyls- Metal complexes isoelectronic with CO: RNC, CS, NO and CN- Phosphines: Structure and bonding - Tolman electronic parameter, cone angle and bite angle - and phosphine related ligands, Dissociative substitution, Associative mechanism, Redox effects-

mechanism and rearrangement. Substitution – photochemical substitution, steric and solvent effects in substitutions.

Metal-ligand multiple bonds: Fischer and Schorock Carbenes, Carbynes, Bridging carbenes, carbynes, N-Heterocyclic Carbenes, Polydentate heterocyclic complexes- multiple bonds to heteroatoms, applications – Alkene Metathesis,

UNIT – IV (18hrs)

ORGANOMETALLIC CHEMISTRY - II

Complexes of π-Bound Ligands: Alkene and Alkyne Complexes, Allyl Complexes, Diene Complexes, Cyclopentadienyl Complexes, Arenes and other Alicyclic Ligands, Metalacycles and Isoelectronic and Isolobal replacement, Stability of Polyene and Polyenyl Complexes.

Insertion and elimination reactions involving CO, Insertions involving alkenes, alpha, beta, gamma and omega elimination

Cyclopentadienyl complexes: metallocenes - synthesis of metallocenes - bonding in metallocenes - reactions of metallocenes - Cp_2Fe/Cp_2Fe^+ couples in biosensors - bent sandwich complexes - bonding in bent sandwich complexes - metallocene halides and hydrides - metallocene and stereospecific polymerisation of 1-alkenes - cyclopentadiene as a non-spectator ligand.

UNIT-V (18 hrs)

CATALYSIS BY TRANSITION METAL COMPLEXES

General principles of catalysis - basic reactions involved in the catalysis by organometallic compounds – Tolman catalytic loops – catalytic mechanism in the following reactions: hydrogenation of olefins (Wilkinson's catalyst) – hydroformylation (oxo process) – Monsanto acetic acid synthesis from methanol – oxidation of alkenes to aldehydes and ketones (Wacker process) – catalysis in the formation of synthesis gas (syn gas) – homologation – water gas shift reaction (WGSR) – synthetic gasoline by using ZSM – 5 catalyst (Fisher – Tropsch and mobil process – political process) – cyclooligomerisation of acetylenes (Reppe's orWilke's catalyst) – olefin isomerisation using Ni catalyst – olefin metathesis catalysed by Schröck type carbene – catalytic deuteration of benzene.

COURSE OUTCOME

1. An in depth knowledge about electron transfer reactions and its mechanism is imparted to the students.
2. The fundamental principle behind organometallic chemistry, various reactions involving organometallic compounds and their role in catalysing various reactions is taught,which will enable the student to apply the knowledge to understand the analytical concepts involved.

Reference Books

1. Huheey, J. E.; Keiter, E. A. Keiter, R. L. Inorganic Chemistry; 4th Ed.; Harper and Row, NewYork, 1983.
2. Cotton, F. A.; Wilkinson, G.; Murillo, C. A.; Bochmann, M. Advanced Inorganic Chemistry; 6th Ed., Wiley Interscience: New York, 1988.
3. Purcell, K. F.; Kotz, J. C. Inorganic Chemistry; Saunders: Philadelphia, 1976.
4. Moeller, T. Inorganic Chemistry, A Modern Introduction; John Wiley: New York, 1982.
5. Shriver, D. F.; Atkins, P. W.; Langford, C. H. Inorganic Chemistry; 3rd Ed.; Oxford University Press: L0ondon, 2001.
6. Arthur Wilson Adamson, Paul D.S Fleischauer, Concepts of Inorganic Photochemistry, John Wiley & Sons Australia, Limited, 1975.
7. Asim. K. Das and Mahua Das, Fundamentals concepts of Inorganic chemistry, CBS publishers & Distributors private Ltd.
8. Robert H. Crabtree, The organometallic chemistry of the Transition metals, John Wiley & Sons, United States of America, Sixth edition, 2014.
9. Ajai Kumar, Coordination Chemistry, 2nd Edition, Aaryush Educations.
10. Ajai Kumar, Organometallic & Bioinorganic Chemistry, 2nd Edition, Aaryush Educations

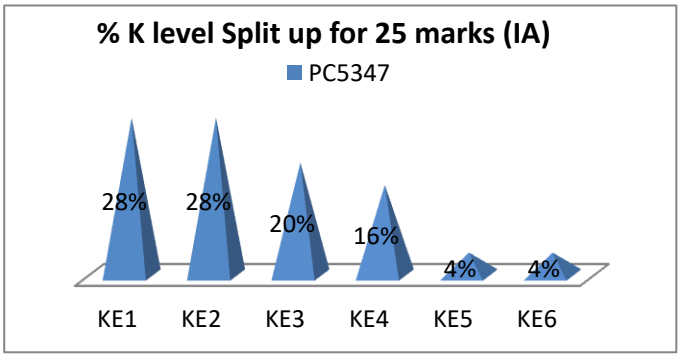
Web References and e-learning sources:

1. https://nptel.ac.in/courses/104/105/104105033/
2. https://chem.yonsei.ac.kr/chem/upload/CHE3103-01/122447755644547.pdf
3. https://authors.library.caltech.edu/25028/1/Langford_Lsp.pdf
4. https://nptel.ac.in/content/storage2/courses/104106064/lectures.pdf
5. https://nptel.ac.in/courses/104/108/104108062/

6. https://www.sscasc.in/wp-content/uploads/downloads/Chemistry/Inorganic-Chemistry.pdf
7. https://www.ias.ac.in/public/Volumes/reso/004/09/0063-0081.pdf
8. https://nptel.ac.in/content/storage2/courses/104103022/download/module11.pdf

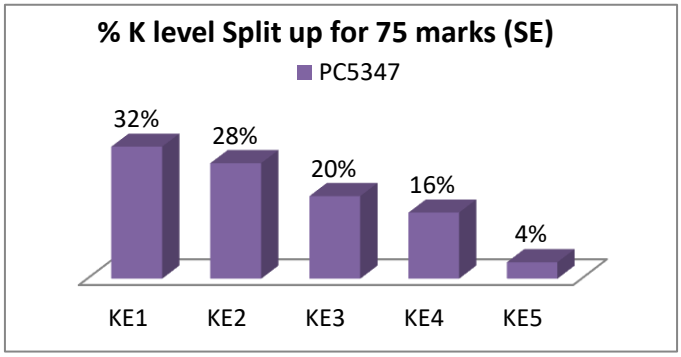
CIE-Continuous Internal Evaluation (25 Marks)

PC5347				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	2	1	3	1
Understand (7)	1	0	1	5
Apply (5)	2	2	0	1
Analyse (4)	0	1	1	2
Evaluate (1)	0	0	0	1
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

PC5347	
Bloom's Taxonomy	**Weightage %**
Remember	32%
Understand	28%
Apply	20%
Analyze	16%
Evaluate	4%



QUEEN MARY'S COLLEGE (AUTONOMOUS), CHENNAI – 4

M. Sc. CHEMISTRY

ORGANIC CHEMISTRY PRACTICAL- II (Core)
Semester-II

Course: VIII **Max Marks: 75**
Code: PC5348 **Credits: 4**

LEARNING OBJECTIVES

To develop analytical skill in

1 Separation and identification of organic mixture.
2 Organic preparations involving two stages.
3 To understand the techniques involved in estimations of organic compounds.
4 To develop the skill in interpretation of spectral data of various organic compounds

Course Outcomes : K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluation, K6 - Create

CO No.	**Course outcomes** Upon completion of the course, students will be able to	**POs addressed**
CO-1	**Identify** the nature of the two components in an organic mixture by solvent extraction method. **Understand** the principle behind solvent extraction method **Infer** the nature of functional group in the organic compound by carrying out chemical reactions. **Separate** the components in a given organic mixture. **Viva (PO3, PO4)** **Web resources (PO9)** https://www.youtube.com/watch?app=desktop&v=Tn0P2x0X_vs http://amrita.olabs.edu.in/?sub=73&brch=2&sim=96&cnt=207	K1 K2 K3 K4
CO-2	**Identify** the functional groups present in organic compounds by **interpretting** their spectra. **predict** the spectral features of organic compounds. **examine** the spectra of any unknown compound, **compile** spectral data and **propose** its structure. **Group Activity (PO5)** Elucidating **(PO3, PO4)** the structures of organic compounds by analysing sets of spectra for each compound through group discussion and presenting the results through powerpoint **(PO7)** **Viva (PO3, PO4)** **Web resources (PO9, PO10)** https://webspectra.chem.ucla.edu//	K1 K2 K3 K4 K5 K6
CO-3	**recollect** the procedures for preparation organic compounds and **explain**	K1

	the principle of organic reactions **operate** various equipments in chemistry laboratory. **construct** experimental set up for various organic reactions. **Viva (PO3, PO4)** **Web resources (PO9)** https://www.youtube.com/watch?app=desktop&v=oROSQnzSdZE	K2 K3 K5
CO-4	**express** the concentration of solutions containing organic compounds using standard terms. **perform** titration and **analyze** solution of unknown concentration. **estimate** the amount of phenol and aniline present in it. **Viva (PO3, PO4)**	K1 K2 K3 K4
CO-5	**state** procedure for estimation of glucose **interpret** the results obtained in the experiment	K1 K2

CO/PO	PO									
	1 Disciplinary knowledge and skills	**2 skilled communicator**	**3 critical thinker and problem solver**	**4 sense of inquiry**	**5 Team player / worker**	**6 skilled project manager**	**7 Digitally efficient**	**8 Ethical awareness and reasoning**	**9 National and international Perspective**	**10 Lifelong learners**
CO1	3	2	2	2	1	1	1	1	2	1
CO2	3	2	3	3	2	1	3	1	1	1
CO3	3	2	2	2	1	1	2	1	1	1
CO4	3	1	2	2	2	1	1	1	1	1
CO5	3	1	1	1	1	1	1	1	1	1
PC5348-AVG	3	2	2	2	1	1	2	1	1	1
PC5348-TOTAL	15	8	10	10	7	5	8	5	6	5

Course Outline

Experiments:

1. Separation and identification of components in a two component mixture and preparation of their derivative

2. Identification of organic compounds using spectroscopic data.

3. Synthesis of organic compounds involving two steps.

i. Preparation of phthalimide from phthalic anhydride, preparation of anthranilic acid from phthalic anhydride.

ii. preparation of p-bromo acetanilide from acetanilide, preparation of p-bromoaniline from p-bromo acetanilide.

iii. Preparation of p-nitroacetanilide from acetanilide, preparation of p-nitroaniline from p-nitroacetanilide.

iv. Preparation of 2,4,6-tribromoaniline from aniline, preparation of 1,3,5-tribromobenzene from 2,4,6-tribromoaniline.

*****4. Quantitative estimation of organic compounds

(i) Estimation of Aniline.
(ii) Estimation of Phenol.
(iii) Estimation of Glucose.

*Experiments only for internal assessment

COURSE OUTCOME

The student

1 Can separate any organic mixture and identify it.
2 Acquires knowledge in preparing organic compounds.
3 Acquires the skill in estimation of organic compounds.
4 Possess the ability to interpret any spectral data which help her in

REFERENCE BOOKS

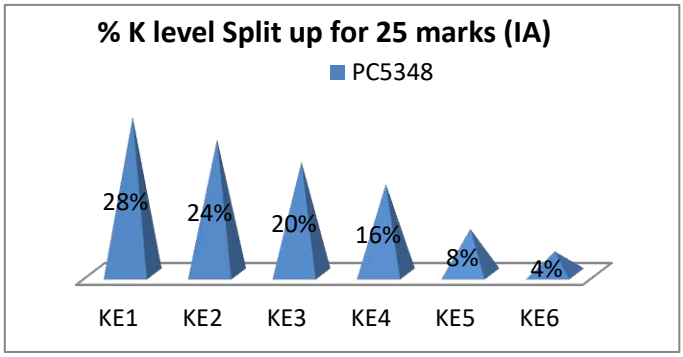
1. N. S. Gnanapragasam and G. Ramamurthy, Organic chemistry - Lab manual, S. Viswanathan Co. Pvt. Ltd., 1998.
2. J.N. Gurtu and R. Kapoor, Advanced Experimental Chemistry (Organic), S. Chand and Co., 1987.
3. Vogel's Textbook of Practical organic chemistry, 5th Ed., ELBS/Longman, Ingland 1996.
4. V. Venkatesan, R. Veeraswamy, A. R. Kulandaivelu, basic principles of practical chemistry, S. Chand and Sons, 2004.

Web References and e-learning sources:

1. http://amrita.olabs.edu.in/?sub=73&brch=2&sim=96&cnt=207
2. https://webspectra.chem.ucla.edu//

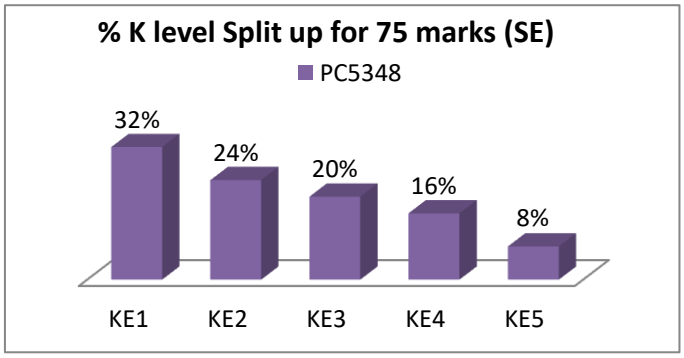
CIE-Continuous Internal Evaluation (25 Marks)

PC5348				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	1	1	2	3
Understand (6)	1	0	1	4
Apply (5)	2	2	0	1
Analyse (4)	0	1	1	2
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

PC5348	
Bloom's Taxonomy	**Weightage %**
Remember	32%
Understand	24%
Apply	20%
Analyze	16%
Evaluate	8%



QUEEN MARYS COLLEGE (AUTONOMOUS), CHENNAI – 4
M.Sc. CHEMISTRY
ELECTRO CHEMISTRY – (Elective)

Semester : II

Course No. : IX **Max Marks: 75**
Code: PE5317 **Credits : 3**

LEARNING OBJECTIVES:

1. To enable the students to understand the behaviour of electrolytes in solution.
2. To understand the structure of electrolyte surface.
3. To know the applications of electrode process.

Course Outcomes

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluation, K6 - Create

CO No.	Course outcomes Upon completion of the course, students will be able to	POs addressed
CO-1	**Recognise** and **explain** the types of ion-solvent and ion-ion interaction. **Calculate** the mean activity co-efficient of a uni-univalent dilute solution. **Assignment** on ion-solvent and ion-ion interaction and derivation of its related theories in written format. **Webresources (PO9)** http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000005CH/P000661/M019105/LM/1515648336CHE_P6_M25_Knowmore.pdf https://sci-hub.do/10.1021/jp067133c	K1, K2 K3
CO-2	**Identify** and **describe** diffusion and conduction **Apply** the concept of ionic atmosphere to **infer** the equivalent conductance value of an electrolyte using Debye-Hukel Onsager equation **eQuiz (PO3, PO4)** **webresources (PO9)** https://nptel.ac.in/content/storage2/courses/113104005/lecture_pdf/module3.pdf https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/DeVoes_Thermodynamics_and_Chemistry/10%3A_Electrolyte_Solutions/105_Derivation_of_the_DebyeHuckel_Theory	K1, K2 K3, K4

CO-3	**Identify** and **explain** the electrode electrolyte interface **Construct** electrical double layer with a suitable electrochemical cell **Criticize** the over potential versus current for any electrolyte which involves one electron transfer using Butler Volmer equation. **Webresources (PO9)** https://ocw.mit.edu/courses/chemical-engineering/10-626-electrochemical-energy-systems-spring-2014/lecture-notes/MIT10_626S14_S11lec13.pdf https://nptel.ac.in/content/storage2/courses/downloads_new/113104082/noc20_mm04_assigment_8.pdf http://home.iitk.ac.in/~vidtan/ElectrochemistryNotes/ActivationOverpotential_290615.pdf	K1,K2 K3 K5
CO-4	**Identify** and **discuss** the corrosion and its theories **Apply** the concept of prevention **Analyse** and **evaluate** the quality of product **Design** corrosion free appliances and various accessories **Seminar** on functional group transformation by modern reagents **using PPT (PO2, PO7)** **eResource (PO9):** https://nptel.ac.in/courses/113/104/113104082/ https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Book%3A_Introduction_to_Inorganic_Chemistry/04%3A_Redox_Stability_and_Redox_Reactions/4.06%3A_Pourbaix_Diagrams https://www.youtube.com/watch?v=IxZQ-tCO_G4 (Courtesy) https://people.bath.ac.uk/chsataj/CHEY0016%20Lecture%2015.pdf	K1,K2 K3 K4, K5 K6
CO-5	**Define** and **explain** kinds of electrode **Categorise** the electrodes based on its merits and demerits **Develop** a good lead-storage battery **Seminar** followed by **group discussion** to discuss and criticize the use of different cell and lead storage batteries. **eResources (PO9, PO10)** https://chem.libretexts.org/Bookshelves/Introductory_Chemistry/Map%3A_Chemistry_for_Changing_Times_(Hill_and_McCreary)/08%3A_Oxidation_and_Reduction/8.03%3A_Electrochemistry-_Cells_and_Batteries https://courses.lumenlearning.com/boundless-chemistry/chapter/batteries/ https://youtu.be/OTdnvk-h3cE (courtesy) https://nptel.ac.in/content/storage2/courses/121106014/Week11/lecture34.pdf	K1, K2 K4 K6

	PO									
	1 Disciplinary knowledge and skills	2 skilled communicator	3 critical thinker and problem solver	4 sense of inquiry	5 Team player / worker	6 skilled project manager	7 Digitally efficient	8 Ethical awareness and reasoning	9 National and international Perspective	10 Lifelong learners
CO1	3	1	1	1	1	1	1	1	2	1
CO2	3	1	2	2	2	1	2	1	2	1
CO3	3	1	1	1	1	1	1	1	2	1
CO4	3	3	2	2	2	1	3	2	3	1
CO5	3	2	2	2	2	1	3	2	3	1
PE5317-AVG	3	2	2	2	2	1	2	1	2	1
PE5317-TOTAL	15	8	8	8	8	5	10	7	12	5

Course Outline

UNIT – I **(12 Hrs)**

IONIC PHENOMENA IN SOLUTION – I

Born model of ion-solvent interaction, ion-ion interaction, concept of ionic atmosphere. Debye Hukel equation for the mean activity coefficient of electrolytes – verification and experimental validity of the equation. Bjerrum ion pair theory – Bjerrum modification of Debye Hukel equation.

