G.T.N. ARTS COLLEGE (AUTONOMOUS)

Affiliated to Madurai Kamaraj University

Old Karur Road, Dindigul, Tamil Nadu - 624005

PG CHEMISTRY SYLLABUS

OBE SYLLABUS

(2020 TO 2022)

DEPARTMENT OF CHEMISTRY (PG)

About the Department

G.T.N. Arts college is the only aided college functioning in Dindigul district for the welfare of urban and rural based men and women students. It caters to the needs of the most economically weaker students. Our chemistry department was started during the academic year 1971-72. In the year of 2000 the department was upgraded with P.G. Programme. The department was recognized as centre for research by Madurai Kamaraj University in the year 2003. It was started under the headship of Prof.K.Gopalan. The I Batch itself secured University ranks and 100% results. After Prof.Gopalan, Prof.P.Jayaram took charge as the Head of the department and then followed by Dr.N.Rajendran, Dr.S.Rajendran, Dr.M.S.Dheenadayalan, Dr.J.Sathiyabama and at present, Dr.A.Pandiarajan is the Head of the Department of Chemistry (PG). The P.G and research department has produced more than 30 Ph.D degree holders and 150 M.Phil degree holders. Our Chemistry Department is considered as one of the best departments in Madurai Kamaraj University affiliated colleges producing university rank holders and gold medalists. The department also offers consultation for various chemical based industries in and around Dindigul district. Our Chemistry students are regularly visiting various chemical industries and industrial estates every year as part of the academic and industrial relationships.

PRINCIPAL

Dr. P. Balagurusamy, M.A., M.Phil., M.Ed., P.G.D.C.A., Ph.D.,

STAFF MEMBERS

1	Dr.M.S. Dheenadayalan, M.Sc., M.Phil., Ph.D.,	Associate Professor and Dean
2	Dr.A. Pandia Rajan, M.Sc., M.Phil., Ph.D.,	Assistant Professor and Head
3	Mrs.K. Rathika, M.Sc., M.Phil., (Ph.D).,	Assistant Professor
4	Mr. S. Philip Arockia Raj, M.Sc., M.Phil., (Ph.D).,	Assistant Professor
5	Mrs.V. Vanitha, M.Sc., M.Phil., (Ph.D).,	Assistant Professor
6	Ms.P. Angel, M.Sc., M.Phil., (Ph.D).,	Assistant Professor
7	Mrs.A. Mariammal, M.Sc., M.Phil., (Ph.D).,	Assistant Professor
8	Mrs.M. Shanmuga Priya, M.Sc.,B.Ed., M.Phil.,	Assistant Professor
9	Mrs.S. Sulochana, M.Sc., M.Phil., (Ph.D).,	Assistant Professor
10	Dr.S. Ignatius Arockiam, M.Sc.,B.Ed., M.Phil., Ph.D.,	Assistant Professor
11	Mrs.G. Benita, M.Sc.,B.Ed., M.Phil.,	Assistant Professor
12	Mrs.G. Nivetha, M.Sc.,B.Ed., (M.Phil).,	Assistant Professor
13	Dr.K. Muthu Vengaian, M.Sc., M.Phil, Ph.D.,	Assistant Professor
14	Dr.R. Shanmuga Selvan, M.Sc., Ph.D.,	Assistant Professor
15	Ms.A. Divya Lakshmi, M.Sc., M.Phil.,	Assistant Professor
16	Ms.N. Suba Lekha, M.Sc., M.Phil.,	Assistant Professor

Programme Outcomes

On successful completion of the M.Sc. programme, the graduates will be able to,

1. Apply the knowledge acquired in the respective disciplines and also have a multidisciplinary perspective towards the study of sciences.
2. Attain skills like analytical reasoning, critical thinking and problem solving to evince interest in higher education and research for offering solutions to societal and environmental problems.
3. Communicate articulately and effectively and interpret the results obtained from scientific studies and put forth innovative ideas to carve a niche in their domain.
4. Instill the principles and ethics learnt from the field of study and exhibit the qualities like leadership, entrepreneurship and teamwork for discharging their duties as resPSOnsible citizens.
5. Utilize the growing advancements in Information and Communication Technology and embrace digital learning to become life-long learners.

Programme Specific Outcomes

After successful completion, Graduates will be able to

PSO 1 Gain Knowledge on all the branches of Chemistry including applied chemistry.

PSO 2 Develop Analytical skills that are used to analyze the chemical compound applying modern techniques.

PSO 3 Face Environmental issues and become a lifelong learner, a responsible citizen and also a renowned scientist on applying their knowledge learned through this curriculum.

PSO 4 Undertake career in industries at the national and global level and also get opportunities for carrying out research programme in all branches of Chemistry.

PSO 5 Gain Knowledge on the subject to succeed in competitive examinations and acquire skills to be a successful entrepreneur.

PSO 6 Improve the skill of the students in all the branches of Chemistry area and also good laboratory practice and safety.

Course Pattern for M.Sc Chemistry

The Post Graduate degree course consists of five vital components. They are as follows:

Part III Core Courses (Theory, Practical, Electives, NME, Project and Internship).

Objectives

The Syllabus for M.Sc Chemistry Programme under semester system has been designed on the basis of Outcome Based Education (OBE), which would focus on job oriented programmes and value added education. It will come into effect from June 2020 onwards.

Eligibility

Candidates should have passed the Higher Secondary Examination, Government of Tamil Nadu and; examination accepted by the syndicate of Madurai Kamaraj University as equivalent there to.

Duration of the Course

The students who join the M.Sc Chemistry Programme shall undergo a study period of two academic years – Four semesters.

Summary of Hours and Credits – M.Sc Chemistry

Part	Semester	Specification	No. of Courses	Hrs	Credit	Total credits
III	I-IV	**Core Courses** Theory Practical Electives Project	 14 3 2 1	 67 28 9 10	 67 14 9 5	95
	III	**Non Major Elective Course**	1	6	5	5
Overall Total for all Semesters			**21**	**120**	**100**	**100**

Course Pattern – From 2020-2021 Batch

Sem.	Part	Study Component	Course Code	Course Title	Hrs	Credit
I	III	Core Course I	20PCHC11	Organic Chemistry – I	5	5
		Core Course II	20PCHC12	Inorganic Chemistry – I	5	5
		Core Course III	20PCHC13	Physical Chemistry – I	5	5
		Core Course IV	20PCHC14	Analytical Method - I	5	5
		Core Practical I	20PCHC1P	Organic Chemistry Practical	10	5
		Total			**30**	**25**
II	III	Core Course V	20PCHC21	Organic Chemistry – II	5	5
		Core Course VI	20PCHC22	Inorganic Chemistry – II	5	5
		Core Course VII	20PCHC23	Physical Chemistry – II	5	5
		Core Course VIII	20PCHC24	Analytical Method – II	5	5
		Core Practical II	20PCHC2P	Inorganic Chemistry Practical	10	5
		Total			**30**	**25**
III	III	Core Course IX	20PCHC31	Organic Chemistry –III	4	4
		Core Course X	20PCHC32	Inorganic Chemistry – III	4	4
		Core Course XI	20PCHC33	Physical Chemistry – III	4	4
		Core Elective Course I	20PCHE31/ 20PCHE32	1. Pharmaceutical Chemistry 2. Macromolecular Chemistry	4	4
		Core Practical III	20PCHC3P	Physical Chemistry Practical	8	4
		Non Major Elective Course I	20PCHN31	Environmental Science	6	5
		Total			**30**	**25**
IV	III	Core Course XII	20PCHC41	Organic Chemistry –IV	5	5
		Core Course XIII	20PCHC42	Inorganic Chemistry – IV	5	5
		Core Course XIV	20PCHC43	Physical Chemistry – IV	5	5
		Core Elective Course II	20PCHE41/ 20PCHE42	1. Nano Chemistry 2. Green Chemistry	5	5
	III	Core Project I	20PCHC4P	Project Work	10	5
		Total			**30**	**25**
		Total of all Four Semesters			**120**	**100**

Programme	**M.Sc Chemistry**	**Programme Code**	**PCH**
Course Code	**20PCHC11**	**Number of Hours/Cycle**	**5**
Semester	**I**	**Max. Marks**	**100**
Part	**III**	**Credit**	**5**
Core Course I			
Course Title	**Organic Chemistry – I**		
Cognitive level Up to K4			

Preamble

This course deals the concepts of Reaction Mechanism**,** Aliphatic Nucleophilic substitution, aromatic electrophilic substitution and the concepts Aromatic Characters. Synthesis of important terpenes and alkaloids.

Unit 1 Introduction to Reactions 15 Hours

Reaction intermediates – free radicals, carbenes, nitrenes, carbanions and carbocation‘s – formation and stability of reaction intermediates – methods of determination of reaction mechanism – kinetic and thermodynamic control of chemical reactions. Principle of microscopic reversibly – Energy profile diagram – Hammond Postulate. Addition compounds - EDA complexes – inclusion compounds – effect of structure on the dissociation constants of acids and bases – concept of Hard and Soft acids and bases.

Unit 2 Substitution Reactions-I 15 Hours

Aliphatic nucleophilic substitution – Mechanisms; SN1, SN2, SNi – stereochemical aspects of nucleophilic substitution reactions – Ion-pairs in SN1 mechanism – Neighbouring group participation – Non-classical carbocations – Substitutions at allylic and vinylic carbons – Reactivity: Effect of structure, nucleophile, leaving group and solvent – Ambident substrates and nucleophiles. Aliphatic electrophilic substitution: SE1, SE2, SEi mechanisms – Simple examples only.

Unit 3 Substitution Reactions-II 15 Hours

Aromatic electrophilic substitution- orientation –reactivity – mechanism of nitration, halogenations, Friedel-Craft‘s reaction and sulphonation – partial rate factors ortho/para ratio – Quantitative treatment of reactivity of the electrophile – Aromatic nucleophilic substitution reactions- SnAr, Sn1and benzyne mechanisms. Quantitative treatment of the effect of structure on reactivity – The Hammen relationship –siginficance of reaction and substitutents constants – application of the Hammett equation in reaction mechanism – limitations and deviations.

Unit 4 Aromatic Character 15 Hours

Aromatic character in benzene, six membered rings, five, seven, eight membered rings-other systems with aromatic sextets – Huckel‘s rule. Craig‘s rule - concept of homo aromaticity and anti aromaticity - systems with 2, 4, 8, 10 and more than 10 electrons – Alternant and nonalternant hydrocarbons. Chemistry of cyclopentedienyl anion – Fulvene, Azulene and Annulens.

Novel Ring System

Nomenclature of bicyclic and tricyclic systems – chemistry of adamantine, diamantine [congressane], cubane and catenanes.

Unit 5 Terpenes And Alkaloids 15 Hours

Introduction - classification - isoprene rule - structural determination of terpenoids’- α- pinene, camphor, zingiberene, cadinene , α-santinin, abietic acid and squalene.

Introduction - isolation of alkaloids - total synthesis of quinine - morphine and reserpine.

Pedagogy

Lecture by use of boards, LCD projectors, Assignments, Seminars, Group Discussion, Self- learning such as use of NPTEL materials and internets, Simulation.

Text Book

1. Jain M.K, Sharma S.C, (2017), “Modern Organic Chemistry”, Vishal Publishing Co, JALANDHAR - 144 008 (PB.) INDIA. Golden Jubilee Yr. Revised Edition.

2. Renuga S,(2017), "*Name Reactions and Reagents in Organic synthesis",*Vishal Publishing Co,JALANDHAR - 144 008 (PB.) INDIA. Golden Jubilee Yr. Revised Edition
3. Mukherji S.M, Singh, S.P, (1990) "Organic Reaction Mechanism", MacMillan India Ltd., Chennai.

References

1. Sykes P, (1976), "*Guidebook to Mechanism in Organic Chemistry"*, Orient Longman.
2. Jerry March, John Wiley & Sons,(2015), "*Advanced Organic Chemistry"*,7th Edition.
3. I.L Finar, (2002), ELBS, "*Organic Chemistry*", Vol. 1 and 2.5th,6 th Edition

E-Resources

- Organic syntheses.
- Science of synthesis.
- Dictionary of organic compounds .
- Dictionary of natural products
- Dictionary of organic compounds .

Course Outcomes

On successful completion of the course, the student will be able to

CO1	Illustrate the Reactive intermediates and its properties
CO2	Explain the aliphatic nucleophilic and electrophilic substitution reactions
CO3	Interpret the aromatic electrophilic and nucleophilic substitutions reactions
CO4	Categorize the Aromaticity of organic compounds and its applications
CO5	Inference the synthesis of important terpenes and alkaloids.