UNIT – II **(12 Hrs)**

IONIC PHENOMENA IN SOLUTION –II

Ion association treatment – diffusion – Fick's law of diffusion – Einstein Smolunchowki equation – conduction – Stoke Einstein equation - Plank Henderson equation – influence of ionic atmosphere on conductivity of electrolytes. Debye Huckel Onsager equation for the equivalent conductance of electrolyte – Experimental verification.

UNIT-III **(12 Hrs)**

STRUCTURE AND THEORIES OF ELECTRIFIED INTERFACE

The electrode electrolyte interface – electrical double layer – electro capillary phenomena – Helmholtz – Perrin model, Guoy Chapman diffuse model and Stern model.

Significance of equilibrium – exchange current density and symmetry factor. Butler- Volmer equation for one electron transfer. Electro kinetic phenomena – zeta potential – Tisselius method of separation of proteins.

UNIT – IV **(12 Hrs)**

SOME ELECTROCHEMICAL SYSTEMS OF TECHNOLOGICAL INTEREST

Corrosion and the stability of metals. Theories of corrosion – charge transfer reaction of corrosion, short circulate energy producing cell, corrosion of ultrapure metals – corrosion current and corrosion potential. Evans diagrams, potential – pH diagram (Pourbaix diagram) – Prevention of corrosion – electronic approach to the stability of metals.

UNIT – V **(12 Hrs)**

Electrode, SHE, Dipping calomel electrode, Quinhydrone electrode, glass electrode – merits and demerits. Fuel cells – kinds of fuel cells and their relative merits – electricity storage – Lead storage battery - Lechlanche cell – silver – zinc cell and sodium – sulphur cell.

COURSE OUTCOME

Sound knowledge in the theories and concepts of electrochemistry

REFERENCE BOOKS:

1. J.O.M.Bockris and A.K.N.Reddy, Modern Electrochemistry, vol.1&2. Plenum Press, New York, 1970.
2. S.Glasstone, Electrochemistry, Affiliated East – West Press Pvt. Ltd., New Delhi, 1974..
3. L.Andropov, Theoretical Electrochemistry, Mir Publications, Moscow, 1977.

4. J. Rajaram and J.C.Kuriakose, Kinetics and Mechnism of Electrochemical Transformations, Macmillan Inida Ltd.,New Delhi, 1993.

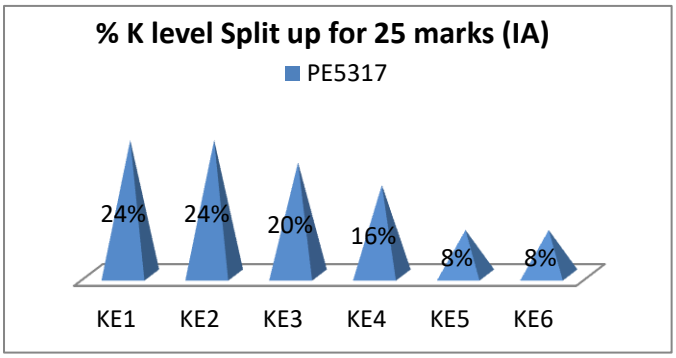
Web References and e-learning sources:

1.http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000005CH/P000661/M019105/LM/1515648336CHE_P6_M25_Knowmore.pdf
2. https://sci-hub.do/10.1021/jp067133c
3. https://nptel.ac.in/content/storage2/courses/113104005/lecture_pdf/module3.pdf
4.https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/DeVoes_Thermodynamics_and_Chemistry/10%3A_Electrolyte_Solutions/105_Derivation_of_the_DebyeHuckel_Theory
5.https://ocw.mit.edu/courses/chemical-engineering/10-626-electrochemical-energy-systems-spring-2014/lecture-notes/MIT10_626S14_S11lec13.pdf

6.https://nptel.ac.in/content/storage2/courses/downloads_new/113104082/noc20_mm04_assignment_8.pdf
7.http://home.iitk.ac.in/~vidtan/ElectrochemistryNotes/ActivationOverpotential_290615.pdf
8. https://nptel.ac.in/courses/113/104/113104082/
9.https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Book%3A_Introduction_to_Inorganic_Chemistry/04%3A_Redox_Stability_and_Redox_Reactions/4.06%3A_Pourbaix_Diagrams
10. https://nptel.ac.in/content/storage2/courses/121106014/Week11/lecture34.pdf

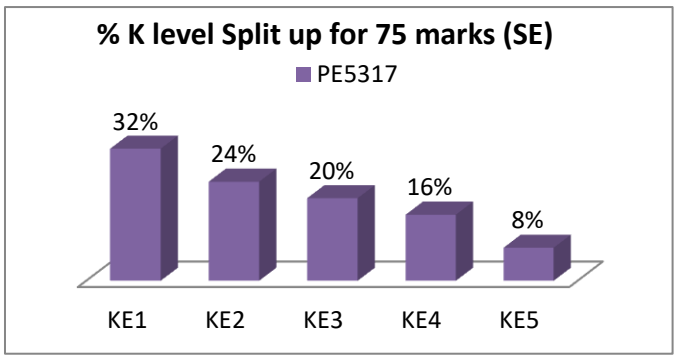
CIE-Continuous Internal Evaluation (25 Marks)

PE5317				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember(6)	1	1	1	3
Understand (6)	1	0	1	4
Apply (5)	2	2	0	1
Analyse (4)	0	1	1	2
Evaluate (2)	1	0	1	0
Create (2)	0	1	1	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

PE5317	
Bloom's Taxonomy	**Weightage %**
Remember	32%
Understand	24%
Apply	20%
Analyze	16%
Evaluate	8%



QUEEN MARY'S COLLEGE (AUTONOMOUS) CHENNAI – 4

M. Sc. CHEMISTRY-

NANO CHEMISTRY (Elective)

Semester- II

Course No. : X **Max Marks: 75**

Code: PE5318 **Credits: 3**

LEARNING OBJECTIVES

1. To acquire knowledge about nanochemistry
2. To learn the synthesis of nanomaterials, characterization and applications.

Course outcome: -

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluation, K6 - Create

CO No	Course outcomes Upon completion of the course, students will be able to	POs addressed
CO-1	**Recall** the Nano revolution of the XX century- **Explain** basic idea & structure of nanomaterial, **Infer** properties at Nano scale. PO1 Assignment : Demonstrate basic idea & structure of nanomaterial	K1 K2 K3
CO-2	**Describe** top down and bottom up approach. **Explain** sol-gel process. **Illustrate** synthesis, purification, properties and uses of CNT. **Distinguish** metal Nanoparticles, Nanotubes and Nano rods. **Hypothesize** energy band structure of semiconductor and quantization effect of nanomaterials. PO9 https://youtu.be/fZlsUFhwpyQ (space elevator) https://youtu.be/fVCZej5Z5yg https://youtu.be/dlCCNMtoJvk /International University Videos	K1 K2 K3 K4 K6
CO-3	**Recall** and e**xplain** techniques used for characterization of nanomaterials. **Analyse and evaluate** nanomaterials using SEM, TEM, HR-TEM (SAED). PO9- https://youtu.be/eXusvz0bI4I https://youtu.be/ksQT1W0cmHE / Hands on training (virtual lab videos)	K1 K2 K4 K5

CO-4	**Summarize** theories and techniques used for characterization of nanomaterials using UV-Visible spectra**. Describe** and **illustrate** SPM, AFM, STM, XPS, and XANES techniques. PO5-Industrial/Lab Visit (CLRI, IIT)	K1 K2 K3
CO-5	**List** applications of nanomaterials in various fields. **Describe** Solar energy Conversion and Catalysis. **Demonstrate** uses of Nano composites, chemical and Nano biosensors. **Explain** usage of Nano medicine and Nano biotechnology NEMS. **Assess** pros and cons of nanomaterials in agriculture, as fertilizer, and pesticides. PO5- Group discussion	K1 K2 K3 K4 K5

CO/PO	**PO**									
	1 Disciplinary knowledge and skills	**2 skilled communicator**	**3 critical thinker and problem solver**	**4 sense of inquiry**	**5 Team player / worker**	**6 skilled project manager**	**7 Digitally efficient**	**8 Ethical awareness and reasoning**	**9 National and international Perspective**	**10 Lifelong learners**
CO-1	3	1	1	1	1	1	1	1	1	1
CO-2	3	1	2	2	1	1	1	1	2	1
CO-3	3	2	1	1	1	1	1	1	1	1
CO-4	3	1	2	2	2	1	2	1	1	1
CO-5	3	2	1	2	2	1	2	1	2	1
PE5318-AVG	3	1	1	2	1	1	1	1	1	1
PE5318-TOTAL	15	7	7	8	7	5	7	5	7	5

Course outline

UNIT - I **(12 hrs)**

FUNDAMENTALS AND OVERVIEW OF NANOSCIENCE

Nano revolution of the XX century-Basic idea of nanomaterials-Structure-Nucleation and grain growth-Grain boundaries, Properties at nanoscale: Strength and Hardness, optical, electrical, magnetic, mechanical and chemical properties.

UNIT - II **(12 hrs)**

SYNTHESIS OF NANOMATERIALS

Top down approach – Nanolithography, Chemical Vapour Deposition (CVD). Bottom up approach - sol-gel processing, chemical synthesis. self assembly-Supramolecular approach. Reverse micelles and role of surfactants, capping of nanoparticles, Synthesis, purification, properties and uses of CNT, metal Nanoparticles. Nano tubes, Nano rods, Bucky balls-fullerenes, Nanofibers, Nanoshells. Semiconductor Nanoparticles - Energy band structure of Semiconductors Quantum dots-Quantization effect.

UNIT - III **(12 hrs)**

CHARACTERISATION OF NANOMATERIALS-I

Theories and Techniques used for characterization-UV-Visible and PL spectroscopy-XRD-Electron microscopes-SEM, TEM, HR-TEM (SAED).

UNIT - IV **(12 hrs)**

CHARACTERISATION OF NANOMATERIALS-II

Theories and Techniques used for characterization SPM, AFM, STM, XPS, XANES.

UNIT - V **(12 hrs)**

APPLICATIONS OF NANOMATERIALS

Solar energy conversion and catalysis - Uses of Nanocomposites, chemical and nano biosensors. Nanomedicine and Nanobiotechnology-NEMS. Nanomaterials in bone substitutes and dentistry, drug delivery and its application- nanoparticles in cancer targeting and treatment. Food and cosmetic applications, textiles, paints, Nanotechnology in agriculture, fertilizer and pesticides. Nanoparticles in Pollution control.

COURSE OUTCOME

The student

1. Know the different approaches to synthesise a nanomaterial
2. can practice the application of nanomaterial in different field

Reference Books

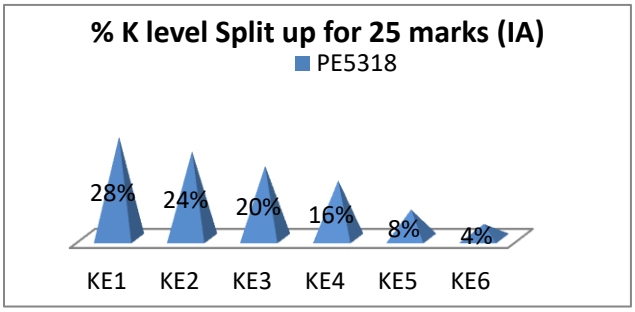
1. Pradeep, T., "Nano: the Essentials", Tata McGraw Hill, New Delhi, 2007.
2. Rao, C.N.R. and Cheetham, A.K., "The chem. of Nanomaterials: Synthesis, Properties and Applications", Wiley-VCH, 2004.
3. Hari Singh Nalwa, "Nanostructured materials and Nanotechnology", Acad. press, 2002.
4. Charles P. Poole and Frank J. Owens, "Intro. to Nanotechnology" Wiley-Intersci., 2003.
5. A.Nanobook, "Organic and Inorganic Nanostructures", Artech House, 2005.
6. Sulabha K. Kulkarni, "Nanotech.: Principles and Practices", Capital Publishing Co, 2007.

Web References and e-learning sources:

1. https://youtu.be/fZlsUFhwpyQ (space elevator)
2. https://youtu.be/fVCZej5Z5yg
3. https://youtu.be/dlCCNMtoJvk /International University
4. https://youtu.be/eXusvz0bI4I
5. https://youtu.be/ksQT1W0cmHE / Hands on training (virtual lab videos)

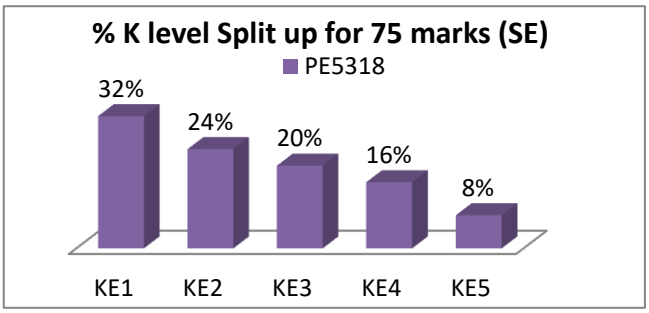
CIE-Continuous Internal Evaluation (25 Marks)

PE5318				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	1	1	2	3
Understand (6)	1	0	1	4
Apply (5)	2	2	0	1
Analyse (4)	0	1	1	2
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

PE5318	
Bloom's Taxonomy	**Weightage %**
Remember	**32%**
Understand	24%
Apply	20%
Analyze	16%
Evaluate	8%



QUEEN MARY'S COLLEGE (AUTONOMOUS), CHENNAI – 4

M. Sc. CHEMISTRY-

FOOD CHEMISTRY - (Other Elective)
Semester- II

Course No. : XI **Max Marks: 75**
Code: PD5308 **Credits: 3**

LEARNING OBJECTIVES

1. To understand the basic concepts in food chemistry
2. To understand type of additives added to a food product
3. To understand the processing and preservation techniques adopted in a food process.
4. To have knowledge in analysis of various content present in food.
5. To know the various types of adulterants that may be mixed in a food product.

COURSE OUTCOMES

K1-Remember, K2-Understand, K3-Apply, K4-Analyze, K5-Evaluation, K6-Create

Upon completion of the course students will be able to.

CO. NO.	COURSE OUTCOMES	POs Addressed
CO 1	**Identify** the basic five groups to which food belongs. **Compare and Contrast** different food groups. **Use** food guide to choose correct food consumption pattern Activities .(i) Class tests and (ii) assignments followed by presentation on different food groups (PO1, PO2, PO7) (III) WEB RESOURCES NPTEL ***http://nptel.ac.in./content/storage2/courses/126104004/Lecture* Notes/**	**K1** **K2** **K3**
CO-2	**List** a number of additives added to food for different reasons **Classify** food additives, on the basis of their function. **Select** a suitable additive depending on the need. **Inspect** the functioning of a chosen additive . **Evaluate** and **rate** the usefulness of an additive. **Develop** a new additive which would increase the value of food Activities (i) Class tests and (ii) assignment and seminar on the food additives. (PO1, PO2, PO7)	**K1** **K2** **K3** **K4** **K5** **K6**

	(iii) E-quiz on food additives (PO3) (iv)Group Discussion on food additives. (PO5) (v). NPTEL resource on food processing. **http://nptel.ac.in/courses/126/105/126105015/**	
CO-3	**Recognise** the causes of food deterioration **Illustrate** different methods of preservation and processing of food **Apply** a suitable method of preservation for food of interest **Distinguish** between different methods of preservation. Activities (i) Class tests and (ii) assignment followed by presentation on different methods of preservation and processing of food (PO1, PO2, PO7) Group discussion on food processing methods. (PO5)	**K1** **K2** **K3** **K4**
CO-4	**Name** the methods available for analysis of components of food. **Explain t**he procedures adopted for analysis **Choose** a particular method from available methods Activities. Assignment and seminar (PO1, PO2, PO7) on the analysis of components of food	**K1** **K2** **K3**
CO-5	**List** the methods to illustrate the presence of adulterants in food **Relate** the presence of adulterants to health hazard **Make use** of laboratory tests to identify adulterants **Correlate** the extent of damage to the amount of adulterants present **Plan** methods estimate and eliminate to the adulterants Activities. (i) Class tests and (ii) assignment followed by presentation (PO1, PO2, PO7) on the adulterants and their effect on food. (iii). E-quiz on adulterants and their effects on food. (PO3) (iv). Group discussion on adulterants. (PO5)	**K1** **K2** **K3** **K4** **K5**

CO/PO	PO									
	1 Disciplinary knowledge and skills	2 skilled communicator	3 critical thinker and problem solver	4 sense of inquiry	5 Team player / worker	6 skilled project manager	7 Digitally efficient	8 Ethical awareness and reasoning	9 National and international Perspective	10 Lifelong learners
CO1	3	2	1	1	1	1	2	1	1	1
CO2	3	2	2	2	3	1	2	2	2	1
CO3	3	2	1	1	3	1	2	2	2	1
CO4	3	2	1	1	1	1	2	1	1	1
CO5	3	2	2	2	3	1	2	1	1	1
PD5308-AVG	3	2	1	1	2	1	2	1	1	1
PD5308-TOTAL	15	10	7	7	11	5	10	7	7	5

Course outline

UNIT- I **(12 hrs)**

CONCEPTS IN FOOD CHEMISTRY

Introduction to food chemistry, water structure, interactions of water with food materials and food components, water binding, moisture contents in foods, role of water in food preparation, food guide- basic five groups, and usage of food guide.

UNIT- II **(12 hrs)**

FOOD ADDITIVES

Food additives: Need for food additives, Antioxidants, chelating agents, colouring agents, curing agents, emulsions, Flavours and flavour enhancers, Texuring agents, Humecants, sweeteners- Nonnutritive sweeteners, Preservatives, stabilizers and thickeners, other additives.

UNIT- III **(12 hrs)**

FOOD PRESERVATION AND PROCESSING

Food Deterioration- Microbial spoilage, food enzyme, insects, parasites and rodents, temperature, moisture, oxygen, light and time, food safety in the home.

Methods of Preservation and Processing- Preservation and processing by- heat, cold. Chill storage, Deep freezing, Drying, Concentration, Fermentation, Radiation.

UNIT- IV **(12 hrs)**

FOOD ANALYSIS

Food sampling- sample and sample preparation of foods.

Analysis of protein- determination of moisture content, ash content, nitrogen content- Kjeldahl method.

Analysis of oils and fats- analysis of crude fats, determination of iodine number, acid number, saponification value.

Analysis of carbohydrates- analysis of glucose and starch- Benedict's method, Anthrone method, Nelson- Somoyogi- analysis of crude fibers. Estimation of vitamins- Thiamine and Riboflavin.

Enzyme Activity- Measurement of enzyme activity-principle, estimation of catalase in chow-chow and radish.

UNIT- V **(12 hrs)**

FOOD ADULTERATION

Detection of adulteration in coffee, tea, oil, fooddhal, sugar, milk, ghee, supari, turmeric powder, kesari powder, chilli powder, spices, jaggery, sweets, jam, jelly, honey- laboratory tests, chemistry behind each test and health hazards of the adulterants.

Estimation of benzoic acid, saccharin powder and B.O.A. A test.

COURSE OUTCOME

The student

1. Gain a sound knowledge in food chemistry
2. Can identify the type of adulterant mixed in a food product and even analyse the products to determine its quality.

REFERENCES

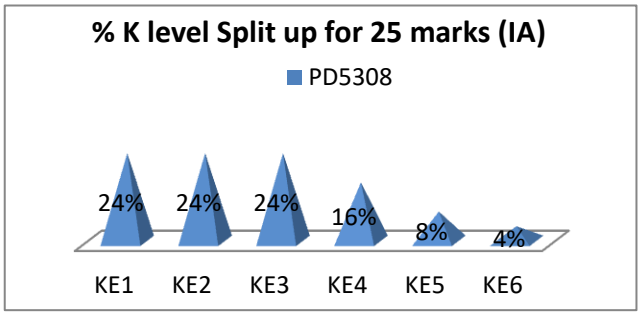
1. Beritz. H.D., Grosch. M.W, "Food Chemistry", 2nd edition, Springer, Verlag, Germany.
2. Geetha Swaminathan, Mary George, "Laboratory Chemical Methods in Food Analysis", 1999, Margham publication, Chennai.
3. Sharma. B. K, "Instrumental Methods of Chemical Analysis", Goel Publishing house, Meerut.
4. Swaminathan. M., "Text Book on Food Chemistry", Printing and Publishing Co ltd., Bangalore.
5. Coultate. T. P., "Food Chemistry of is Components"3rd Edition, 1999, Royal Society of Chemistry, Cambridge.
6. Lehninger. A.L., 'Principles of Biochemistry", Worth Publishers.
7. Voet and Voet, "Biochemistry", John Wiley.
8. Norman N. Potter, Food science, CBS publishers and distributors, New Delhi. 1994.
9. Lillian Hoagoland Meyer, Food Chemistry, CBS publishers and distributors, New Delhi. 1994.
10. Owen R Fennema, Food Chemistry, Marcel Decker Inc., New York. 1996.
11. Srilakshmi B., Food Science, New age International Pvt. Ltd. Publishers, III ed. 2003.
12. Siva Sankar B., Food Processing and Preservation. Prentice – Hall of India Pvt. Ltd., New Delhi. 2002.
13. Shakuntala Manay. N, Shadaksharaswamy.M., Foods Facts and Principles.,New age International Pvt. Ltd. Publishers.
14. Chopra.H.K, Panesar.P.S., Food Chemistry., Narosa Publishing House.

Web References and e-learning sources:

1. ***http://nptel.ac.in./content/storage2/courses/126104004/Lecture* Notes/**
2. **http://nptel.ac.in/courses/126/105/126105015/**

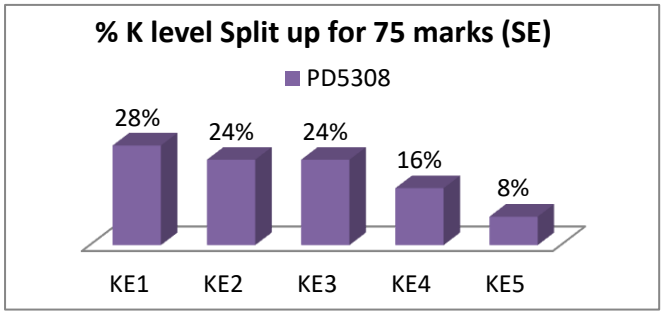
CIE-Continuous Internal Evaluation (25 Marks)

PD5308				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (6)	1	1	2	2
Understand (6)	1	0	1	4
Apply (6)	2	2	0	2
Analyse (4)	0	1	1	2
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

PD5308	
Bloom's Taxonomy	**Weightage %**
Remember	**28%**
Understand	24%
Apply	24%
Analyze	16%
Evaluate	8%



QUEEN MARY'S COLLEGE (AUTONOMOUS) CHENNAI – 4

M.Sc. CHEMISTRY

ORGANIC CHEMISTRY – III
Semester- III

Course No. : XII **Max Marks: 75**
Code: PC5349 **Credits: 4**

LEARNING OBJECTIVES

1 To understand the basic principle in photochemical reactions.
2 To understand the concept behind pericyclic reactions
3 To have a thorough knowledge in identifying the aromaticity concepts in organic compounds.
4 To identify the reactions involving specific reagents and their mechanism.
5 To acquire knowledge in retro synthetic analysis.

Course Outcomes

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluation, K6 - Create

CO No.	Course outcomes Upon completion of the course, students will be able to	POs addressed
CO-1	**Aromatic electrophilic substitution reactions** **Identify and differentiate** between activating and deactivating groups. **Activity** **Debate** on the correlation between nature of substituents and reactivity towards aromatic electrophilic substitution reactions (**PO2**) **eResources** **https://nptel.ac.in/content/storage2/courses/104101005/downloads/LectureNotes/chapter%209.pdf**	K1 K2
CO-2	**Photochemistry** **define** the characteristics of organic photochemical reactions and **describe** underlying principles. **illustrate** the mechanism of rearrangement reactions under photochemical conditions **eResources** https://authors.library.caltech.edu/25034/29/BPOCchapter28.pdf https://nptel.ac.in/courses/104/105/104105038/	K1 K2 K3
CO-3	**Pericyclic reactions** **identify** different types of pericyclic reactions and **explain** them with suitable examples. **predict** and **explain** the regiochemical and stereochemical outcomes of pericyclic reactions. **Activities**	K1 K2 K3 K4

	Seminar on pericyclic reactions (**PO2, PO7**) **eQuiz** on pericyclic reactions **(PO3, PO4)** **webresources (PO9)** http://ursula.chem.yale.edu/~chem220/chem220js/STUDYAIDS/pericyclic/PericyclicRxn.pdf http://www.iiserpune.ac.in/~harinath/images/CHM-311-Oct-24-2013.pdf https://nptel.ac.in/courses/104/106/104106077/	
CO-4	**Reactions involving modern reagents in organic synthesis** **name** modern reagents in organic synthesis and **illustrate** their applications. **choose** suitable reagents for functional group transformations. **decide** methods for synthesis of organic compounds. **Activity** **Seminar** on functional group transformation by modern reagents **using PPT (PO2, PO7)** **eResource (PO9): https://hwpi.harvard.edu/files/myers/files/12-the_suzuki_reaction.pdf** **https://nptel.ac.in/content/storage2/courses/104103023/download/module3.pdf**	K1 K2 K3 K5
CO-5	**Asymmetric synthesis** **recall** various methods for asymmetric synthesis. **describe** strategies for the conversion of achiral starting materials into pure enantiomers / diastereomers by employing selective reactions. **construct** synthetic schemes for asymmetric synthesis. **analyse and assess** different strategies for stereoselective synthesis of target molecules. **formulate** synthetic sequences for organic compounds employing chiral substrates / reagents / catalysts. **Activity** **Assignment** on prediction of stereochemistry of products obtained from chiral substrates using Cram's rule, Prelog's rule, and Felkin-Ahn model followed by **group discussion (PO1, PO3, PO4, PO7)** **eResources (PO9, PO10)** **http://chemlabs.princeton.edu/macmillan/wp-content/uploads/sites/6/JLA_Synthetic_Planning.pdf** **https://www.asu.edu/courses/chm233/notes/retrosynthesis/retrosynthesisS2020.pdf** **https://nptel.ac.in/courses/104/105/104105087/**	K1 K2 K3 K4 K5 K6

CO/PO	PO									
	1 Disciplinary knowledge and skills	2 skilled communicator	3 critical thinker and problem solver	4 sense of inquiry	5 Team player / worker	6 skilled project manager	7 Digitally efficient	8 Ethical awareness and reasoning	9 National and international Perspective	10 Lifelong learners
CO1	3	1	1	1	1	1	2	1	1	1
CO2	3	2	2	2	2	1	2	2	1	1
CO3	3	2	1	1	1	1	2	1	2	1
CO4	3	3	2	2	2	1	3	1	2	1
CO5	3	2	3	3	2	1	2	2	3	1
PC5349-AVG	3	2	2	2	2	1	2	1	2	1
PC5349-TOTAL	15	10	9	9	8	5	11	7	9	5

Course outline

UNIT – I **(18 hrs)**

AROMATIC ELECTROPHILIC SUBSTITUTION REACTIONS

S_E1, S_E2 reaction mechanism, Arenium ion mechanism, ortho/para ratio; orientation and reactivity in monosubtituted benzene rings and benzene rings with more than one substituent; Ortho directing reactions (i) using lithium: ortho lithiation - directing groups containing oxygen, nitrogen, several lithiation ; (ii) halogens , (iii) alpha lithiation and (iv) lateral lithiation and halogens, multiple directed lithiations, several lithiations.

UNIT - II **(18 hrs)**

PHOTOCHEMISTRY

Photochemical excitation: Experimental techniques, electronic transitions, Jablonskii diagrams, intersystem crossing (ISC), energy transfer.

Reactions of electronically excited ketones, π- π* and n- π* triplets, α – cleavage: Norrish type I and Norrish type II reactions; β- cleavage; photo reductions, phot oxidation and dimerisation, Paterno – Buchi reactions, photochemistry of an α, β-unsaturated ketones, cis-trans isomerisation.

Photochemical rearrangement : di-pi methane rearrangement, 1,3,5-trimethylbenzene to 1,2,4-trimethylbenzene, Barton reactions.

UNIT –III **(18 hrs)**

PERICYCLIC REACTIONS

Classification, Woodward – Hoffmann rules – Frontier Molecular Orbital (FMO), Orbital symmetry correlation approaches. Huckel Molecular orbital method or perturbation molecular orbital method.

Electrocyclic reactions: Conrotatory and disrotatory motions of 4n, 4n+2, allyl systems, selection rules. Cycloaddition reactions: antarafacial and suprafacial additions, notation of cycloadditions in 4n and 4n+2 systems, [2+2] and [4+2], ene reactions and 1, 3-dipolar cycloaddition reactions, stereochemical effects and effect of substituents on the rate of cycloaddition.

Sigmatropic rearrangements: selection rules with simple examples, 1, 3- and 1, 5- hydrogen shift – Cope, hetero cope and Claisen and thio-Claisen rearrangements.

UNIT IV **(18 hrs)**

REACTIONS INVOLVING MODERN REAGENTS IN ORGANIC SYNTHESIS

Stork-Enamine reaction, Mannich reaction, Baylis-Hillman reaction, Biginelli reaction, Mitsunobu reaction, Dieckmann reaction, Japp-Klingemann reaction, Ziegler alkylation, Hoffmann-Loffler reaction, Simmon-Smith reaction, Heck reaction, Stille coupling, Suzuki coupling, Sonogashira coupling, Fukuyama coupling, Hiyama coupling,.

UNIT V **(18 hrs)**

ASYMMETRIC SYNTHESIS

Asymmetric synthesis on chiral substrate: nucleophilic addition to alpha-chiral carbonyl compounds, prediction of stereochemistry-Cram's rule, Prelog's rule, Felkin-Ahn model. Asymmetric synthesis using chiral reagents: Chiral modification of lithium aluminium hydride – BINAL-H – Application in reduction of prochiral ketones; oxazaborolidines, T.S. Model, Asymmetric synthesis using chiral auxiliary: Chiral auxiliaries derived from proline, camphor,

and menthol. Asymmetric synthesis using chiral catalysts: Asymmetric alkylation and allylation of carbonyl compounds. Yeast as biocatalyst in asymmetric synthesis.

COURSE OUTCOME

The student

1 can suggest methodologies to synthesize compounds with high stereochemical and regiochemical selectivity by employing light/ heat energy/modern reagents.

2 can determine whether a compound is aromatic/non aromatic /anti aromatic.

3 can analyse the target material and design its synthesis through retrosynthesis.

Reference Books

1. J. March, Advanced Organic Chemistry; Reactions, Mechanisms and Structure, 6th Ed., Wiley interscience, 2007.
2. J. Clayden, N. Greeves, S. Warren and P. Wothers, Organic Chemistry, Oxford University Press, 1st Ed., 2000.
3. F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry, Parts A and B. 5th Ed., Springer, 2007.
4. H. O. House, Modern Synthetic Reactions, 2nd Ed. W. A. Benjamin, New York, 1972.
5. K. Mackie, M. Smith, P. Aitken, Guide Book to Organic Synthesis, 3rd Ed., ELBS, England, 2000.
6. S. Warren, P. Wyatt, Organic Synthesis, The Disconnection Approach, Wiley, 2009.
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8. W. Carruthers, I. Coldham, Modern Methods of Organic Synthesis, 4th Ed., Cambridge University Press, Cambridge, 2004.
9. J. D. Morrison, Asymmetric Synthesis, Vol 1-5, Academic Press, 1983.
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12. H. B. Kagan, Asymmetric Synthesis, Thieme Medical Publishers, 1st Ed., 2003.
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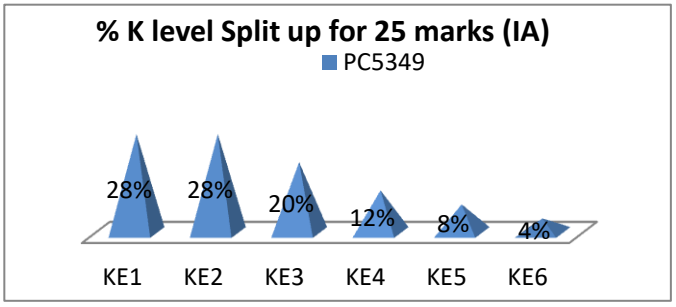
14. J. M. Coxon, B. Halton, Organic Photochem., Cambridge University Press, 2nd Ed., 1987.
15. S. Sankararaman, Pericyclic Reactions – A Textbook, Wiley-VCH, 2005.
16. J. Singh, Photochemistry and Pericyclic Reactions, New Age International, 2003..

Web References and e-learning sources:

1. http://ursula.chem.yale.edu/~chem220/chem220js/STUDYAIDS/pericyclic/PericyclicRxn.pdf
2. http://www.iiserpune.ac.in/~harinath/images/CHM-311-Oct-24-2013.pdf
3. https://nptel.ac.in/courses/104/106/104106077/
4. **https://hwpi.harvard.edu/files/myers/files/12-the_suzuki_reaction.pdf**
5. **https://nptel.ac.in/content/storage2/courses/104103023/download/module3.pdf**

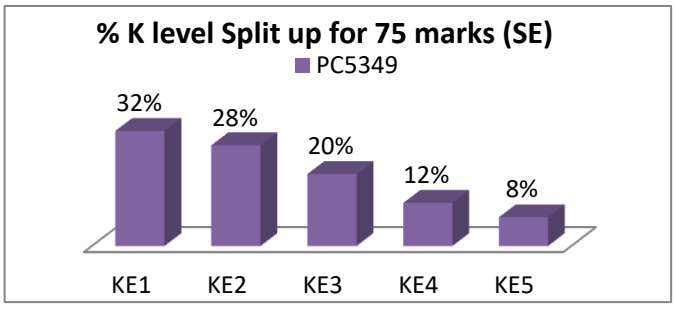
CIE-Continuous Internal Evaluation (25 Marks)

PC5349				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	1	1	2	3
Understand (7)	1	0	1	5
Apply (5)	2	2	0	1
Analyse (3)	0	1	1	1
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

PC5349	
Bloom's Taxonomy	**Weightage %**
Remember	**32%**
Understand	28%
Apply	20%
Analyze	12%
Evaluate	8%



QUEEN MARYS COLLEGE (AUTONOMOUS), CHENNAI – 4
M.Sc. CHEMISTRY
GROUP THEORY, SURFACE PHENOMENA AND THERMODYNAMICS –(CORE)

Semester - III

Course No. : XIII **Max Marks: 75**
Code: PC5350 **Credits: 4**

LEARNING OBJECTIVES

1. To understand the concept of group theory and its applications and significance.
2. To apply the concepts of statistical thermodynamics.
3. To give an insight into the area of surface chemistry.