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**2**	**2**	**0**	**2**	**2**	**0**
CO2	**2**	**2**	**3**	**3**	**3**	**3**
CO3	**2**	**0**	**2**	**0**	**0**	**2**
CO4	**3**	**3**	**3**	**0**	**3**	**0**
CO5	**2**	**0**	**0**	**3**	**2**	**3**

1 – Low, 2 – Medium & 3- High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**Cos**	**K – Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Open Choice**
			No. of Questions	**K-Level**	**No. of Questions**	**No. of Questions**
1	CO1	Up to K2	2	K1 & K2	2(K2&K2)	1(K2)
2	CO2	Up to K3	2	K1 & K2	2(K3&K3)	1(K3)
3	CO3	Up to K3	2	K1 & K2	2(K2&K2)	1(K3)
4	CO4	Up to K4	2	K1 & K2	2(K2&K2)	1(K4)
5	CO5	Up to K4	2	K1 & K2	2(K4&K4)	1(K4)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems
K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or Choice)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-	-	5	5%	5%
K2	5	24	10	39	39%	39%
K3	-	8	20	28	28%	28%
K4	-	8	20	28	28%	28%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit	Description	Hours	Mode
I	Reaction intermediates – free radicals, carbenes, nitrenes, carbanions and carbocation‘s – formation and stability of reaction intermediates `	5	Chalk and talk, Power Point presentation
	methods of determination of reaction mechanism – kinetic and thermodynamic control of chemical reactions	4	
	Addition compounds - EDA complexes – inclusion compounds	3	
	Effect of structure on the dissociation constants of acids and bases – concept of Hard and Soft acids and bases.	3	
II	Aliphatic nucleophilic substitution – Mechanisms; SN1, SN2, SNi – stereochemical aspects of nucleophilic substitution reactions.	4	Chalk and talk, Power Point presentation
	Ion-pairs in SN1 mechanism – Neighbouring group participation – Non-classical carbocations.	4	
	Substitutions at allylic and vinylic carbons – Reactivity: Effect of structure, nucleophile, leaving group and solvent – Ambident substrates and nucleophiles.	4	
	Aliphatic electrophilic substitution: SE1, SE2, SEi mechanisms – Simple examples only.	3	
III	Aromatic electrophilic substitution- orientation –reactivity.	3	Chalk and talk, Power Point presentation
	mechanism of nitration, halogenations, Friedel-Craft‘s reaction and sulphonation	3	
	partial rate factors ortho/para ratio – Quantitative treatment of reactivity of the electrophile.	2	
	Aromatic nucleophilic substitution reactions- SnAr, Sn1and benzyne mechanisms.	3	
	Quantitative treatment of the effect of structure on reactivity – The Hammen relationship – siginficance of reaction and substitutents constants – application of the Hammett equation in reaction mechanism – limitations and deviations.	4	

IV	Aromatic character in benzene, six membered rings, five, seven, eight membered rings-other systems with aromatic sextets– Huckel's rule.	3	Chalk and talk, Power Point presentation, Group Discussion
	Craig's rule - concept of homo aromaticity and anti aromaticity.	3	
	Craig's rule - concept of homo aromaticity and anti aromaticity - systems with 2, 4, 8, 10 and more than 10 electrons	3	
	Alternant and nonalternant hydrocarbons. Chemistry of cyclopentedienyl anion – Fulvene, Azulene andAnnulens.	3	
	Novel Ring System: Nomenclature of bicyclic and tricyclic systems – chemistry of adamantine, diamantine [congressane], cubane and catenanes.	3	
V	Introduction - classification - isoprene rule	2	Chalk and talk, Power Point presentation, Group Discussion
	structural determination of terpenoids'- α-pinene, camphor, zingiberene, cadinene , α-santinin, abietic acid and squalene.	6	
	Introduction - isolation of alkaloids	3	
	total synthesis of quinine - morphine and reserpine.	4	

Course Designed by 1. Dr.A.Pandiarajan, 2. Dr.M.S.Dheenadayalan

Programme	M.Sc Chemistry	Programme Code	PCH
Course Code	20PCHC12	Number of Hours/Cycle	5
Semester	I	Max. Marks	100
Part	III	Credit	5
Core Course II			
Course	Inorganic Chemistry – I		
Cognitive Level Up to K4			

Preamble

The objective of the course is to imparrt knowledge in bonding reaction mechanisms and various theories and basic concept of coordination compounds.

Unit I Chemical Bonding I **15 Hours**

Nature of Covalent Bond –Valence Bond Theory (VBT)- Concept of Resonance –Molecular Orbital Theory (MOT) – Molecular orbital Configurations of Some Homonuclear Diatomic Species – Bond Multiplicity – Molecular orbital Configurations of Some Heteronuclear Diatomic Species – Shapes of Covalent Molecules – Crystal field theory(CFT)-Crystal field splitting in octahedral, tetrahedral and square planar complexes-Limitation of CFT.

Unit II Chemical Bonding -II **15 Hours**

Ionic radii-covalent radii-Vanderwaals radius-bond length, bond order, bond Polarity-partial ionic character of covalent bonds-electro negativity –electron affinity-lattice energy-Born Haber Cycle-covalent character in ionic compounds-different types of electrostatic interactions-Hydrogen bond.

Unit III Coordination Chemistry-I **15 Hours**

Quantum numbers- JJ Coupling, spin multiplicity,spin-spin coupling ,orbit-orbit coupling,spin-orbit coupling-Term symbol-Terms for d electron system-Ground terms for d^n configuration-selection rule for electronic transitions-Charge transfer transition-Jahn Teller effect- Orgel diagram-Electronic spectra of d^2,d^3,$d^7$and d^8 ions in octahedral and tetrahedral field,Tanabe-Sugano diagram for d^2 and d^3 ions.

Unit IV Coordination Chemistry – II **15 Hours**

Trans effect-Trans effect series-uses of trans effects-theories of trans effects-The polarization theory and pi-bonding theory-Factors affecting the rate of substitution reaction in square planar complexes-cis trans isomerism in planar complexes-substitution reaction in octahedral complexes,SN_1CB mechanisms, Labile and inert complexes.

Unit V Coordination Chemistry - III **15 Hours**

Mechanism of one electons transfer reactions- inner sphere mechanisms –direct electron transfer reactions-outer sphere mechanism 5,6 -Factors affecting the rates of direct electron transfer reactions-Two electron transfer reactions- complementary and non-complementary reactions.

Pedagogy

Lecture by use of boards, LCD projectors, Assignments, Seminars, Laboratory experiments/teaching aids Self- learning such as use of NPTEL materials and internets, Simulation.

Text Books

1. Puri B.R, Sharma L.R, and Pathania M.S, (2019)"*Advanced inorganic chemistry"* - Vishal Publishing Co.,
2. Soni L, KatyalM, (2010)"*Text book of Inorganic Chemistry"*, Sultan Chand and Publishers, 20threvised Edition.
3. Douglas B, Me Daniel D.H and J.J 2001,"*Alexander,Concepts and Models of Inorganic Chemistry"*, John Wiley and Sons, New Delhi,.

Reference Books

1. Cotton F.A, and Wilkinson G, John Wiley & Sons, (1998), *"Advances Inorganic Chemistry"* 5th Edition, Singapore
2. Mackay K.M, and Mackay R.A,1989, "*Introduction to Modern Inorganic Chemistry*", 4th Edition, Prentice Hall, New Jersey.
3. James HuheeyE, Ellen KeitlerA, and Richard KeitlerL, (1993), *"Inorganic Chemistry"*,4th Edition Harper Collins College Publishers, New York.

E-Resources

- Dictionary of Inorganic and Organometallic Compounds .
- Aldrich Catalog: Organics and Inorganics for Chemical Synthesis.
- Annual Review of Inorganic Chemistry.
- Nature Inorganic Chemistry.
- Combined Chemical Dictionary.

Course Outcomes

On successful completion of the course, the student will be able to

CO1	Apply the various theories of VBT, MOT, CFT and its limitations.
CO2	Analyse the concepts of chemical bonding.
CO3	Interpret the electronic transition metal complexes in coordination chemistry.
CO4	Categorize the Ligands substitution reaction in coordination complexes.
CO5	Justify the electron transfer reactions in coordination compounds.

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**3**	**3**	**2**	**3**	**2**
CO2	**3**	**2**	**3**	**2**	**2**	**0**
CO3	**2**	**0**	**2**	**2**	**3**	**0**
CO4	**2**	**2**	**3**	**0**	**3**	**2**
CO5	**2**	**2**	**3**	**2**	**2**	**3**

Low, 2 – Medium & 3- High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**COs**	**K – Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Open Choice**
			No. of Questions	**K-Level**	**No. of Questions**	**No. of Questions**
1	CO1	Up to K2	2	K1 & K2	2(K2&K2)	1(K2)
2	CO2	Up to K3	2	K1 & K2	2(K3&K3)	1(K3)
3	CO3	Up to K3	2	K1 & K2	2(K3&K3)	1(K3)
4	CO4	Up to K4	2	K1 & K2	2(K3&K3)	1(K4)
5	CO5	Up to K4	2	K1 & K2	2(K4&K4)	1(K4)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems
K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or Choice)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-	-	5	5%	5%
K2	5	8	10	23	23%	23%
K3	-	24	20	44	44%	44%
K4	-	8	20	28	28%	28%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit	Description	Hours	Mode
I	Nature of Covalent Bond –Valence Bond Theory (VBT)	3	Chalk and talk, Power Point presentation
	Concept of Resonance –Molecular Orbital Theory (MOT)	3	
	Molecular orbital Configurations of Some Homonuclear Diatomic Species – Bond Multiplicity	3	
	Molecular orbital Configurations of Some Heteronuclear Diatomic Species – Shapes of Covalent Molecule.	3	
	Crystal field theory(CFT)-Crystal field splitting in octahedral, tetrahedral and square planar complexes-Limitation of CFT.	3	
II	Ionic radii-covalent radii-Vanderwaals radius-bond length, bond order, bond polarity-partial ionic character of covalent bonds.	5	Chalk and talk, Power Point presentation
	electro negativity –electron affinity	3	
	lattice energy-Born Haber Cycle-covalent character in ionic compounds	4	
	different types of electrostatic interactions-Hydrogen bond.	3	
III	Quantum numbers- JJ Coupling, spin multiplicity,spin-spin coupling ,orbit-orbit coupling,spin-orbit coupling	3	Chalk and talk, Power Point presentation
	Term symbol-Terms for d electron system-Ground terms for dn configuration.	3	
	selection rule for electronic transitions-Charge transfer transition-Jahn Teller effect	3	
	Orgel diagram-Electronic spectra of d2,d3,d7and d8 ions in octahedral and tetrahedral field.	3	
	Tanabe-Sugano diagram for d2 and d3 ions.	3	
IV	Trans effect-Trans effect series-uses of trans effects-theories of trans effects	3	Chalk and talk, Power Point presentation
	The Polarization theory and pi-bonding theory	3	
	Factors affecting the rate of substitution reaction in square planar complexes-cis trans isomerism in planar complexes	3	
	Substitution reaction in octahedral complexes	3	
	SN_1CB mechanisms, Labile and inert complexes.	3	
V	Mechanism of one electons transfer reactions-inner sphere mechanisms	4	Chalk and talk, Power Point presentation.
	direct electron transfer reactions-outer sphere mechanism	4	
	5,6 -Factors affecting the rates of direct electron transfer reactions	3	
	Two electron transfer reactions-complementary and non-complementary reactions	4	

Course Designed by 1. Dr.M.S.Dheenadayalan 2. Mrs.A.Mariammal

Programme	M.Sc Chemistry	Programme Code	PCH
Course Code	20PCHC13	Number of Hours/Cycle	5
Semester	I	Max. Marks	100
Part	III	Credit	5
Core Course III			
Course Title	Physical Chemistry – I		
Cognitive level Up to K4			

Preamble

This course provides various laws of electrochemistry and different principles of electrochemistry and also provides the applications of electrochemistry. Various reactions of photochemistry and chemistry in nanoscience are to be discussed.

Unit 1 Electrochemistry - I **15 Hours**

Ions in Solutions: Conductivity of solutions and their measurement - the Arrhenius ionisation theory - transport numbers and mobilities of ions - measurement of transport numbers - Hittorff method and moving boundary method - ionic activities and activity coefficients and their determination by various methods - Debye-Huckel Onsager theory - ionic atmosphere - Debye-Huckel limiting law - Electrolytic conductance – Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.

Unit 2 Electrochemistry - II **15 Hours**

Metal/Electrolyte Interface**:** Outer Helmholtz plane and Inner Helmholtz plane (IHP) - Potential profile across double layer region - Potential difference across electrified interface - Structure of the double layer - Helmholtz-Perrin, Gouy-Chapman, and Stern models – Electrode kinetics - Butler-Volmer equation–one step one electron transfer kinetics - exchange current density - Tafel equation and plots - Polarizable and non-Polarizable interfaces - Hydrogen overpotential – Theories of hydrogen overvoltage - Mechanism of hydrogen evolution reactions - Passivity – electrochemical corrosion and its protection.

Unit 3 Electrochemistry – III **15 Hours**

Electrochemical Cells: Measurement of EMF - calculation of the EMF of a cell - the - the electrochemical Potential - the cell EMF and the cell reaction - reversible cells - types of half cells - the standard EMF of a cell - standard electrode Potentials - calculation of EMF of a cell - Nernst equation and its limitations - solubility products - calculation of solubility products standard free energies and entropies of aqueous ions - electrode and electrolyte concentration - liquid junction Potential - measurement of pH, concentration cells with transference.

Unit 4 Photochemistry **15 Hours**

Absorption and emission of radiation – Theories – Spontaneous and induced emission –Laser-– Jablonski diagrams – Emission – Resonance emission – Selection rule – Fluorescence – Phosphorescence – Delayed fluorescence- E and P type – Excimer and Exciplex complex formation – Stern Volmer equation – Photosensitization- Chemiluminescence – Experimental techniques Actinometry - Photochromism – Photostabilization

Unit 5 Nano Chemistry **15 Hours**

Nanomaterials – Preparation: Plasma arcing - Chemical vapor deposition – Sol-gel method – silica gels – Zirconia and ytrrium gels – Aluminosilicate gels – Electrodeposition – Ball milling –Applications of nanomaterials – Machine tools – Batteries – High Power magnets – Motor vehicles and aircraft.