Course Outcomes

K1 – Remember,K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluation, K6 - Create

CO No.	Course outcomes Upon completion of the course, students will be able to	POs addressed
CO-1	**Attain** indepth knowledge on the symmetry elements and symmetry operations. **Classify** molecules into point groups. **Describe** matrix representation of symmetry operation, reducible and irreducible representation. **Construct** character table for point groups. E- quiz is conducted in identification of point group. **(PO3 and PO4)** E resources https://youtu.be/e473_8NMp0s?list=PLj_Alq7xw30knZPTpa9whzqiSn_RZHGWP (nptel) https://youtu.be/Had8fQfSL2U?list=PLj_Alq7xw30knZPTpa9whzqiSn_RZHGWP(nptel) https://youtu.be/TGS5QidgGPo?list=PLj_Alq7xw30knZPTpa9whzqiSn_RZHGWP(nptel)	K1 K2 K4 K6
CO-2	**Define** symmetry selection rule for IR and Raman spectra. **Apply** selection rule to **determine** the symmetries of vibrational modes in various molecules. Assignment given in identification of symmetries of vibrational modes in various molecules. E resources(PO9,PO10) https://youtu.be/gM-CMcBYp18?list=PLj_Alq7xw30knZPTpa9whzqiSn_RZHGWP(nptel)	K1 K2 K3
CO-3	**Define** basic concepts in surface phenomena. **Explain** electrical phenomena at interfaces including electro kinetic phenomena, micelles, solubilisation , micro emulsion etc. **Analyse** the surfaces using SEM. **Seminar** on surface phenomena followed by **group discussion** to assess their importance in the environment **(PO1, PO3, PO4, PO5, PO7)** E resources https://youtu.be/FVMdog5zzE4	K1 K2 K4

CO-4	**Know** about the thermodynamic probability and distribution law. **Describe** Fermi – Dirac and Bose-Einstein statistics. **Summarise** the relation between molecular and molar partition function. **Apply** the molar and molecular partition function to linear and non-linear molecules. E resources https://youtu.be/KBe1d8BdjqQ (nptel) https://youtu.be/1aHFG7VLr-g (nptel)	K1 K2 K3 K5
CO-5	**Introduce** the concepts of thermodynamics. **Explain** Onsager's theory **Illustrate** irreversible thermodynamics to biological and non linear systems. E resources (PO9,PO10) https://youtu.be/S0I37M2sx_0	K1 K2 K3

CO/PO	PO									
	1 Disciplinary knowledge and skills	2 skilled communicator	3 critical thinker and problem solver	4 sense of inquiry	5 Team player / worker	6 skilled project manager	7 Digitally efficient	8 Ethical awareness and reasoning	9 National and 2international Perspective	10 Lifelong learners
CO1	3	1	1	2	1	1	2	1	2	1
CO2	3	2	2	2	2	1	2	1	2	1
CO3	3	2	2	2	2	1	2	1	2	1
CO4	3	1	1	1	1	1	2	1	1	1
CO5	3	1	1	1	1	1	2	1	1	1
PC5350 -AVG	3	1	1	1	1	1	2	1	2	1
PC5350 TOTAL	15	7	7	8	7	5	10	5	8	5

Course outline

UNIT - I **(18 hrs)**

GROUP THEORY – I

Symmetry elements and symmetry operations. Groups, subgroups and classes of symmetry operations. Systematic classification of molecules into point groups.

Matrix representation of symmetry operation, Reducible and irreducible representations. Direct product representation. Orthogonality theorem – construction of character table for point groups-C_{2v}, C_{2h}, C_3v.

UNIT – II **(18 hrs)**

GROUP THEORY – II

Symmetry selection rules for IR and Raman spectra. Systematic procedure for determining the symmetries of vibrational modes in molecules such as H_2O, NH_3, trans N_2F_2. Rule of mutual exclusion. Hybrid orbitals for sigma bonding in BF_3, CH_4, SF_6 and PCl_5.

UNIT - III **(18 hrs)**

SURFACE PHENOMENA

Surface tension, adsorption on solids, surface excess and its importance. Gibbs adsorption isotherm, electrical phenomena at interfaces, including electro kinetic phenomena, micelles and reverse micelles, solubilisation, micro emulsion.. SEM to the study of surfaces.

UNIT - IV **(18 hrs)**

THERMODYNAMICS - I

Statistical Thermodynamics - Different types of ensembles, thermodynamic probability and distribution law (Boltzmann statistics). Partition function and thermodynamics parameters: Relation between partition function and E, H, S, C_v, P, A and G.

Relation between molecular and molar partition function, translational partition function, rotational partition function for linear and nonlinear molecules, vibrational partition function, electronic partition function, equilibrium constant in terms of partition function.

Introduction to quantum statistics: Distribution law for fermions (Fermi-Dirac Statistics) and for bosons (Bose-Einstein statistics)

UNIT - V **(18 hrs)**

THERMODYNAMICS - II

Irreversible Thermodynamics - Near equilibrium process: Conservation of mass and energy- Entropy production in chemical reactions – entropy production and entropy flow in open systems. - Onsager theory – Onsager's reciprocal relations – validity and verification. Thermoelectricity-Electro kinetic and thermo mechanical effects. Application of irreversible thermodynamics to biological and non- linear systems.

COURSE OUTCOME

The student

1. Can identify the symmetry elements present in a molecule and classify the molecule into appropriate point group
2. Can understand and use the symmetry selection rules for IR and Raman for different molecules in a point group
3. Can explain the physical and chemical adsorption concept and its analysis techniques
4. Know the concept of statistical thermodynamics and its application in quantum statistics

REFERENCE BOOKS:

1. Alan.Vincent, Molecular Symmetry and Group Theory. A Programmed Introduction to Chemical Applications. John and Wiley & Sons Ltd., 1977
2. D. A. McQuarrie, J. D. Simon, Physical chemistry - A Molecular Approach, Viva Books Pvt. Ltd., New Delhi, 1998.
3. Donald A. McQuarrie, Quantum Chemistry. Viva Books PW. Ltd.. New Delhi. 2003.
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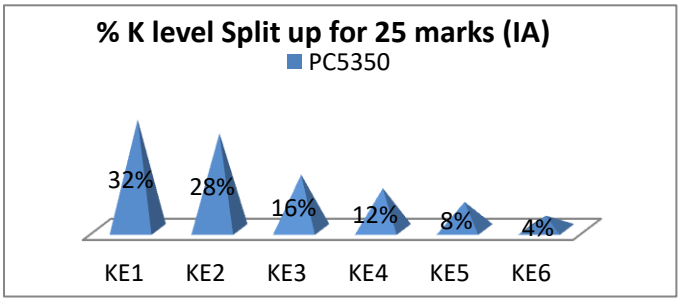
11. M. C. Gupta, Statistical Thermodynamics, New Age International Pvt. Ltd., New Delhi, 1995.
12. R. P. Rastogi and R. R. Misra, Classical Thermodynamics, Vikas Publishing Pvt. Ltd., New Delhi, 1990
13. S. H. Maron and J. B. Lando, Fundamentals of Physical chemistry, MacMillan Publishers, New York, 1974

Web References and e-learning sources:

1. https://youtu.be/e473_8NMp0s?list=PLj_Alq7xw30knZPTpa9whzqiSn_RZHGWP (nptel)
2. https://youtu.be/Had8fQfSL2U?list=PLj_Alq7xw30knZPTpa9whzqiSn_RZHGWP(nptel)
3. https://youtu.be/TGS5QidgGPo?list=PLj_Alq7xw30knZPTpa9whzqiSn_RZHGWP(nptel)
4. https://youtu.be/gM-CMcBYp18?list=PLj_Alq7xw30knZPTpa9whzqiSn_RZHGWP(nptel)

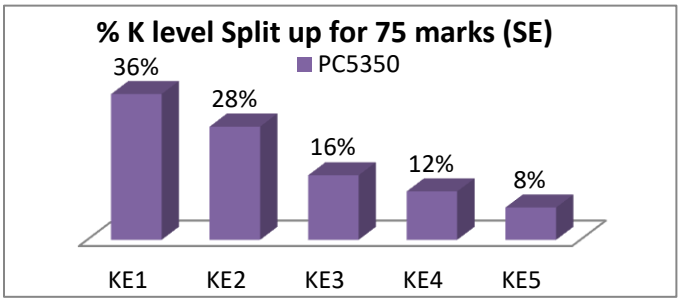
CIE-Continuous Internal Evaluation (25 Marks)

PC5350				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (8)	2	2	2	2
Understand (7)	1	0	1	5
Apply (4)	1	1	0	2
Analyse (3)	0	1	1	1
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

PC5350	
Bloom's Taxonomy	**Weightage %**
Remember	**36%**
Understand	28%
Apply	16%
Analyze	12%
Evaluate	8%



QUEEN MARYS COLLEGE (AUTONOMOUS), CHENNAI – 4
M.Sc. CHEMISTRY
PHYSICAL CHEMISTRY PRACTICAL – III (core)
Semester: III

Course No. :XIV **Max Marks: 75**
Code: PC5351 **Credits : 4**

Learning Objectives

The aim of the course is to enable the students to understand the important concepts in Physical Chemistry by carrying out suitable related experiments.

Course Outcomes : K1 – Remember,K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluation, K6 - Create

CO No	Course Outcomes Upon completion of the course, student will be able to	POs addressed
CO-1	**Identify** the nature of the experiment. **Understand** the principle behind conductometric titrations. **Apply** the experimental skill to obtain and tabulate the data. **Correlate** the experimental observation with graphical plot. **Construc**t the experimental setup for various titrations. Viva (PO3, PO4) Web Resources (PO9) https://youtu.be/aWwEGCNtKwk(courtesy-youTube)	K1 K2 K3 K4 K5
CO2	**Recognize** the need for the determination of equivalent conductance of Strong electrolytes. **Relate** Kohlrausch law for the determination of Dissociation constant of weak electrolyte. Viva (PO3, PO4) Web resources (PO9) https://youtu.be/pBLRhxsXC4k(courtesy-youTube)	K1 K2
CO-3	I**dentify** the principle and type of potentiometric titration. I**nterpret** the experimental data for quantitative estimation of the given substance. **Operate** the appropriate instruments for accurate analysis. **Analyze** the solution of unknown concentration by performing potentiometric titration. **Estimate** the amount of FAS and KI present in the given solution. Viva (PO3, PO4) Web Resources (PO9) https://youtu.be/gd1YQr-74sw (courtesy-youTube)	K1 K2 K3 K4 K5
CO-4	**Recall** the procedure for the kinetic study of the reaction between Potassium persulphate and Potassium iodide. **Correlate** the ionic strength and rate constant of the reaction by applying kinetics. **Summarize** the experimental data and **Construct** the graphical plot to obtain expected outcome. Viva (PO3, PO4) Web Resources (PO9) https://youtu.be/9stfMz0_-R0(courtesy-youTube)	K1 K2 K3 K4

CO-5	**Describe** and **express** the concentration of various solutions used in Conductometric and Potentiometric titrations using standard terms. Work as an individual and as **team member**	K1 K2 K6

CO/PO	PO									
	1 Disciplinary knowledge and skills	**2 skilled communicator**	**3 critical thinker and problem solver**	**4 sense of inquiry**	**5 Team player / worker**	**6 skilled project manager**	**7 Digitally efficient**	**8 Ethical awareness and reasoning**	**9 National and international Perspective**	**10 Lifelong learners**
CO1	3	2	2	3	1	2	2	1	1	1
CO2	3	2	1	1	1	1	1	1	1	1
CO3	3	2	3	1	2	3	2	2	1	1
CO4	3	1	2	2	2	1	2	2	1	1
CO5	3	1	1	2	1	1	2	1	2	1
PC5351-AVG	3	2	2	2	1	1	2	1	1	1
PC5351TOTAL	15	8	9	9	7	8	9	7	6	5

Course outline

I. CONDUCTOMETRIC TITRATIONS:

a. Strong acid vs. Strong base
b. Weak acid vs strong base
c. Mixture of acids vs. Strong base
d. Determination of the equivalent conductance at infinite dilution of the given electrolyte
e. Determination of the equivalent conductance , degree of dissociation and dissociation constant of the weak acid.

II. POTENTIOMETRIC TITRATIONS:

a. Acid – Base titrations
b. Redox titrations
c. Determination of dissociation constant of weak acid.
d. pH of buffer.

III. KINETICS:

Persulphate – Iodide reaction – Determination of order, Effect of ionic strength on rate constant.

COURSE OUTCOME

The student by applying the concept of conductometric and potentiometric titrations

1. Can determine the strength of strong/weak acid or base
2. Can determine the dissociation constant of weak acid
3. Can perform a redox titrations
4. Can correlate the ionic strength and rate constant by applying kinetics

REFERENCES :

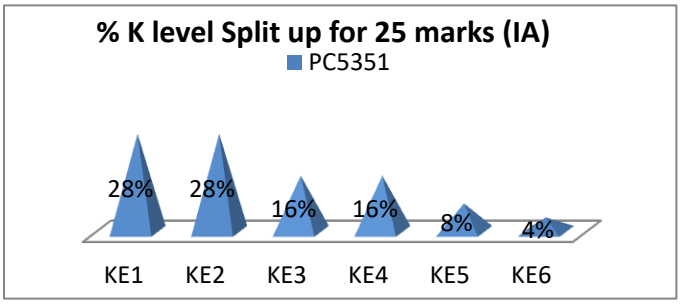
1. Experimental Physical Chemistry, G. Peter Mathews, Oxford Science Publications, 1985.
2. Experimental Physical Chemistry, Ed. By G. Daniet, International Students Ed., McGraw Hill Hogakusha Ltd., 1970.
2. Senior Practical Chemistry, D.D. Khosla, V.C. Carg, R. Chand & Co. New Delhi, 1975

Web References and e-learning sources:

1. https://youtu.be/aWwEGCNtKwk
2. https://youtu.be/gd1YQr-74sw
3. https://youtu.be/9stfMz0_-R0

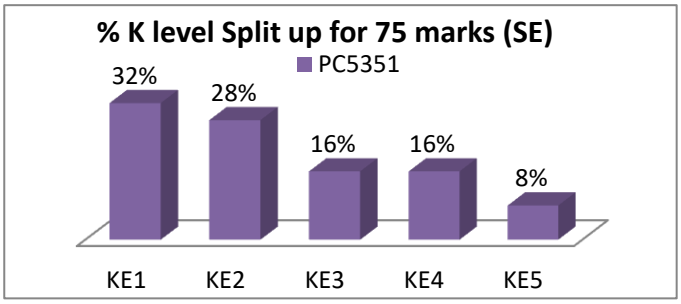
CIE-Continuous Internal Evaluation (25 Marks)

PC5351				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	2	2	2	1
Understand (7)	1	0	1	5
Apply (4)	1	1	0	2
Analyse (4)	0	1	1	2
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

PC5351	
Bloom's Taxonomy	**Weightage %**
Remember	**32%**
Understand	28%
Apply	16%
Analyze	16%
Evaluate	8%



QUEENMARY'S COLLEGE (A), CHENNAI - 4
M.Sc CHEMISTRY
PROBLEM SOLVING IN CHEMISTRY- (Elective)
Semester -III

Course No: XV **Max Marks: 75**
Code: PE5319 **Credits: 3**

LEARNING OBJECTIVES

The target of the course is to apply theoretical concepts to solve numericals and develop critical thinking and reasoning ability

1 To learn the strategy of problem solving in coordination chemistry, quantum chemistry and chemical kinetics.

2 .Can bring about the functional group transformations choosing proper reagents and analyse the correct products based on stereo chemical aspects.