Pedagogy

Chalk and talk method,Class Room Lectures, Power Point presentation, Group Discussion, Seminar and Case Study.

Text Books

1. John M. Bockris and Amulya K.N, Reddy,(2000),"*Modern Electrochemistry"*, Vol. I & II, 2nd Edition,Springer, New Delhi.

2. Rohatgi Mukherjee K.K., *(*2009*),"Fundamentals of photochemistry"*, New Age International Pvt. Ltd., New Delhi.

Reference Books

1. Atkin's, (2014),"*Physical Chemistry"*, Peter Atkins and Julio de Paula Oxford Publishers.
2. J.P Srivastava, (2003), "*Elements of Solid state Physics"*, Prentice Hall of India.
3. Michael Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons and Burkhard Raguse, (2004), "*Nanotechnology – Basic Science and Emergin Technologies*", Chapman & Hall (CRC).

E-Resources

- Annual Review of Physical Chemistry.
- Smithsonian Physical Tables.
- Lange's Handbook of Chemistry.
- Nature Physical Chemistry.
- Hawley's Condensed Chemical Dictionary.

Course Outcomes

On successful completion of the course, the student will be able to

CO1	Infer the fundamentals of electrochemistry and develop the knowledge in electro chemistry
CO2	Apply the Principles of electrochemical cell models
CO3	Analyze the Applications of electrochemical cell models
CO4	Categorize the various instrumental techniques in photochemistry
CO5	Interpret the various functions of Nanoscience and nanotechnology.

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**2**	**2**	**3**	**0**	**0**
CO2	**3**	**3**	**2**	**0**	**3**	**3**
CO3	**2**	**0**	**3**	**0**	**2**	**2**
CO4	**2**	**3**	**0**	**3**	**0**	**0**
CO5	**3**	**3**	**2**	**3**	**3**	**3**

1 – Low, 2 – Medium & 3- High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**Cos**	**K – Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Open Choice**
			No. of Questions	**K-Level**	**No. of Questions**	**No. of Questions**
1	CO1	Up to K2	2	K1 & K2	2 (K2&K2)	1(K2)
2	CO2	Up to K3	2	K1 & K2	2(K3&K3)	1(K3)
3	CO3	Up to K4	2	K1 & K2	2(K3&K3)	1(K4)
4	CO4	Up to K4	2	K1 & K2	2(K4&K4)	1(K4)
5	CO5	Up to K3	2	K1 & K2	2(K3&K3)	1(K3)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems
K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or Choice)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-	-	5	5%	5%
K2	5	8	10	23	23%	23%
K3	-	24	20	44	44%	44%
K4	-	8	20	28	28%	28%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit	Description	Hours	Mode
I	Ions in Solutions: Conductivity of solutions and their measurement - the Arrhenius ionisation theory - transport numbers and mobilities of ions - measurement of transport numbers	4	Chalk and talk, Power Point presentation
	Hittorff method and moving boundary method - ionic activities and activity coefficients and their determination by various methods	4	
	Debye-Huckel Onsager theory - ionic atmosphere - Debye-Huckel limiting law - Electrolytic conductance – Kohlrausch's law and its applications; ionic equilibria;	5	
	conductometric and potentiometric titrations.	2	
II	Metal/Electrolyte Interface**:** Outer Helmholtz plane and Inner Helmholtz plane (IHP) - potential profile across double layer region - Potential difference across electrified interface	4	Chalk and talk, Power Point presentation
	Structure of the double layer - Helmholtz-Perrin, Gouy-Chapman, and Stern models – Electrode kinetics - Butler-Volmer equation– one step one electron transfer kinetics - exchange current density	6	
	Tafel equation and plots - Polarizable and non-polarizable interfaces - Hydrogen overpotential	2	
	Theories of hydrogen overvoltage - Mechanism of hydrogen evolution reactions - Passivity – electrochemical corrosion and its protection.	3	
III	Electrochemical Cells: Measurement of EMF - calculation of the EMF of a cell - the electrochemical Potential - the cell EMF and the cell reaction	4	Chalk and talk, Power Point presentation
	reversible cells - types of half cells - the standard EMF of a cell - standard electrode Potentials - calculation of EMF of a cell	3	
	Nernst equation and its limitations - solubility products - calculation of solubility products	3	
	standard free energies and entropies of aqueous ions - electrode and electrolyte concentration - liquid junction Potential - measurement of pH, concentration cells with transference.	5	

IV	Absorption and emission of radiation – Theories – Spontaneous and induced emission – Laser-– Jablonski diagrams	5	Chalk and talk, Power Point presentation
	Emission – Resonance emission – Selection rule – Fluorescence – Phosphorescence – Delayed fluorescence- E and P type	4	
	Excimer and Exciplex complex formation – Stern Volmer equation – Photosensitization	3	
	Chemiluminescence – Experimental techniques Actinometry - Photochromism – Photostabilization.	3	
V	Nanomaterials – Preparation: Plasma arcing	4	Chalk and talk, Power Point presentation, Group Discussion
	Chemical vapor deposition – Sol-gel method – silica gels – Zirconia and ytrrium gels – Aluminosilicate gels	4	
	Electrodeposition – Ball milling –Applications of nanomaterials – Machine tools	4	
	Batteries – High Power magnets – Motor vehicles and aircraft .	3	

Course Designed by 1. Dr.S.K.Selvaraj 2. Dr.S.Ignatius Arockiam

Programme	**M.Sc Chemistry**	**Programme Code**	**PCH**
Course Code	**20PCHC14**	**Number of Hours/Cycle**	**5**
Semester	**I**	**Max. Marks**	**100**
Part	**III**	**Credit**	**5**
Core Course IV			
Course	**Analytical Method - I**		
Cognitive Level Up to K4			

Preamble

Students will be dealing with fundamental concepts in analytical chemistry and to study the various methods involved in analytical techniques and to learn the quantitative measurements in the absorption and emission spectroscopy. To learn the separation process using various chromatographic techniques and the knowledge of electrochemistry in practical applications.

Unit 1 Quantitative Analysis And Precipitation Techniques 15 Hours

Theoretical basis of quantitative inorganic analysis-common ion effect solubility product, effect of acid, temperature and solvent upon the solubility of a precipitate. Formation and treatment of precipitates-co precipitation and Post-precipitation. Precipitation from homogeneous solution. Specific and selective precipitants. Principles of acid-base, oxidation-reduction, precipitation and complexometric titrations-indicators used in such titrations. Uses of organic reagents in inorganic quantitative and qualitative analysis.

Unit 2 Error Analysis 15 Hours

Errors in chemical analysis – Defining terms: mean, median, accuracy and precision – classification of errors: Systematic errors and random errors. Improving accuracy of analysis – mean, standard deviation and Q-test. Comparison of results – Least square, T-test, F-test.