3 Can solve the problems from electro chemistry and solid state chemistry

Course Outcomes

K1 – Remember,K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluation, K6 - Create

CO No.	**Course outcomes** Upon completion of the course, students will be able to	**POs addressed**
CO-1	**Name** the different type of coordination complexes	K1
	Compare the different magnetic properties of complexes	K2
	Solve problems based on CFT **(PO2)** **Web resource (PO9)** **https://unacademy.com/lesson/questions-part-1/8SZA3VLA**	K3
CO-2	**Identify** name reactions and the reagents involved	K1
	Explain the selectivity in some reaction mechanisms **seminar (PO2)**	K2
	Predict the correct reagents for a particular synthesis	K3
	Prioritise and select the correct reagent for a particular synthesis **(PO3)**	K4
CO-3	**Recognize** enantiomers	K1
	Differentiate Norrish typeI and II reactions.	K2
	Apply stereochemical concepts to pericyclic reactions	K3

	To explain effect of substituents on cycloaddition reactions **Predict** the products in a reaction and substantiate the same **(PO2)** **Develop** eco friendly novel pathways in reaction mechanism to arrive at stereochemically preferred product **Group activity (PO5) Quiz (PO4)** **web resources (PO9) (PO10)** **http://ursula.chem.yale.edu/~chem220/chem220js/STUDYAIDS/pericyclic/PericyclicRxn.pdf** **http://www.iiserpune.ac.in/~harinath/images/CHM-311-Oct-24-2013.pdf** **https://nptel.ac.in/courses/104/106/104106077/** .	K4 K5 K6
CO-4	**Describe Huckel M.O. theory** **explain** the need for normalization of a wave function **apply** the Schrodinger equation to various dimensions. **infer** the degree of degeneration **Solve** numerical based on above concepts**(PO3)** Web resource **(PO9)** https://unacademy.com/lesson/introduction/W134859Y https://www.youtube.com/watch?v=U__f57yY7_U	K1 K2 K3 K4 K5
CO-5	**Identify** different types of crystal systems and order of reactions. **Interpret** miller indices for planes and direction. **Group activity (PO5)** **Apply** Nernst equation and Kohlrausch's law to solve numerical and interpret spontaineity of a chemical reaction **Derive** the Arrhenius equation and apply the same to solve numerical **(PO2)** **Evaluate** the kinetics of equilibrium reactions **Web resources (PO9)** https://www.ugcpoint.in/net-gate-sample-study-material/Sample_paper_stady_materials/Chemical%20Kinetics.pdf http://mteducare.com/images/mhtcet_2016_notes/chemistry/Electrochemistry.pdf	K1 K2 K3 K4 K5

Strongly correlated -3 **Moderately correlated -2** **Weakly correlated -1**

CO/PO/PSO	PO									
	1 Disciplinary knowledge and skills	**2 skilled communicator**	**3 critical thinker and problem solver**	**4 sense of inquiry**	**5 Team player / worker**	**6 skilled project manager**	**7 Digitally efficient**	**8 Ethical awareness and reasoning**	**9 National and international Perspective**	**10 Lifelong learners**
CO1	3	3	3	2	2	1	2	1	1	1
CO2	3	1	3	3	2	1	2	1	1	1
CO3	3	2	3	3	3	1	2	2	2	1
CO4	3	1	3	2	2	1	2	1	2	1
CO5	3	2	3	2	3	1	2	1	2	1
PE5319-AVG	3	2	3	2	2	1	2	1	2	1
PE5319-TOTAL	15	9	15	12	12	5	10	6	8	5

Course outline

UNIT – I **(12hrs)**

INORGANIC CHEMISTRY

Coordination chemistry- Nomenclature, isomerism, hybridization, CFT, CFSE, paramagnetic and diamagnetic properties, strong and weak ligands, nephelauxetic series, stability, colour, concepts of acids and bases: Hard-Soft acids and base concept – Non aqueous solvents.

UNIT – II **(12hrs)**

ORGANIC CHEMISTRY -I

2.1 Reaction Mechanism – selectivity of alkylation of enolates, Micheal addition reactions, Lithium directed aromatic electrophilic substitutions.

2.2 Reagents in Organic synthesis

Grignard reagent – Diborane – mCPBA - Cu reagents: Simmon-Smith reaction, Gilman reagent - Titanium reagents: Sharpless asymmetric epoxidation. Palladium reagents: Fukuyama coupling, Heck reaction, Stille coupling, Suzuki coupling -
Palladium & Copper: Sonogashira coupling - Palladium & Silicon: Hiyama coupling.

UNIT – III **(12 hrs)**

ORGANIC CHEMISTRY – II

3.1 Stereochemistry and Conformational Analysis

Enantiotopic and diastereotopic atoms, groups and faces – R, S notation.

3.2 Photochemistry & Pericyclic Reactions

Jablonskii diagrams - Norrish type I and Norrish type II reactions - Paterno – Buchi reactions. HOMO LUMO in ethylene and 1, 3-butadiene

Electrocyclic reactions – Conrotatory and disrotatory motions.

Cycloaddition reactions – 1, 3 Dipolar additions - Diels Alder reaction: Nature of diene, Effect of substituents, Stereochemistry, Regioselectivity.

Sigmatropic rearrangements – Cope rearrangement, Claisen Rearrangment

UNIT -IV **(12 hrs)**

Acceptable wave function-Normalisation of wave functions – Eigen value and Eigen functions – particle in 1D, 2D, 3D boxes – degree of degeneracy – Huckel Molecular Orbital Theory – first order perturbation – Variation method.

UNIT-V **(12 hrs)**

5.1Chemical kinetics: Rate law - Order determination , theories , ARRT – photochemical reactions.

5.2 Electrochemistry:Nernst equation – Debye Huckel Theory – conductance – Kohlrausch's law and its application – ionic equilibria.

5.3 Solid state:Unit cells, miller indices, density and radius.

COURSE OUTCOME

The student

1. Can attempt and solve the problems from coordination chemistry, quantum chemistry and kinetics.
2. Can bring about the functional group transformations choosing proper reagents and analyse the correct products

REFERENCE BOOKS

UNIT I

1. Huheey, J. E.; Keiter, E. A. Keiter, R. L. Inorganic Chemistry; 4th Ed.; Harper and Row, NewYork, 1983.
2. Cotton, F. A.; Wilkinson, G.; Murillo, C. A.; Bochmann, M. Advanced Inorganic Chemistry; 6th Ed., Wiley Interscience: New York, 1988.
3. R. S. Drago, PhysicaI Methods in Chemistry; Saunders: Philadelphia, 1977.
4. SathyaPrakash, G.D.Tuli, S. K. Basu and R. D. Madan, Advanced Inorganic Chemistry, Volume I and Volume II, S.Chand, Reprint 2008

UNIT II & UNIT III

5. J. March, Advanced Organic Chemistry; Reactions, Mechanisms and Structure, 6th Ed.,
6. Wiley interscience, 2007.
7. D. Nasipuri, Stereochemistry of Organic Compounds-Principles and Applications, New Age International, 2nd Ed., 2002.
8. E.L. Eliel, S. H. Wilen, L. N. Mander, Stereochemistry of Organic Compounds, John Wiley & Sons, Inc., 2005.
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10. J. Clayden, N. Greeves, S. Warren and P. Wothers, Organic Chemistry, Oxford University Press, 1st Ed., 2000.
11. F. A. Carey and R. J. Sundberg, Advanced Organic Chem., parts A and B. 5^{th} Ed., Springer, 2007.
12. S. Sankararaman, Pericyclic Reactions – A Textbook, Wiley-VCH, 2005.

13. J. Singh, J. Singh, Photochemistry and Pericyclic Reactions, New Age International, 2003.

UNIT IV

14. Atkins' Physical chemistry , 8thEd,Oxford university press 2006
15. Donald A McQuarrie,John D .Simon, Physical Chemistry a molecular approach,Viva Books Pvt.Ltd.,2010
16. Thomas Engel,PhilipReid,PhysicalChemistry,Pearson Education,2006.
17. S.K.Dogra ,S.Dogra ,Physical chemistry through problems,New Age International Publishers,2004
18. Clyde R Metz, Schaum's outline series theory and problems of Physical chemistry,McGraw-Hill book company

UNIT V

19. J N Gurtu ,R.Kapoor, A.Kapoor, Numerical Chemistry,S.Chand& Co. ,I Edn,1993.
20. ArunBahl,B.S.Bahl, Numerical problems in physical chemistry, S.Chand& Co. , I Edn,2009.
21. K. D. Sharma, Anu Sharma, Numerical chemistry for competitions, S.Chand& Co. , I Edn,2009

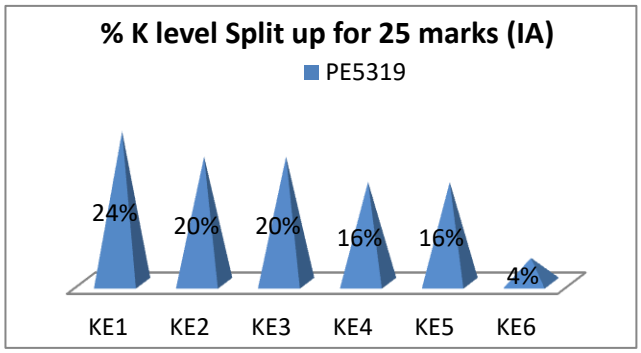
Web References and e-learning sources:

1. **https://unacademy.com/lesson/questions-part-1/8SZA3VLA**
2. **http://ursula.chem.yale.edu/~chem220/chem220js/STUDYAIDS/pericyclic/PericyclicRxn.pdf**
3. **http://www.iiserpune.ac.in/~harinath/images/CHM-311-Oct-24-2013.pdf**
4. **https://nptel.ac.in/courses/104/106/104106077/**
5. https://unacademy.com/lesson/introduction/W134859Y
6. https://www.ugcpoint.in/net-gate-sample-study-material/Sample_paper_stady_materials/Chemical%20Kinetics.pdf

http://mteducare.com/images/mhtcet_2016_notes/chemistry/Electrochemistry.pdf CIE-

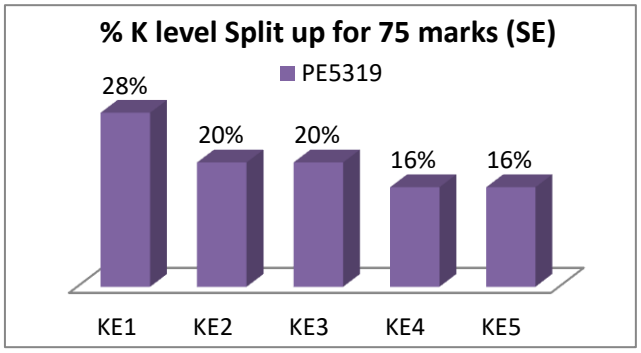
Continuous Internal Evaluation (25 Marks)

PE5319				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (6)	1	1	2	2
Understand (5)	1	0	1	3
Apply (5)	2	2	0	1
Analyse (4)	0	1	1	2
Evaluate (4)	1	0	1	2
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

PE5319	
Bloom's Taxonomy	**Weightage %**
Remember	**28%**
Understand	20%
Apply	20%
Analyze	16%
Evaluate	16%



QUEEN MARY'S COLLEGE (AUTONOMOUS) CHENNAI-4

M. Sc. CHEMISTRY

INORGANIC CHEMISTRY – III (Elective)

SEMESTER III

Course No. : XVI **Max Marks: 75**
Code: PE5320 **Credits: 3**

LEARNING OBJECTIVES

1 To gain knowledge about the main group elements.
2 To gain knowledge about the mechanism of nuclear reactions, the instrumentation involved and applications of radio isotopes.
3 To provide indepth knowledge on the different inorganic reactions within the biological system and the enzymes involved.
4 To offer insight into the field of boranes, cage compounds and supramolecular chemistry.

Course Outcomes

K1 – Remember,K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluation, K6 - Create

CO No.	Course outcomes Upon completion of the course, students will be able to	POs addressed
CO-1	**Attain** (K1) indepth knowledge on the different inorganic reactions within the biological system and the enzymes involved. **Classify** (K4) copper containing proteins **Describe**(K2) Bohr effect models for cooperative interaction in Hb E resources https://authors.library.caltech.edu/25052/1/BioinCh.pdf https://aiimsrishikesh.edu.in/documents/195_hb_structure_and_function_mbbs_2017_batch.pdf	K1 K2 K4
CO-2	**Know**(**K1**) about essential and trace elements in biological system. **Apply(K3)** the Pt, Au and metallocenes in medical field. **Explain**(K2) biological cycles **Seminar** on biological cycle followed by **group discussion** to assess their importance in the environment **(PO1, PO3, PO4, PO5, PO7)** http://webdelprofesor.ula.ve/ciencias/isolda/libros/quimica_bioinorganica.pdf	K1 K2 K3
CO-3	**Define (K1)** Bethe notation. **Explain (K2**) principle of compound nucleus theory **Solve (K3) problems in nuclear chemistry.** **Compare (K5)** different types of nuclear reactions. **Analyse** (K4) the radioactive sample using isotopic dilution analysis. E resources https://www.slideshare.net/translateds/thermonuclear-bomb-hydrogen-	K1 K2 K3 K4 K5

	bomb e quiz conducted in nuclear chemistry (PO3 and PO4)	
CO-4	**Classify (K4)** the boranes, naming of boranes **Explain (K2)** the classification of carboranes. **Calculate(K3)** the number of of electron deficient bonds **Know (K1)** about the polyacids https://www.dalalinstitute.com/books/a-textbook-of-inorganic-chemistry-volume-1/problems-stereochemistry-and-bonding-in-main-group-compounds/	K1 K2 K3 K4
CO-5	**Introduce (K1)** the concepts of supramolecular chemistry. **Explain (K2)**about various types of supramolecules. **Recognise(K1)** various supramolecules **Hypothesise(K6)** various supramolecules using macro cyclic ligands **E journal** International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438 Volume 4 Issue 4, April 2015 www.ijsr.net Supramolecular Chemistry-Concepts and Applications, Ajay Kumar Manna https://www.nobelprize.org/prizes/chemistry/1987/lehn/lecture https://youtu.be/08RBLIQ8VPE courtesy	K1 K2 K6

CO/PO	PO									
	1 Disciplinary knowledge and skills	**2 skilled communicator**	**3 critical thinker and problem solver**	**4 sense of inquiry**	**5 Team player / worker**	**6 skilled project manager**	**7 Digitally efficient**	**8 Ethical awareness and reasoning**	**9 National and international Perspective**	**10 Lifelong learners**
CO1	3	1	1	1	1	1	2	1	2	1
CO2	3	2	2	2	2	1	2	1	1	1
CO3	3	2	2	2	2	1	2	1	1	1
CO4	3	1	1	1	1	1	2	1	2	1
CO5	3	1	1	1	1	1	2	1	2	1
PE5320-AVG	3	1	1	1	1	1	2	1	1	1
PE5320-TOTAL	15	7	7	7	7	5	10	5	8	5

Course Outline

UNIT- I **(18 hrs)**

BIOINORGANIC CHEMISTRY-I

Porphyrin ring system – metalloporphyrins –Oxygen carrier proteins in vertebrates-hemoglobin and myoglobin – structures and functions. Bohr effect and Haldane effect-allosteric interactions- mechanism of cooperative binding of oxygen to haemoglobin- oxygen transport in human body- non heme iron- Sulphur proteins, hemocyanins and hemerythrin- as oxygen carriers- synthetic oxygen carriers.

Cytochromes and respiration- cytochrome C - structure and functions – cytochrome c oxidase – mechanism of O2 reduction mediated by cytochrome oxidase c- Cyanide poisoning and remedy.

Copper proteins– structure of blue copper protein– copper proteins as oxidases — Chlorophylls a and b- Structure – Photosynthetic sequence – photosystems I & II.

UNIT – II **(18hrs)**

BIOINORGANIC CHEMISTRY-II

Carboxypeptidase A: Structure, function – carbonic anhydrase – inhibition and poisoning – corin ring system – vitamin B12 and B12 coenzymes – in-vivo and in-vitro nitrogen fixation. Essential and trace elements in biological systems. Metal ion deficiency and disease: Fe, Cu and Zn. Metal ion toxicity: Classes of toxic metal compounds – Cu, Cd, Fe, Pb, Ca and Hg toxicity – detoxification. Molecular mechanism of ion transport across the membrane – sodium and potassium ions pumps. Metals in medicine: Au in rheumatic arthritis – Pt, Au and metallocenes in anticancer drugs – metals in radio diagnosis and magnetic resonance imaging. Biological cycles: Nitrogen cycle – hydrogen cycle.

Metal storage and transport: Fe,Cu,Zn and V storage and transport – metallothionein: transporting some toxic metals – Zn^{2+} ion complexes: carbonic anhydrase II – carboxypeptidase A, Carboxypeptidase G2, Cobalt for Zn ion substitution.

UNIT-III **(18hrs)**

NUCLEAR CHEMISTRY-I

Bethe's notation – comparison between nuclear and chemical reaction – general mechanism of nuclear reactions – compound nuclear theory – direct nuclear reaction mechanism

– scattering reactions, photonuclear reaction, trans mutation – stripping & pick–up reaction, nuclear fission, spallation, fragmentation and fusion. Comparison between fission, spallation and fragmentation.

Hydrogen and cobalt bomb – cosmic abundance of elements – charged particle accelerator, linear accelerator, cyclotron – synchrotron – counters: Applications of radioactive isotopes : characteristics of tracer isotopes – principle, applications and limitation of isotope dilution analysis – neutron activation analysis – radiation dosimetry – radiometry – radiolysis of water

Numerical problems in Nuclear Chemistry.

UNIT-IV (18hrs)

BORON AND RING COMPOUNDS

Classification of boranes - nomenclature -structure and -molecular frame work of hydrides of boron skeletal electro pair counting and Wade's rule -polyhedral skeletal electron pair theory (PSEPT)- calculation of the number of election deficient bonds – equations of balance – Styx number and topology of boron hydrides – concept of multicentred bond as applied to electron deficient molecules –borazine,

Carboranes – types such as closo and nido – preparation, properties and structure. Metallocarboranes – a general study.

Chain: Catenation, heterocatenation, intercalation, Rings: phosphazenes, homocyclic inorganic systems Cages: Phosphorus cages. Polyacids- Isopolyacids of V, Cr, Mo and W; Heteropolyacids of Mo and W.