Unit 3 Spectro Analytical Methods 15 Hours

Colorimetry: Theoretical and practical aspects of colorimetric analysis. Flame emission and atomic absorption spectroscopy – types of atomic spectroscopy – emission methods – absorption methods – fluorescence methods – flame atomizers – Electro thermal atomizers – principle and applications of atomic absorption spectroscopy. Advantages of atomic absorption spectrometry.

Unit 4 Electrochemical and Thermo Analytical Method 15 Hours

Cyclic Voltammetry, coulometry and amperometry-principle and applications.Thermal Characterization techniques, Principle and applications of Differential Thermal Analysis (DTA), Differentials Scanning Calorimetry (DSC) and Thermogravimetric Analysis (TGA) Thermometric titration.

Unit 5 Chromatographic Methods 15 Hours

Classification – techniques and applications in column, size-exclusion, ion exchange, paper and thin layer chromatography. Gas chromatography and high performance liquid chromatography (HPLC) – principle, equipment design, sample injection system, columns, detectors and applications.

Pedagogy

Class Room Lectures, Power Point presentation, Group Discussion, Seminar, Quiz, Assignments, Experience Sharing, Case Study.

Text Books

1. Skoog D. A, and West D. M., (1982), "*Fundamentals of Analytical Chemistry"*, Old Reinhord & Winston, Publication, 4th Edition.
2. Sharma B. K. (2005),"*Instrumental methods of Chemical analysis"*, Goel Publishing House, 4th Edition.
3. Gurdeep R., Chatwal, Sham K. Anand, (1979), "*Instrumental Methods of Chemical Analysis"*,Himalayan Publication.

Reference Books

1. F. W. Fifield, D. Kealey, (2000), "*Principles and Practice of Analytical Chemistry"*, 5thEdition, Blackwell Sciences Ltd,
2. Willard Merrit, (1986), "*Dean and Settle, Instrumental methods of analysis"*, 6thEdition, CBS Publ.
3. A. I. Vogel, (1982), "*Textbook of Qualitative Inorganic Analysis"*, 3rdEdition, ELBS, 1976 OldReinhord & Winston, Publication.

E-Resources

- Dictionary of Analytical Reagents.
- Combined Chemical Dictionary.
- Annual Review of Analytical Chemistry
- ChemSpider
- PubChem

Course Outcomes

On successful completion of the course, the student will be able to

CO1	Apply the results of the quantitative and qualitative measurements and also make use of precipitation techniques.
CO2	Solve the verification strategy in the error analysis
CO3	Compare the various instrumental techniques and distinguish its applications.
CO4	Examine the various electro and thermo analytical techniques.
CO5	Evaluate the quantitative analysis by using different chromatographic methods

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**2**	**2**	**0**	**3**	**0**	**3**
CO2	**0**	**3**	**3**	**0**	**3**	**0**
CO3	**2**	**0**	**2**	**0**	**2**	**2**
CO4	**0**	**2**	**0**	**3**	**3**	**0**
CO5	**2**	**3**	**3**	**0**	**2**	**3**

1 – Low, 2 – Medium & 3- High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**COs**	**K – Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Open Choice**
			No. of Questions	**K-Level**	**No. of Questions**	**No. of Questions**
1	CO1	Up to K2	2	K1 & K2	2(K2&K2)	1(K2)
2	CO2	Up to K3	2	K1 & K2	2(K3&K3)	1(K3)
3	CO3	Up to K3	2	K1 & K2	2(K3&K3)	1(K3)
4	CO4	Up to K4	2	K1 & K2	2(K3&K3)	1(K4)
5	CO5	Up to K4	2	K1 & K2	2(K4&K4)	1(K4)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems
K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-	-	5	5%	5%
K2	5	8	10	23	23%	23%
K3	-	24	20	44	44%	44%
K4	-	8	20	28	28%	28%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit	Description	Hours	Mode
I	**a)** Theoretical basis of quantitative inorganic analysis-common ion effect solubility product, effect of acid, temperature and solvent upon the solubility of a precipitate. b) Formation and treatment of precipitates-co precipitation and Post-precipitation. Precipitation from homogeneous solution. Specific and selective precipitants. c) Principles of acid-base, oxidation-reduction, precipitation and complexometric titrations-indicators used in such titrations. Uses of organic reagents in inorganic quantitative and qualitative analysis.	5 5	Chalk and talk, Power Point presentation, Group Discussion
II	a) Errors in chemical analysis – Defining terms: mean, median, accuracy and precision b) Classification of errors: Systematic errors and random errors. Improving accuracy of analysis c) Mean, standard deviation and Q-test. Comparison of results – Least square, T-test, F-test.	5 5 5	Chalk and talk, Power Point presentation
III	a) Colorimetry: Theoretical and practical aspects of colorimetric analysis. Flame emission b) Principle and applications of atomic absorption spectroscopy. c) Types of atomic spectroscopy – emission methods – absorption methods – fluorescence methods. d) Flame atomizers – Electro thermal atomizers –Advantages of atomic absorption spectrometry.	5 3 3 4	Chalk and talk, Power Point presentation

IV	a) Cyclic Voltammetry, coulometry and amperometry b) Thermal Characterization techniques, Differential Thermal Analysis (DTA), c) Differentials Scanning Calorimetry (DSC) and Thermogravimetric Analysis (TGA) Thermometric titration.	5 5 5	Chalk and talk, Power Point presentation
V	a) Principle, equipment design, sample injection system, columns, detectors and applications. b) Column, size-exclusion, ion exchange, paper and thin layer chromatography. c) Gas chromatography and high performance liquid chromatography (HPLC)	5 5 5	Chalk and talk, Power Point presentation,

Course Designed by 1. Mr.S.Philip Arockiaraj 2. Mrs.M.Shanmugapriya

Programme	**M.Sc**	**Programme Code**	**PCH**
Course Code	**20PCHC1P**	**Number of Hours/Cycle**	**10**
Semester	**I**	**Max. Marks**	**100**
Part	**III**	**Credit**	**5**
Core Practical I			
Course Title	**Organic Chemistry Practical**		
Cognitive Level Up to K4			

Preamble

To utilize the qualitative analysis of an organic mixture and to Estimate the organic compounds

Separation of Mixtures

- Separation of organic mixtures
- Elemental analysis
- Functional group(s) identification
- Preparation of derivatives
- The physical constants are to be reported
- Analysis with minimum one Confirmation tests for each group.

Volumetric analysis

- Estimation of phenol/aniline
- Estimation of glucose (Bertrand's method)
- Estimation of glucose (Lane and Eynon method)
- Estimation of ketone
- Estimation of formaldehyde/carbonyl compounds

Course Outcomes

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

CO1	Analyze the solubility nature of organic substances of different functional group.
CO2	Familiarize the test involving identification of special elements.
CO3	Analyze the separation of mixtures. To familiarize the systematic producers organic substances analysis.
CO4	Identify the various functional groups.
CO5	Examine the various Estimation.

Pedagogy

Demonstration, Experience Sharing, Laboratory experiments/teaching aids, Self-learning such as use of NPTEL materials and internets, Simulation.

Text Books

1. Gnanapragasam N.S, Ramamurthy G., (2010), "*Organic Chemistry Lab Manual"*, S.Vishwanath Printers & Publishers Pvt. Ltd.,Chennai,.
1. Day & Underwood, (2004), "*Quantitative Analysis"*, Prentice Hall of India Pvt. Ltd., New Delhi. 6th Edition,

Reference Books

1. Arthur Vogel I., Elementary, (1989), *"Practical Organic Chemistry* (Part 1, 2 and 3*)"*, CBS Publishers and Distributors, New Delhi,5th Edition.
2. Leonard J, Lygo B, Procter G.(2004), "*Advanced Practical Organic Chemistry*", Stanley Thornes (Publishers) Ltd., 1st Indian Edition.

E-Resources

- International Union of Pure and Applied Chemistry.
- Organic syntheses.
- Science of synthesis.
- Annual Review of Organic Chemistry.
- Nature Organic Chemistry.

Internal: 40 Marks **and External** 60 Marks**: 6 Hours Practical**

Course Designed by: 1. Dr.A.Pandiarajan 2. Dr.M.S.Dheenadayalan

Programme	**M.Sc Chemistry**	**Programme Code**	**PCH**
Course Code	**20PCHC21**	**Number of Hours/Cycle**	**5**
Semester	**II**	**Max. Marks**	**100**
Part	**III**	**Credit**	**5**
Core Course V			
Course Title	**Organic Chemistry – II**		
Cognitive Level Up to K4			

Preamble

To understand the concepts of Stereochemistry and to learn the basics and applications of Stereochemistry, conformational analysis, the principles of Green chemistry. To acquire basic knowledge about the heterocyclic chemistry involving in natural Products.

Unit 1 Stereochemistry-I **15 Hours**

Stereoisomerism – Chirality and symmetry – Enantiomers and diastereomers. Projection formulae -- Wedge, Fischer, Sawhorse and Newmann. Optical isomerism due to centre of chirality. Erythro and threo nomenclature. Configuration – determination of configuration. Cahn Ingold and Prelog system of designation of configuration. Geometrical isomerism:E-Z nomenclature – determination of configuration of geometrical isomers using physical and chemical methods – stereoisomerism in monocyclic compounds [upto six membered ring].

Unit 2 Streochemisty-II **15 Hours**

Prochirality and, prosteroisomerism, enantiotopic and diasterotopic ligands and faces and their nomenclature pro –R and pro-S Re and Si faces. Stereospecific and stereoselective reaction. Asymmetric synthesis Cram and Prolog rules. Optical isomers due axial chriality – biphenyls allenes and spiranes. Molecules with planar chirality – paracyclophanes, trans cyclooctene, ansacompounds .

Unit 3 Conformational Analysis **15 Hours**

Configurations and conformations – conformations of ethane and n- butane-conformation analysis – stereoelectronic and steric factors- conformation of simple acyclic compounds -conformation of monosubstituted and disubstituted cyclohexanes-conformational free energy – Curtin Hammett principle Quantitative treatment of mobile system– Eliel –Ro equation – conformations and reactivity of cyclohexamones-conformational analysis of aldohexopyranoses.

Unit 4 Green Chemistry **15 Hours**

Principles of green chemistry – planning a green synthesis in a laboratory – general interest for solvent free processes – solvent free techniques – Microwave synthesis: Introduction and Characteristics of microwave heating – interaction of microwave radiation with the material – difference between conventional heating and microwave heating. Dielectric Polarization – diaPolar Polarization – applications and advantages of microwave heating over conventional heating.

Unit 5 Steroids **15 Hours**

Steroids – Basic skeleton – Isolation – Structure determination – Structure of cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progesterone. Prostaglandins - General study of prostaglandins - Structures.

Pedagogy

Lecture by use of boards, LCD projectors, Assignments, Seminars, Mini projects, Self- learning such as use of NPTEL materials and internets, Simulation.

Text Book

1. 1.Jain M.K, Sharma S.C, (2017) , Golden Jubilee Yr. Revised Edition"*Modern Organic Chemistry"*,Vishal Publishing Co, JALANDHAR - 144 008 (PB.) INDIA
2. Renuga S., 2017, Golden Jubilee Yr. Revised Ed. "*Name Reactions and Reagents in Organic synthesis",*Vishal Publishing Co, JALANDHAR - 144 008 (PB) INDIA

References

1. Jerry March, John Wiley & Sons, (2015), "*Advanced Organic Chemistry*", 7th Edition.
2. Gould E.S, (1965), "*Mechanism and structure in Organic Chemistry"*, Henry Holt & Co., New York.
3. Finar I.L., (2002), "*Organic Chemistry , Vol.1 and 2"*. ELBS, 5th,6 th Edition.

E-Resources

- Annual Review of Organic Chemistry
- Nature Organic Chemistry
- Dictionary of organic compounds .
- Dictionary of natural products
- Dictionary of organic compounds .

Course Outcomes

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

CO1	Distinguish the isomerism of the compounds
CO2	Solve the configuration of the organic compounds
CO3	Classify the structural features of the organic molecules
CO4	Importance of sustainable chemistry
CO5	Make use of various types of steroids.

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**-**	**2**	**3**	**-**	**2**	**-**
CO2	**2**	**2**	**-**	**3**	**3**	**2**
CO3	**2**	**-**	**3**	**-**	**-**	**-**
CO4	**-**	**3**	**3**	**2**	**3**	**2**
CO5	**2**	**3**	**-**	**-**	**2**	**-**