UNIT – V (18hrs)

SUPRAMOLECULAR CHEMISTRY

Introduction, Some important concepts - Introduction to Recognition, information and complementarity, Principles of molecular receptor designs, Spherical recognition (cryptates of metal cations) Tetrahedral recognition by macrotricycliccryptands, Recognition of ammonium ions, Recognition of neutral molecules and anionic substrates (anionic coordination)

COURSE OUTCOME

1 A better understanding about the various reaction mechanisms in biological systems is provided.
2 Concepts taught in nuclear chemistry facilitates the learner to apply the concepts to solve numerical problems.
3 Unique structures based on different types of bonding patterns in boranes and phosphorous cages is introduced to the learner.
4 The fundamentals and concepts taught helps the learner to develop analytical reasoning skills and helps to apply the concepts to application oriented questions

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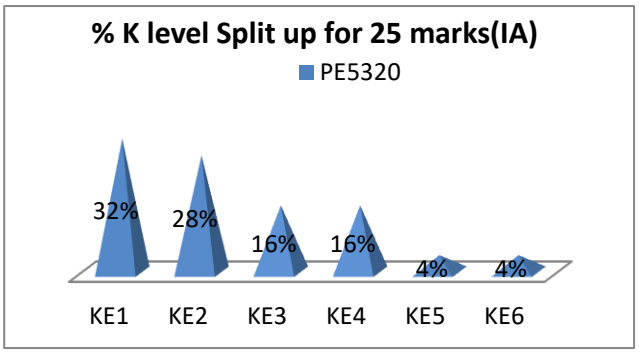
2. https://aiimsrishikesh.edu.in/documents/195_hb_structure_and_function_mbbs_2017_batch.pdf
3. http://webdelprofesor.ula.ve/ciencias/isolda/libros/quimica_bioinorganica.pdf
4. https://www.slideshare.net/translateds/thermonuclear-bomb-hydrogen-bomb
5. https://www.dalalinstitute.com/books/a-textbook-of-inorganic-chemistry-volume-1/problems-stereochemistry-and-bonding-in-main-group-compounds/
6. https://www.nobelprize.org/prizes/chemistry/1987/lehn/lecture

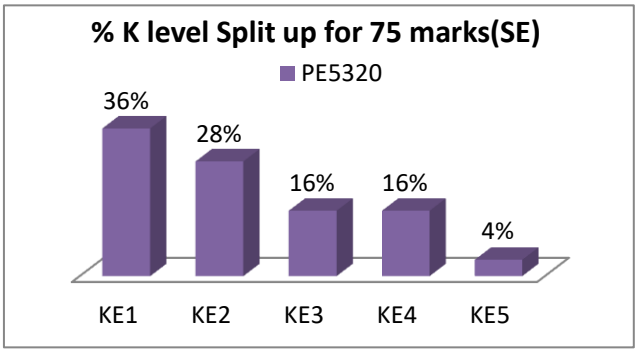
CIE-Continuous Internal Evaluation (25 Marks)

PE5320				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (8)	3	2	3	0
Understand (7)	1	0	1	5
Apply (4)	1	1	0	2
Analyse (4)	0	1	1	2
Evaluate (1)	0	0	0	1
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

PE5320	
Bloom's Taxonomy	**Weightage %**
Remember	**36%**
Understand	28%
Apply	16%
Analyze	16%
Evaluate	4%



QUEEN MARY'S COLLEGE (AUTONOMOUS), CHENNAI – 4

M. Sc. CHEMISTRY

CHEMISTRY OF ENGINEERING MATERIALS- (Other Elective)

Semester -III

Course No. : XVII **Max Marks: 75**
Code: PD5309 **Credits: 3**

LEARNING OBJECTIVES

1. To understnd the application of chemistry materials in various fields.

2. To gain knowledge and apply in the usage of fabricated chemistry materials such as lubricants, abrasives, plastics and polymers.

3. To Know the methodology of purifying water and the reverse osmosis system.

COURSE OUTCOMES:

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluation, K6 - Create

CO. No	COURSE OUTCOME	POs Addressed
CO 1	**Define and classify** lubricants with suitable examples. **Explain** the characteristics of solid lubricants and **illustrate** their applications. **https://www.thelubricantstore.com/lubricant-properties**	K1,K4, K2,K3
CO 2	**Define** abrasives **classify** abrasives on the basis of hardness. **Construct a chart** based on hardness, properties and applications of abrasives. **https://link.springer.com/content/pdf/10.1007%2F978-1-4471-1572-4_2.pdf**	K1,K2,K3
CO 3	**Recall** the properties of plastics and Polymers **Classify** of thermoplastics and thermosetting plastics. **Design** various moulding methods **Explain** the characteristics of Engineering plastics. **e quiz** plastic types and its application in engineering https://fibertechinc.net/custom-rotational-molding/a-simple-guide-to-plastic-molding/	K1, K2, K4, K6,
CO 4	**Define** hardness of water. **Illustrate** requirements of potable water. **Classify and explain** various internal and external conditioning of water treatment. **Evaluate** the suitability of water in boilers **Seminar** Water purification techniques https://www.chemengonline.com/water-treatment-technologies/	K1,K2,K5,K4,K3

CO 5	**Define** fuels, combustion, octane and cetane number. **Compare** proximate and ultimate analysis of coal. **Explain** Otto hoffmann method **Calculate** minimum volume and weight of air requirement of fuels. https://www.sgsgroup.in/en-gb/mining/analytical-services/coal-and-coke/proximate-and-ultimate-analysis	K1,K2, K5,K3

Strongly correlated -3 **Moderately correlated -2** **Weakly correlated -1**

CO/PO	**PO**									
	1 Disciplinary knowledge and skills	**2 skilled communicator**	**3 critical thinker and problem solver**	**4 sense of inquiry**	**5 Team player / worker**	**6 skilled project manager**	**7 Digitally efficient**	**8 Ethical awareness and reasoning**	**9 National and international Perspective**	**10 Lifelong learners**
CO1	3	2	2	2	2	1	2	1	2	1
CO2	3	2	2	2	2	1	2	2	1	1
CO3	3	2	2	2	3	1	2	1	2	1
CO4	3	3	2	2	2	1	3	2	1	1
CO5	3	2	2	2	2	1	3	1	1	1
AVG PD5309	3	2	2	2	2	1	2	1	1	1
TOTAL PD5309	15	11	10	10	11	5	12	7	7	5

Course Outline

UNIT-I **(12hrs)**

LUBRICANTS

Classification of lubricants with examples- properties (viscosity index, flash and fire points- cloud and pour point oiliness)- solid lubricants – graphite- molybdenum sulphide.

UNIT-II **(12 hrs)**

ABRASIVES

Abrasive- types and classification- bonded, coated and others and their uses. Abrasive minerals, Choice of abrasives.

UNIT-III **(12 hrs)**

PLASTICS AND POLYMERS

Classification of plastics- Engineering plastics- PVC, Teflon, Polycarbonate, Polyurethane and Thermocole- properties-applications-compounding of plastics, moulding methods- injection moulding and compreesionmoulding- polymer blends, alloys and some examples.

UNIT-IV **(12 hrs)**

WATER TECHNOLOGY

Boiler feed water- requirements- disadvantages of using hard water in boilers- internal conditioning (phosphate, calgon and carbonate conditioning methods)- External conditioning- demineralization process- desalination- reverse osmosis- domestic water treatment.

UNIT-V **(12 hrs)**

FUELS AND COMBUSTION

Proximate and ultimate analysis of coal- significance, characteristics of metallurgical coke- manufacture by Otto- Hoffman method- synthetic petrol- knocking- octane number- improvement of knocking characteristics- cetane number, gaseous fuels- water gas, producer gas and CNG, gross and net calorific values-(definitions only)- theoretical calculation of calorific values(Dulong's formula)- simple problems- calculation of minimum air requirements- simple problems- flue gas, analysis- orsat's apparatus.

COURSE OUTCOME

The students

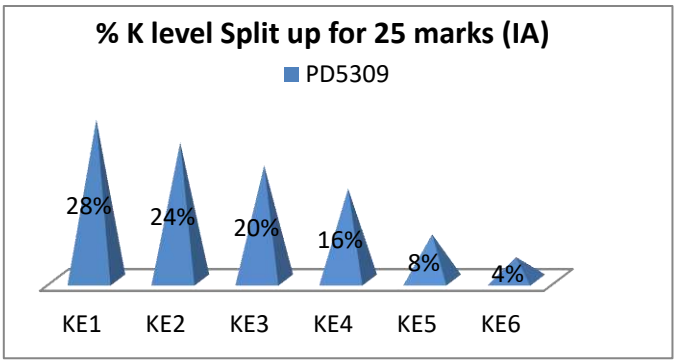
1. Gain knowledge and apply in the usage of fabricated chemistry materials such as lubricants, abrasives, plastics and polymers
2. Know the methodology of purifying water and the reverse osmosis system

REFERENCES

1. Engineering Chemistry by A. Ravikrishnan
2. Engineering Chemistry by Jain and Jain.
3. Industrial chemistry by B.K. Sharma

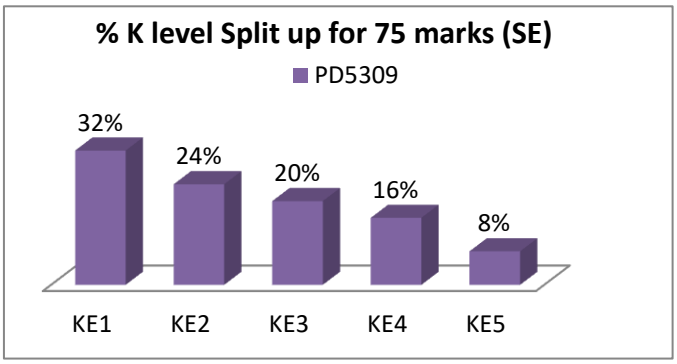
CIE-Continuous Internal Evaluation (25 Marks)

PD5309				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	1	1	2	3
Understand (6)	1	0	1	4
Apply (5)	2	2	0	1
Analyse (4)	0	1	1	2
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

PD5309	
Bloom's Taxonomy	**Weightage %**
Remember	**32%**
Understand	24%
Apply	20%
Analyze	16%
Evaluate	8%



QUEEN MARY'S COLLEGE (AUTONOMOUS) CHENNAI – 4

M. Sc. CHEMISTRY

ORGANIC CHEMISTRY – IV
SEMESTER- IV

Course No. : XVIII **Max Marks: 75**
Code: PC5352 **Credits: 4**

LEARNING OBJECTIVES

1 To understand the techniques involved in the extraction and methods of determination of structure of natural products.

2 To enable the student to understand and appreciate the importance of biomolecules.

3 To apply the knowledge of chemical reactions in solvent free organic synthesis

4 To comprehend the importance of heterocyclic compounds.

COURSE OUTCOMES:

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluation, K6 – Create

CO-No.	**Course outcomes** Upon completion of the course, students will be able to	POs addressed
CO1	**Rearrangement** **define** rearrangements involving migration to electron-deficient carbon **describe** Wagner-Meerwein, Dienone Phenol, Demjanov and Wolff rearrangements **apply** Sommelet-Hauser Favorskii, Fries, Stevens, Neber rearrangements to organic synthesis	K1 K2 K3
CO-2	**Retrosynthesis** **recall** guidelines for retrosynthetic analysis. **convert** target organic molecules into simpler and commercially available starting materials. **discover** methodologies for the synthesis of target molecules. **analyse** different disconnection strategies for the target molecule. assess various synthetic methodologies for target molecules and design the synthesis of organic compounds by best synthetic sequence which is economically viable and environment friendly **Activity** **Assignment** on synthesis of drug molecules through retrosynthetic analysis followed by **group discussion** to assess the effectiveness of the methodology **(PO1, PO3, PO4, PO7)**	K1 K2 K3 K4

	eResources (PO9, PO10) **http://chemlabs.princeton.edu/macmillan/wp-content/uploads/sites/6/JLA_Synthetic_Planning.pdf** **https://www.asu.edu/courses/chm233/notes/retrosynthesis/retrosynthesisS2020.pdf** **https://nptel.ac.in/courses/104/105/104105087/**	
CO-3	**Natural products** **List** the natural products **Classify** the terpenoids and alkaloids **Illustrate** the methods of structural elucidation of terpenoids and alkaloids **Activities** **eQuiz** on alkaloids and terpenoids (**PO3,PO4)** **eResource (PO9)** **http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000016FS/P000696/M011524/ET/1516251590FSC_P9_M33_e-text.pdf**	K1 K2 K3
CO-4	**Biomolecules** **Identify** the chemistry of bio molecules. **Outline** the basic aspects of structure and classifications of carbohydrates, lipids, amino acids, proteins and nucleic acids. **Organize** the flow of genetic information **Assess** the nature of genetic code, transcription and translation. **develop** strategies for regulation of gene expression **Activities** **Seminar** on the structure and basic aspects of bio molecules **using PPT (PO2, PO7**) followed by **group discussion (PO5)** **eResource (PO9)** **https://ncert.nic.in/textbook/pdf/lech205.pdf** **https://www.biologie.ens.fr/~mthomas/L3/intro_biologie/2-sucres-lipides-acides-nucleiques.pdf**	K1 K2 K3 K5 K6
CO-5	**Green chemistry** **Describe** the need for green chemistry and eco-efficiency **Articulate** the challenges in green chemistry. **Summarize** the pollution control and pollution prevention methods. **Explain** experimental protocols incorporating the twelve principles of green chemistry. **eQuiz** on green chemistry **(PO3,PO4)** **Web resource (PO9)** http://sureshchem.weebly.com/uploads/1/4/2/7/14275226/green_chemistry_unit-viii.pdf https://www.intechopen.com/books/green-chemistry/the-role-of-green-solvents-and-catalysts-at-the-future-of-drug-design-and-of-synthesis	K1 K3 K2 K4

Strongly correlated -3 **Moderately correlated - 2** **Weakly correlated -1**

CO/PO/PSO	PO									
	1 Disciplinary knowledge and skills	2 skilled communicator	3 critical thinker and problem solver	4 sense of inquiry	5 Team player / worker	6 skilled project manager	7 Digitally efficient	8 Ethical awareness and reasoning	9 National and international Perspective	10 Lifelong learners
CO1	3	2	2	2	1	1	1	1	1	1
CO2	3	2	2	1	2	1	2	1	2	1
CO3	3	1	1	1	1	1	2	1	3	1
CO4	3	2	2	2	1	1	2	1	2	1
CO5	3	2	2	1	2	1	2	1	2	1
PC5352-AVG	3	2	2	1	1	1	2	1	2	1
PC5352-TOTAL	15	9	9	7	7	5	9	5	10	5

Course outline

UNIT I **(18 hrs)**

REARRANGEMENTS

Rearrangements involving migration to electron-deficient carbon: Wagner-Meerwein, Dienone Phenol, Demjanov and Wolff rearrangements. Rearrangements involving migration to electron-rich carbon: Sommelet-Hauser Favorskii, Fries, Stevens, Neber, Von Richter rearrangement.

UNIT II **(18 hrs)**

RETROSYNTHESIS

An introduction to synthons and synthetic equivalent groups, electron donors (nucleophiles), electron acceptors (electrophiles). Guidelines for retrosynthesis. One group C-X disconnections – carbonyl derivatives, alcohols and ethers. Two group C-X disconnections - 1,1-, 1,2-, and 1,3-, difunctionalised compounds. One group C-C disconnections – ketones, acids; Alkene synthesis. chemoselectivity and regioselectivity. Umpolung reactions, Diels Alder reactions

UNIT III **(18 hrs)**

NATURAL PRODUCTS

Terpenoids: Isolation and classification – methods of structural elucidation of zingeberine, squalene, caryophyllene, cadinene and abietic acid

Alkaloids: Structural elucidation of papaverine and cocaine. Synthesis and functions of atropine, heptaphyllene and morphine

UNIT IV

(18 hrs)

BIOMOLECULES

Carbohydrates -Glycosylation and its importance, purpose of N- linked glycosylation, O-linked glycosylation, C-linked glycosylation. Structure and synthesis of lactose and mannose.

Amino acids and Proteins: Structure, analysis of N-terminal and C-terminal in a polypeptide. Sanger method, Edman degradation and Enzymatic analysis. Primary, secondary and tertiary structure of proteins.

Nucleic acids: Chemistry of nucleic acids, nucleosides and nucleotides- structure of RNA and DNA and their biological importance.

UNIT V **(18 hrs)**

GREEN CHEMISTRY

The need for green chemistry and eco-efficiency, challenges and green chemistry education, pollution control and pollution prevention – green methods, green products, recycling of waste. Twelve principles of green chemistry, inception of green chemistry, awards for green chemistry and international organizations promoting green chemistry.

Oxidation and reduction reactions, Alkylation reactions, Esterification and ether forming reactions, C-C and C-hetereoatom forming reactions, Dihydroxylation.

COURSE OUTCOME

The student

1 can suggest methodologies for stereoselective synthesis of organic compounds by employing chiral substrates/reagents/catalysts.

2 can suggest methods for the synthesis and transformation of natural products, biomolecules and heterocyclic compounds.

3 has familiarity with green methods for the synthesis.

Reference Books

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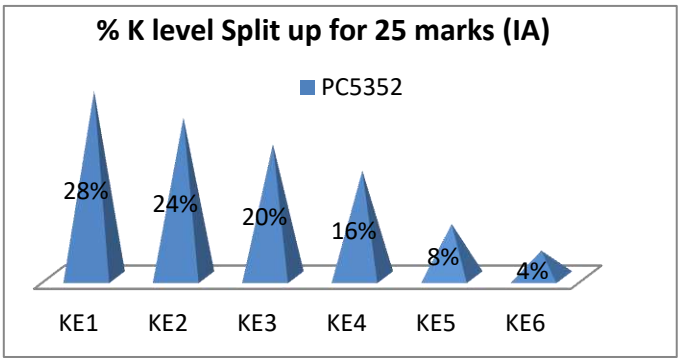
20. K. Mackie, M. Smith, P. Aitken, Guide Book to Organic Synthesis, 3rd Ed., ELBS, England, 2000.
21. S. Warren, P. Wyatt, Organic Synthesis, The Disconnection Approach, Wiley, 2009.
22. R. K. Kar, Fundamentals of Organic Synthesis-The retrosynthetic analysis, New Central Book Agency, 2007.

Web References and e-learning sources:

1. **http://chemlabs.princeton.edu/macmillan/wp-content/uploads/sites/6/JLA_Synthetic_Planning.pdf**
2. **https://www.asu.edu/courses/chm233/notes/retrosynthesis/retrosynthesisS2020.pdf**
3. **https://nptel.ac.in/courses/104/105/104105087/**
4. **http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000016FS/P000696/M011524/ET/1516251590FSC_P9_M33_e-text.pdf**
5. **https://ncert.nic.in/textbook/pdf/lech205.pdf**
6. **https://www.biologie.ens.fr/~mthomas/L3/intro_biologie/2-sucres-lipides-acides-nucleiques.pdf**
7. http://sureshchem.weebly.com/uploads/1/4/2/7/14275226/green_chemistry_unit-viii.pdf
8. https://www.intechopen.com/books/green-chemistry/the-role-of-green-solvents-and-catalysts-at-the-future-of-drug-design-and-of-synthesis

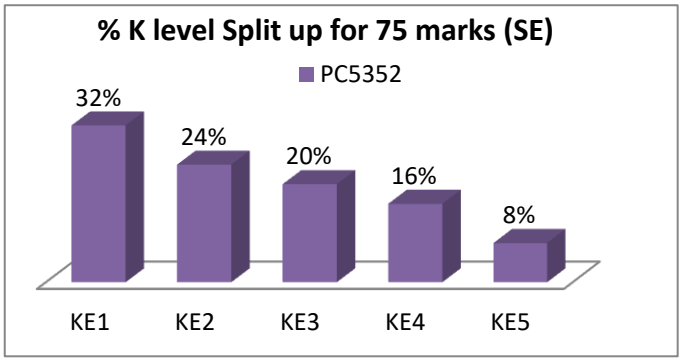
CIE-Continuous Internal Evaluation (25 Marks)

PC5352				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	1	1	2	3
Understand (6)	1	0	1	4
Apply (5)	2	2	0	1
Analyse (4)	0	1	1	2
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

PC5352	
Bloom's Taxonomy	**Weightage %**
Remember	**32%**
Understand	24%
Apply	20%
Analyze	16%
Evaluate	8%



QUEEN MARY'S COLLEGE (A), CHENNAI - 4
M.Sc CHEMISTRY
PHYSICAL CHEMISTRY AND ANALYTICAL TECHNIQUES (Core)

Semester -IV

Course No: XIX **Max Marks: 75**
Code: PC5353 **Credits: 4**

LEARNING OBJECTIVES

1. To understand the chemistry of macromolecules and kinetics of polymerisation.
2. To understand the techniques involved in the instrumental analysis and electroanalytical methods.

Course Outcomes

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluation, K6 - Create

CO No.	Course outcomes Upon completion of the course, students will be able to	POs addressed
CO-1	**Describe** the types and **Explain** the mechanism of polymerization. **Interpret** the stereochemistry of polymers **Seminar** on characterization of polymers-measurement of mass and size. (**PO2,PO7)** **e-Resource: (PO9)** https://nptel.ac.in/courses/104/105/104105039/	K1 K2 K3
CO-2	**Recognize** gas phase reactions. **Summarize** the factors influencing reaction rate. **Evaluate** the entropy of activation using ARRT.	K1 K2 K5
CO-3	**Describe** polarography and **construct** the polarogram **Compare** voltammetry and amperometry **interpret** various titration curves of amperometry. **E-Resource: (PO9)** Polarography: http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000014ER/P000272/M027510/ET/1519203786paper2_Module27_etext.pdf Cyclic volatametry: http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000014ER/P000272/M028089/ET/1520333353Paper2_Module29_e-text_Cyclicvoltammetry.pdf Amperometry https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=944	K1 K2 K3 K4
CO-4	**Describe** the principles of Atomic absorption spectroscopy **Explain** and **demonstrate** the instrumentation of AAS. **Analyse** cations using AAS. **Assignment on** Analysis of Zn^{2+},Cu^{2+}, Pb^{2+},Cd^{2+} using AAS **(PO1.PO2,PO3,PO4)**	K1 K2 K3 K4
CO-5	**State** the principle of photoelectron spectroscopy	K1

	describe its instrumentation and **list** the application. **State** the principle of Auger electron spectroscopy **Hypothesize** Koopman's theorem	K2 K3 K6

CO/PO	PO									
	1 Disciplinary knowledge and skills	**2 skilled communicator**	**3 critical thinker and problem solver**	**4 sense of inquiry**	**5 Team player / worker**	**6 skilled project manager**	**7 Digitally efficient**	**8 Ethical awareness and reasoning**	**9 National and international Perspective**	**10 Lifelong learners**
CO1	3	2	1	2	2	2	3	1	1	1
CO2	3	1	1	1	1	1	2	1	1	1
CO3	3	1	1	2	1	1	2	1	3	1
CO4	3	1	1	1	1	1	2	1	1	1
CO5	3	1	1	1	2	1	2	1	1	1
SUB CODE PC5353	3	1	1	1	1	1	2	1	1	1
TOTAL PC5353	15	6	5	7	7	6	11	5	7	5

Course outline

UNIT-I **(18 hrs)**

MACROMOLECULES

Polymerisation in homogeneous and heterogeneous phases – kinetics and mechanism of polymerization – addition and condensation – chain initiation, propagation and termination – chain transfer – Inhibition and retardation, molecular weight of polymers, molecular weight determination by light scattering, osmometry and viscometry, ultracentrifuge and gel permeation chromatography – Crystallinity of polymers – Glass transition temperature.

UNIT – II **(18 hrs)**

REACTIONS IN SOLUTION

Comparison of gas phase reactions with reactions in solutions, factors influencing reaction rates in solution - effect of dielectric constant and influence of ionic strength - Primary and secondary salt effect. Application of ARRT – Entropy of activation for reactions in solution.

UNIT – III **(18 hrs)**

ELECTROANALYTICAL TECHNIQUES

Polarography: Introduction, Instrumentation, Ilkovic equation and its verification. Derivation of wave equation: Determination of half wave potential, qualitative and quantitative applications. Applications of AC polarography, cyclic voltammetry and differential pulse voltammetry to the study of coordination compounds: Amperometry: Basic principles, instrumentation, nature of titration curves, and analytical applications.

UNIT-IV **(18 hrs)**

ATOMIC ABSORPTION SPECTROSCOPY

Principle – instrumentation – flame sources- hollow cathode lamp – Analysis of Zn^{2+}, Cu^{2+}, Pb^{2+},Cd^{2+}. Flameless AAS for Hg^{2+} analysis – inductively coupled plasma (ICP) spectroscopy – introduction, instrumentation, interferences and applications.

UNIT-V **(18 hrs)**

PHOTOELECTRON SPECTROSCOPY

Principle and technique of PES, Ultraviolet PES, X-ray PES, Koopman's theorem. Instrumentation, applications of ESCA,Auger electron spectroscopy –principle instrumentation and applications .

COURSE OUTCOME

The student can describe the instrumentation techniques and explain the principles involved in it.

REFERENCE BOOKS

1. V. R. Gowarikar, N.V. Viswanathan and JayadevSreedhar "Polymer Science" New Age international (P) ltd., Publishers New Delhi, 2005.
2. Fred W. Billmeyer, JR "Text book of polymer science" A wiley – interscience publication John wiley& sons, New Yark, 1994
3. Ayodhya sing "polymer Chemistry" campus Books, New Delhi, 2003
4. Jettery, Bassett, Mendham, Denney "Vogel's Text book of Quantitative chemical analysis", ELBS, 1997
5. Skoog, West, Holler "Fundamentals of Analytical Chemistry"
6. F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann, Advanced Inorganic Chemistry; 6th Ed.; Wiley Interscience: New York, 1988.
7. J. E. Huheey, E. A. Keiter, and R. L. Keiter, Inorganic Chemistry; 4th Ed.; Harper and Row: New York, 1983.
8. K. F. Purcell, and J. C. Kotz, Inorganic Chemistry; Saunders: Philadelphia, 1976.
9. D. F. Shriver, P. W. Atkins, and C. H. Langford, Inorganic Chemistry; 3rd Ed.; Oxford University Press: London, 2001.
10. T. Moeller, Inorganic Chemistry, A Modern Introduction; John Wiley: New York, 1982.
11. W. L. Jolly, Modern Inorg. Chem., 2nd Ed., McGraw-Hill International Edition, 1991.
12. G. S. Girolami, T. B. Rauchfuss, and R. J. Angelici, Synthesis and Technique in Inorganic Chemistry, 3rd Ed., University Science Books, Sausalito, 1999.
13. W. L. Jolly, The Synthesis and Characterisation of Inorganic Compounds, Prentice Hall, New Jersey, 1970.
14. J.Rajaram and J.C. Kuriacose kinetics and mechanism of chemical Transformation, McMillan India Ltd, 1993.
15. Polymer Science,V.R. Gowariker, N.V. Viswanathan and Jayadev Sreedhar.
16. Text book of Polymer Science,3rd edition, Fred.W.Billmeyer, Jr.

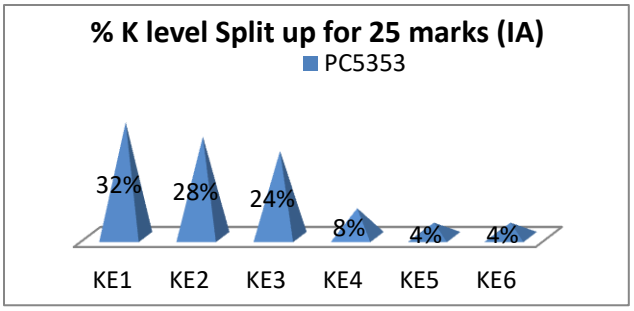
Web References and e-learning sources:

1. Shttps://nptel.ac.in/content/storage2/courses/103108100/module2/module2.pdf
2. http://ddugu.ac.in/ePathshala_Attachments/E_PS375257@8203269ci.pdf
3. https://nptel.ac.in/content/storage2/courses/105104102/turbidity.html
4. https://nptel.ac.in/courses/113/104/113104084/

5. http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000014ER/P000272/M027510/ET/1519203786paper2_Module27_etext.pdf

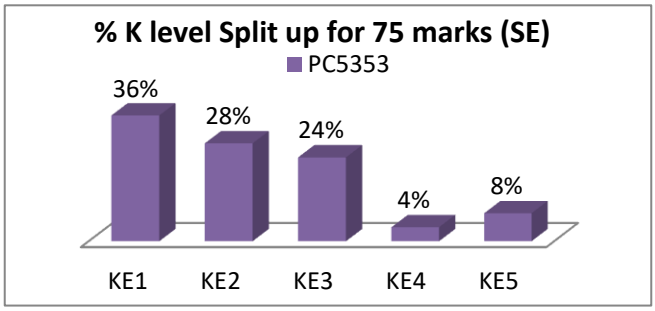
CIE-Continuous Internal Evaluation (25 Marks)

PC5353				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (8)	2	1	3	2
Understand (7)	1	0	1	5
Apply (6)	2	2	0	2
Analyse (2)	0	1	1	0
Evaluate (1)	0	0	0	1
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

PC5353	
Bloom's Taxonomy	**Weightage %**
Remember	**36%**
Understand	28%
Apply	24%
Analyze	8%
Evaluate	4%



QUEEN MARY'S COLLEGE (AUTONOMOUS) CHENNAI-4

M. Sc. CHEMISTRY

SPECTROSCOPIC METHODS IN INORGANIC CHEMISTRY- (Core)

SEMESTER IV

Course No. : XX **Max Marks: 75**
Code: PC5354 **Credits: 4**

LEARNING OBJECTIVES

1. To learn the fundamental principles of rotational and vibrational spectroscopy and its applications in structure determination
2. To introduce identification of term symbols and to impart the significance of electronic spectroscopy to study the chemistry of transition metals.
3. To provide an insight into the concepts of NMR spectroscopy mechanism involved, instrumentation and application.
4. To provide a thorough knowledge of the principle, splitting pattern,anisotropy involved and applications of EPR spectroscopy.
5. To introduce and interpret data using NQR and Mossbauer spectroscopy.

Course Outcomes

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluation, K6 - Create

CO	CO DESCRIPTION (After the completion of the course, the student would be able to)	Knowledge attributes
CO1	**Tell what** types of molecules would undergo vibrational transition and Raman spectra; **summarize** the selection rules for vibrational, rotational and Raman spectra ; **Explain** Bohn-Oppenheimer approximation and **state** the conditions under which it fails. **Apply** IR spectral data to distinguish between coordinated and uncoordinated water and anions and to identify the mode of binding of certain ligands.	K1 K2 K3
CO2	**Find** the *Term symbols* representing different electronic energy levels in a molecule arising out of electron electron interaction; **List** the Racah parameters B & C; **define** selection rules for electronic transition and coditions under which they break down; **compare** the energy levels of the same Term symbols in different weak field complexes using Orgel Diagram; weak field as well as strong field complexes using Tanabe-Sugano diagrams: **explain** the characteristics of Orgel diagrams and Tanabe-Sugano diagrams; **demonstrate** the effect of distortions on the d orbital energy levels	K1 K2

	apply Orgel diagrams to predict and assign electronic transitions of only the weak field complexes and Tanabe-Sugano diagrams for weak as well as strong field complexes; calculate beta and 10Dq for simple octahedral complexes of Co and Ni; **distinguish** between charge transfer spectra and d-d transitons; **analyze** the effect of solvent polarity on charge transfer spectra	K3 K4
CO3	**Define** Nuclear Magnetic Resonance, **Explain** the concepts of Nuclear Magnetic Resonance, chemical shift, Nuclear Overhauser effect, double resonance, chemical exchange, Lanthanide shift reagents, stereochemical non-rigidity and fluxionality. **Identify** the factors contributing to chemical shift, **Distinguish** between the experimental techniques (Continuous wave CW and Fourier Transform (FT) **Analyze** the NMR of paramagnetic complexes **Test** the use of NMR in the detection of fluxionality of trigonal bipyramidal molecules such as [Ti(acac)Cl with coordination number 6.	K1 K2 K4 K3 K4 K5 K6
CO4	**Define** electron paramagnetic resonance; **Explain** the principle of EPR, peaks in the EPR spectrum, hyperfine splitting of radicals namely methyl, ethyl, phenyl, naphthyl and Bis(salicylaldimine) copper (II)- **Identify** the factors affecting the magnitude of ***g*** values of transition metal ions; **Examine** the interactions affecting the energies of unpaired electrons in transition metal complexes; **Explain z**ero field splitting, and Kramers degeneracy, anisotropy in the ***g*** value and hyperfine coupling constant, nuclear quadrupolar interaction, spin Hamiltonian, line widths in solid state and electron delocalization Evaluate EPR as a structural elucidation technique on the basis of its applications	K1 K2 K3 K4 K5
CO5	**Define** the terms NQR and Mossbauer Spectroscopy-**Explain** the energies of quadrupole transitions -effect of magnetic field on the spectra, electric field gradient and molecular structure, the interpretation of NQR data leading to structural information of the $PCl5_5$, $TeCl4_4$, Doppler shift, recoil energy. Mossbauer spectra: Isomer shift, factors affecting isomer shift, quadrupole interaction, magnetic interaction, structural determination of the inorganic compounds and complexes	K1 K2

CO/PO	PO									
	Disciplinary knowledge and skills	2 skilled communicator	3 critical thinker and problem solver	4 sense of inquiry	5 Team player / worker	6 skilled project manager	7 Digitally efficient	8 Ethical awareness and reasoning	9 National and international Perspective	10 Lifelong learners
CO1	3	2	2	1	2	1	2	2	2	1
CO2	3	2	2	2	3	1	2	2	2	1
CO3	3	2	2	1	2	1	2	1	2	1
CO4	3	2	2	1	2	1	2	1	2	1
CO5	3	2	2	2	3	1	2	1	2	1
PC 5354-AVG	3	2	2	1	2	1	2	1	2	1
PC 5354-TOTAL	15	10	10	7	12	5	10	7	10	5

Course outline

UNIT – I **(18hrs)**

ROTATIONAL AND VIBRATIONAL SPECTROSCOPY

Vibrating diatomic molecule: energy of diatomic molecules -simple harmonic oscillator - anharmonic oscillator energy levels- selection rules,. Diatomic vibrating rotator: Born-Oppenheimer approximation – break down -vibration-rotation spectra, selection rules, P, Q, R branches. Vibrations of polyatomic molecules- fundamental vibrations – Overtones- influence of rotation on the spectra.

Raman spectroscopy: Classical and quantum theory- selection rules-Raman effect- Application of IR to the following: i) Distinction between a) Ionic and coordinate anions such as NO_3^-,SO_4^{2-} and SCN b) Lattice and coordinated water. ii) Mode of bonding of ligands such as urea, dimethylsulphoxide and hexamethylphosphoramide.

UNIT - II **(18hrs)**

ELECTRONIC SPECTRA OF TRANSITION METALS

Electron –electron interactions and term symbols -Racah parameters B and C.-spin orbit coupling in free ions-Selection rules and the intensities of transition- breakdown of selection rules -Orgel diagram –Characteristics – prediction and assignment of transitions for d^n weak field cases. Use of Orgel diagram–Calculation of βand 10Dq for simple octahedral complexes of Co and Ni Tanabe – Sugano diagrams – characteristics – Prediction and assignment of transition for weak field and strong field d^n systems –Effect of distortions on the d-orbital energy levels.Charge transfer spectra in electronic spectra.- effect of solvent polarity

UNIT - III **(18 hrs)**

NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY

Nuclear Magnetic Resonance Spectroscopy: Introduction to Nuclear Magnetic Resonance, Chemical shift, Mechanism of electron shielding and factors contributing to the magnitude of chemical shift, Nuclear overhausser effect, Double resonance, Chemical exchange, Lanthanide shift reagents and NMR spectra of paramagnetic complexes. Experimental technique(CW and FT). Stereochemical non-rigidity and fluxionality: Introduction, use of NMR in its detection, its presence in trigonal bipyramidal molecules(PF_5), Systems with coordination number six ($Ti(acac)_2Cl_2$, $Ti(acac)_2Br_2$, $Ta_2(OMe)_{10}$,).

UNIT-IV **(18 hrs)**

ELECTRON PARAMAGNETIC RESONANCE SPECTROSCOPY

Principle - presentation of the spectrum, nuclear hyperfine splitting in isotropic systems. Hyperfine splitting of radicals, viz., methyl, ethyl, phenyl, naphthyl and Bis(salicylaldiminecopper(II) – factors affecting the magnitude of the ‘g’ values of transition metal ions – interactions affecting the energies of unpaired electrons in transition metal ion complexes. Zero-field splitting and Kramer’s degeneracy – Anisotropy in the ‘g’ value – anisotropy in hyperfine coupling constant-nuclear quadrupolar interaction – Spin Hamiltonian-Line widths in solid state –electron delocalization-applications of EPR.

UNIT - V **(18 hrs)**

NQR AND MOSSBAUER SPECTROSCOPY

Introduction-energies of quadrupole transitions -effect of magnetic field on the spectra, electric field gradient and molecular structure – Interpretation of NQR data, Structural information of the following: PCl_5, $TeCl_4$, Na^+ $GaCl_4$ - , BrCN, HIO_3 and Hexahalometallates

Principles of Mossbauer spectroscopy: Doppler shift, recoil energy.Mossbauer spectra: Isomer shift, factors affecting isomer shift, quadrupole interaction,magnetic interaction - applications – isomer shift and quadrupole splitting . Application of MB spectroscopy in structural determination of the following: i) High spin Fe (II) and Fe (III) halides FeF_2, $FeCl_2.2H_2O$, FeF_3, $FeCl_3.6H_2O$. Low spin Fe(II) and Fe(III) Complexes-Ferrocyanides, Ferricyanides, Prussian Blue. ii) Iron carbonyls. $Fe(CO)_5$, $Fe_2(CO)_9$ and $Fe_3(CO)_{12}$ iii) Inorganic Sn(II) and Sn(IV) halides.

COURSE OUTCOME

1. An introduction to vibrational spectroscopy with the application of IR and Raman rules to identify molecules is given.
2. Learner becomes thorough with term symbols and prediction and assignment of electronic transitions for various d configurations.
3. Fundamental principle involved in NMR ,factors determining signal splitting and its applications are given.
4. Complete information on splitting patterns, anomalies involved and applications of EPR is given along with problem solving skills.
5. Role of NQR and Mossbauer spectroscopy to identify variation in nature and oxidation states of complexes is acquired.

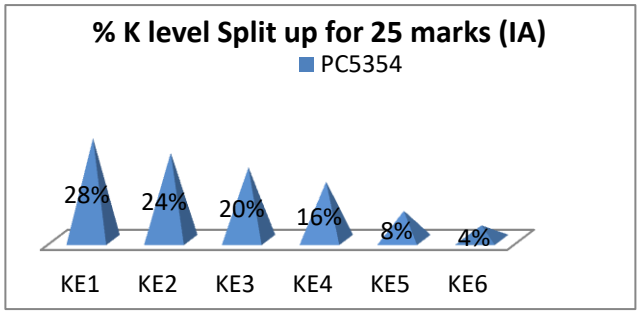
REFERENCE BOOKS

1. R. S. Drago, PhysicaI Methods in Chemistry; Saunders: Philadelphia, 1977.
2. P. Atkins and J. de Paula, Physical Chemistry, 7th Ed., Oxford University Press, Oxford, 2002.
3. I. N. Levine, Molecular Spectroscopy, John Wiley & Sons, New York, 1974.
4. K. Nakamoto, Infrared and Raman Spectra of Inorganic and coordination Compounds, Part B: 5th Ed., John Wiley & Sons Inc., New York, 1997.
5. A. Rahman, Nuclear Magnetic Resonance-Basic Principles, Springer-Verlag, New York, 1986.

6. J. A. Weil, J. R. Bolton and J. E. Wertz, Electron Paramagnetic Resonance; Wiley Interscience, 1994.
7. C. N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw Hill, New Delhi, 2000.
8. D. F. Shriver and P. W. Atkins, Inorg. Chem., W. H. Freeman and Co, London, 1999.
9. F. A. Cotton, G.Wilkinson, C.Murillo and M.Bochman, Advanced Inorg. Chemistry, 6th ed., John Wiley, New York, 1999.
10. T. Moeller, Inorganic Chemistry: A Modern Introduction, Wiley, New York, 1990.
11. S.H.Maron and J.B. Lando, Fundamentals of Phys. Chem., Macmillan Ltd., NY, 1996.
12. P.W. Atkins, Physical Chemistry, Oxford University Press, 1978.

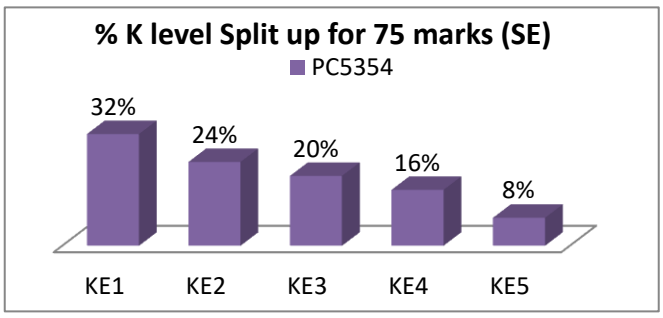
CIE-Continuous Internal Evaluation (25 Marks)

PC5354				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	1	1	2	3
Understand (6)	1	0	1	4
Apply (5)	2	2	0	1
Analyse (4)	0	1	1	2
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

PC5354	
Bloom's Taxonomy	**Weightage %**
Remember	**32%**
Understand	24%
Apply	20%
Analyze	16%
Evaluate	8%



QUEEN MARY'S COLLEGE (AUTONOMOUS) CHENNAI-4

M. Sc. CHEMISTRY
ANALYTICAL CHEMISTRY PRACTICALS-IV- (Core)
Semester- IV

Course No. : XXI **Max Marks: 75**
Code: PC5355 **Credits: 4**

LEARNING OBJECTIVES

1. To learn the basic analytical methods and to have a sound knowledge of chemistry involved in chemical analysis.
2. To know the principle of different chromatographic techniques in separation of mixture of ions.
3. To learn the analytical concepts involved in estimation of certain common chemicals used in day to day life

Course Outcomes

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluation, K6 - Create

CO No.	Course outcomes Upon completion of the course, students will be able to	POs addressed
CO-1	**Recall** Beer-Lambert Absorption law **Outline** color of transition metal complexes **Experiment with** photoelectric colorimeter **Analyze** the given metal ion colorimetrically **Estimate** the amount of metal ion present in the given solution **Viva: (PO3 and PO4)** **Web resources** **https://phet.colorado.edu/en/simulation/beers-law-lab** **https://www.youtube.com/watch?v=LxgZsMhuyNM&t=17s** **(courtesy) (PO9,PO10)**	**K1** **K2** **K3** **K4** **K5**
CO-2	**Describe** the types of chromatography **Demonstrate** paper, thin layer and ion-exchange chromatographic techniques **Identify** the metal ions by paper and ion-exchange Chromatography **Viva:** (PO3 and PO4) **Web resources** **https://www.youtube.com/watch?v=FXw6PiyVWgY** **(courtesy)** **https://www.youtube.com/watch?v=iPpy4khqtks** **(courtesy)**	**K1** **K2** **K3**

	https://www.youtube.com/watch?v=qdmKGskCyh8 (courtesy) (PO9,PO10)	
CO-3	**Find** suitable methods for the estimation **Explain** the principle behind each estimation **Make use of** different types of titrimetric methods for Estimation **Group Activity (PO5)** **Web resources** **https://www.youtube.com/watch?v=ghvF0eYi6rA&t=57s (courtesy)** **https://www.youtube.com/watch?v=oHVSCrZ3Aj4 (courtesy)** **https://www.youtube.com/watch?v=UYnBzwEP5XU&t=5s (courtesy) (PO9,PO10)**	**K1** **K2** **K3**
CO-4	**Tell** about back titration **Demonstrate** the estimation of Aspirin	**K1** **K2**
CO-5	**Recall** what dolomite ore is **Explain** the principle of EDTA titration **Analyze** dolomite ore by EDTA titration **Determine** the strength of calcium and magnesium ions	**K1** **K2** **K3** **K4**

CO/PO	**PO**									
	1 Disciplinary knowledge and skills	**2 skilled communicator**	**3 critical thinker and problem solver**	**4 sense of inquiry**	**5 Team player / worker**	**6 skilled project manager**	**7 Digitally efficient**	**8 Ethical awareness and reasoning**	**9 National and international Perspective**	**10 Lifelong learners**
CO1	3	1	3	2	2	1	2	1	2	1
CO2	3	2	3	2	2	1	2	2	3	1
CO3	3	2	1	1	2	1	1	1	2	1
CO4	3	2	2	2	2	1	3	2	1	1
CO5	3	1	1	1	1	1	1	1	1	1
PC-5355 AVG	3	2	2	2	2	1	2	1	2	1
PC-5355 TOTAL	15	8	10	8	9	5	9	7	9	5

Course outline

1. Colourimetric Estimations:

1. Estimation of Copper

2. Estimation of Nickel

3. Estimation of iron

2. Chromatographic separations and calculation of Rf value.

(i) Separation of a mixture of two metal ions by Paper chromatography.

(ii) Separation of green leaf pigments by Thin layer chromatography.

(iii) Separation of metal ions by ion exchange chromatography.

3. *Estimation

(i) Estimation of bleaching powder
(ii) Estimation of Aspirin
(iii) Estimation of ascorbic acid
(iv) Estimation of H_2O_2

4. *Analysis of Dolomite ore

***Only for Internal Assesment

COURSE OUTCOME

The student know

1. Calorimetric estimations of certain metals
2. To separate metals ions using chromatographic techniques
3. To estimate the presence of certain common chemicals such as bleaching powder, aspirin, ascorbic acid etc.

REFRENCES

1. V. K. Srivastava, K.K. Srivastava, Introduction to Chromatography: Theory and Practice, S. Chand and Sons., New Delhi, 1987.

2. Vogel's Textbook of Practical organic chemistry, 5th Ed., ELBS/Longman, England, 1996a
3. Vogel's Textbook of quantitative chemical analysis, 5th Ed., ELBS/Longman, England

Web References and e-learning sources:

1. https://phet.colorado.edu/en/simulation/beers-law-lab
2. https://www.youtube.com/watch?v=LxgZsMhuyNM&t=17s
3. https://www.youtube.com/watch?v=FXw6PiyVWgY
4. https://www.youtube.com/watch?v=iPpy4khqtks
5. https://www.youtube.com/watch?v=qdmKGskCyh8
6. https://www.youtube.com/watch?v=ghvF0eYi6rA&t=57s
7. https://www.youtube.com/watch?v=oHVSCrZ3Aj4
8. https://www.youtube.com/watch?v=UYnBzwEP5XU&t=5s

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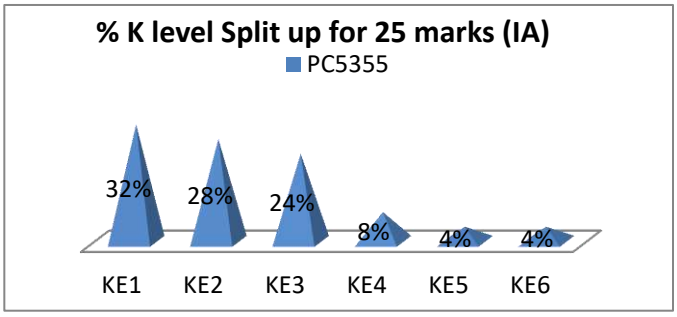

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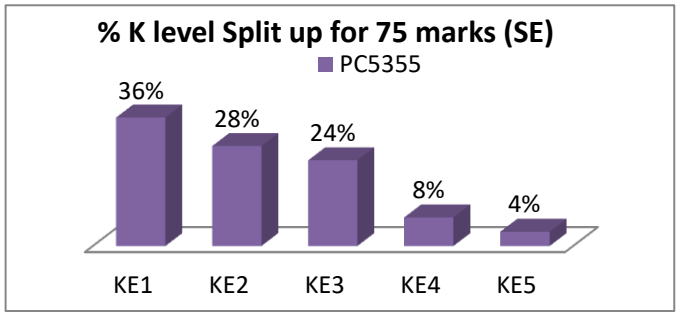


QUEEN MARY'S COLLEGE (AUTONOMOUS) CHENNAI – 4

M. Sc. CHEMISTRY- BATCH IV

DISSERTATION & VIVA VOCE- (Elective)
Semester- IV

Course No:XXII **Max. Marks: 75**
Code: PE5321 **Credits: 3**

LEARNING OBJECTIVES

The target of the course is to

1. introduce students to research and make them efficient in literature survey.

2. learn the art of review and report writing.

3. expose students to the various experimental techniques.

4. give hands on training with analytical instruments.

5. learn interpretation of experimental outcomes and assess future perspectives.

Course Outcomes

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluation, K6 - Create

CO No.	**Course outcomes** Upon completion of the course, students will be able to	**POs addressed**
CO-1	**List** out the various resources available pertaining to a selected topic **Record** the findings from various resources available **Chart** out an outline of basic work done in a chosen field **Seminar on research topic (PO3)** to be presented using power point **(PO7)** **Along with question session (PO4)** **e-resources (PO9)** **http://www.nano.gov** **http://www.gscn.net/about/Eindex.html**	K1 K2 K3
CO-2	**State** in detail about the evolution and progress of a selected research topic **Explain** about the reason behind choice of research topic **Prepare** a report on research work reported hitherto and innovations that could be introduced **Correlate** the need for novelty in the specified work with innovations required. **Assignment / Seminar (PO1, PO3)** on review work done **Group avtivity (PO5)** –review to be done and reported on various topics	 K1 K2 K3 K4
CO-3	**Identify suitable experimental protocols and choose** viable methods **Synthesise** novel products using the available resources. **Compare** the advantages and disadvantages of the existing experimental methods	K1 K2

	available. **Propose** novel synthetic approach to a problem **Validate** experimental findings with theoretical concepts studied. **Internship** at http://schrodinger.zoom.us/skype	K3 K4 K5 K6
CO-4	**Identify** the various characterization methods **Compare** results obtained by different instrumentation techniques and choose the best. **Learn** the appropriate experimental technique by hands on experience. **Select** the appropriate conditions for improvisation of results. **Assess** the credibility of the work done on the basis of percentage of error in results obtained **Visit to instrumentation facility centre**	K1 K2 K3 K4 K5
CO-5	**To reproduce** the experimental results with minimum error limits. **To interpret** reasons for anomaly observed if any and **discuss** methodologies to improve wherever necessary. **e resources (PO9)** https://chemdraw-pro.software.informer.com/8.0 (PO7) mock viva given using digital medium and questions to be defended (PO3, PO7 and PO3)	K1 K2

CO/PO	PO									
	1 Disciplinary knowledge and skills	2 skilled communicator	3 critical thinker and problem solver	4 sense of inquiry	5 Team player / worker	6 skilled project manager	7 Digitally efficient	8 Ethical awareness and reasoning	9 National and international Perspective	10 Lifelong learners
CO1	3	2	3	3	1	2	2	1	3	1
CO2	3	2	3	2	3	2	2	2	2	1
CO3	3	1	2	2	2	2	2	1	3	1
CO4	3	2	2	3	2	2	1	2	2	1
CO5	3	2	3	3	2	1	3	2	3	1
PE5321-AVG	3	2	3	3	2	2	2	2	3	1
PE5321-TOTAL	15	9	13	13	10	9	10	8	13	5

Course Outline

1.LITERATURE SURVEY

2. REVIEW AND REPORT WRITING

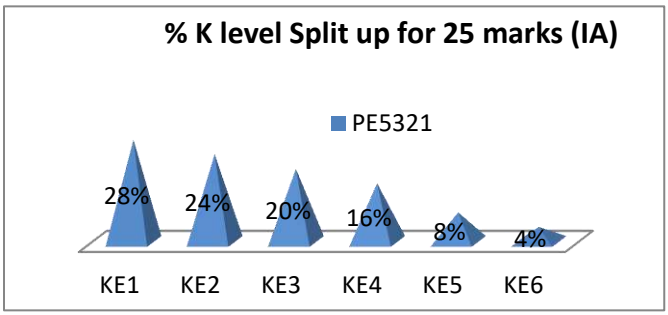
3. EXPERIMENTAL METHODS

4. INSTRUMENTATION

5. RESULTS AND DISCUSSION

CIE-Continuous Internal Evaluation (25 Marks)

PE5321				
Bloom's Taxonomy	**Test**	**Assignment**	**Seminar**	**Model Exam**
Total (25)	**5**	**5**	**5**	**10**
Remember (7)	1	1	2	3
Understand (6)	1	0	1	4
Apply (5)	2	2	0	1
Analyse (4)	0	1	1	2
Evaluate (2)	1	0	1	0
Create (1)	0	1	0	0



ESE- End Semester Examination (75 Marks; Weightage 75 %)

PE5321	
Bloom's Taxonomy	**Weightage %**
Remember	**32%**
Understand	24%
Apply	20%
Analyze	16%
Evaluate	8%