1 – Low, 2 – Medium & 3- High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**Cos**	**K – Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Open Choice**
			No. of Questions	**K-Level**	**No. of Questions**	**No. of Questions**
1	CO1	Up to K2	2	K1 & K2	2(K2&K2)	1(K2)
2	CO2	Up to K3	2	K1 & K2	2(K3&K3)	1(K3)
3	CO3	Up to K3	2	K1 & K2	2(K2&K2)	1(K3)
4	CO4	Up to K4	2	K1 & K2	2(K2&K2)	1(K4)
5	CO5	Up to K4	2	K1 & K2	2(K4&K4)	1(K4)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		4	3
Marks for each Question			1		5	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems
K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or Choice)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-	-	5	5%	5%
K2	5	24	10	39	39%	39%
K3	-	8	20	28	28%	28%
K4	-	8	20	28	28%	28%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit	Description	Hours	Mode
I	Stereoisomerism – Chirality and symmetry – Enantiomers and diastereomers.	4	Chalk and talk, Power Point presentation
	Projection formulae -- Wedge, Fischer, Sawhorse and Newmann. Optical isomerism due to centre of chirality. Erythro and threo nomenclature.	3	
	Configuration – determination of configuration. Cahn Ingold and Prelog system of designation of configuration. Geometrical isomerism:E-Z nomenclature – determination of configuration of geometrical isomers using physical and chemical methods	5	
	stereoisomerism in monocyclic compounds [upto six membered ring].	3	
II	Prochirality and, prosteroisomerism, enantiotopic ligands, diasterotopic ligands	4	Chalk and talk, Power Point presentation
	enantiotopic faces, diasterotopic faces and their nomenclature pro –R, pro-S - Re and Si faces.	3	
	Stereospecific and stereoselective reaction. Asymmetric synthesis Cram and Prolog rules.	5	
	Optical isomers due axial chriality – biphenyls allenes and spiranes. Molecules with planar chirality – paracyclophanes, trans cyclooctene, ansacompounds .	3	
III	Configurations and conformations – conformations of ethane	3	Chalk and talk, Power Point presentation
	n- butane- conformation analysis – stereoelectronic and steric factors-	3	
	conformation of simple acyclic compounds - conformation of monosubstituted and disubstituted cyclohexanes	3	
	conformational free energy – Curtin Hammett principle Quantitative treatment of mobile system	3	
	Eliel –Ro equation – conformations and reactivity of cyclohexamones-	3	

	conformational analysis of aldohexopyranoses.		
IV	Principles of green chemistry – planning a green synthesis in a laboratory	3	Chalk and talk, Power Point presentation, Group Discussion
	general interest for solvent free processes – solvent free techniques	3	
	Microwave synthesis: Introduction and Characteristics of microwave heating – interaction of microwave radiation with the material	3	
	Difference between conventional heating and microwave heating. Dielectric Polarization – diaPolar Polarization	3	
	Applications and advantages of microwave heating over conventional heating.	3	
V	Steroids – Basic skeleton – Isolation Structure determination – Structure of cholesterol,	5	Chalk and talk, Power Point presentation.
	Bile acids, Androsterone,	3	
	Testosterone, Estrone, Progesterone.	4	
	Prostaglandins - General study of prostaglandins - Structures.	3	

Course Designed by 1. Dr.A.Pandiarajan 2. Dr.M.S.Dheenadayalan

Programme	M.Sc Chemistry	Programme Code	PCH
Course Code	20PCHC22	Number of Hours/Cycle	5
Semester	II	Max. Marks	100
Part	III	Credit	5
Core Course VI			
Course Title	Inorganic Chemistry – II		
Cognitive level Up to K4			

Preamble

The Preamble of the course is to develop an understanding of the chemistry of metals complexes and various reactions of organometallic chemistry.

Unit 1 Organo Metallic Chemistry-I **15 Hours**

Nomenclature of organometallic compounds –Definition –Classificatin of ligands on the basic of the number of electrons contributed by the ligand for the metal –carbon bond – Inert gas rule or 18 electron rule –Counting of effectives numbers of electrons-Basis for the 18 electron rule-Explanation for exceptions to the 18- electron rule.

Unit 2- Organometallic Chemistry -II **15 Hours**

Synthesis, Structure and Bonding-Poly nuclear carbonyls –nitrosyl-dinitrogen complexes –metal carbenes-carbynes-alkenes-alkynes-allyl complexes-ferrocene-uses of organo metallic compounds . Reaction of organometallic complexes

Mechanism of substitution reaction in carbonyl complexes –ligand cone angles – Mechanism oxidative addition reductive elimination reactions and insertion reaction.

Unit 3- Organo Metallic Chemistry-III **15 Hours**

Reactivity and Catalysis- Hydrogenation of olefins(Wilkinson's Catalyst)-hydroformylation of olefins using cobalt or rhodium catalysts(The oxo Process)-oxidation of olefins to aldehydes and ketones (Wacker's Process)-Polymerization of olefins(Zeiglar-Natta Catalyst)-Cyclooligomerization of acetylenes (Reppe Wilke's catalysts).

Unit 4- Solid State-I **15 Hours**

Structure of solids-Crystalline and Amorphous solids-size and shape of crystals – space lattice and unit cell-Types of crystals –Structure of diamond-Close packing of identical solid sphere –Limiting radius ratio-radius ratio rule and shape of ionic crystal-structure of NaCl-ZnS crystals (Zinc blende and Wurtzite Structure)-CsCl crystal –TiO_2 Crystal(Rutile).

Unit 5- Solid State-II **15 Hours**

Crystal Defects-Defects-Structures of crystals –schottky defect –Frenkel defect – Metal excess defects-Metal deficiency defects-Thermal defects-Band theory, Hall Effect– Semiconductors-types of Semiconductors-Photovoltoic effect Semiconductors in solar energy conservation-Fabrication of transistors.

Pedagogy

Class Room Lectures, Power Point presentation, Group Discussion, Seminar, Quiz, Assignments, Experience Sharing, Case Study.

Text Book

1. Puri B.R, Sharma L.R, and Pathania.M.S, (2019), "*Advanced inorganic chemistry"* - Vishal Publishing Co.
2. Shriver D.F, Atkins and Langford P.W. (2015), "*Inorganic Chemistry"*, ELBS, Oxford University Press 6thEdition.
3. Soni P. L, Katyal M, (2010)."*Text book of Inorganic Chemistry"*, Sultan Chand and Publishers, 20threvised Edition.

References

1. James HuheeyE, Ellen Keitler A and Richard KeitlerL, (1997),"*Inorganic Chemistry"*, 4th Edition, Harper Collins College Publishers, New York.
2. AddisonW.E, Wiley,(1961), "*Structural Principles of Inorganic Chemistry"*.
3. Wells.A.F, (1975),"*Structursl Inorganic chemisty"*, 4th Edition Oxford, NewYork

E-Resources

- Aldrich Catalog: Organics and Inorganics for Chemical Synthesis.
- Annual Review of Inorganic Chemistry.
- Nature Inorganic Chemistry.
- Combined Chemical Dictionary.
- Dictionary of Inorganic and Organometallic Compounds .

Course Outcomes

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

CO1	Demonstrate the Nomenclature of organometallic compounds and 18 electrons rule.
CO2	Examine the structure and reaction of organometallic complexes.
CO3	Identify the catalytic reaction of organometallic compounds .
CO4	Interpret the arrangement of ions in the structure from the various solid substances.
CO5	Simplify the type of defects in metals, band theory and solid state reactions.

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**2**	**2**	**0**	**2**	**2**
CO2	**3**	**0**	**2**	**2**	**2**	**2**
CO3	**3**	**2**	**3**	**0**	**2**	**3**
CO4	**2**	**0**	**3**	**0**	**2**	**0**
CO5	**2**	**2**	**3**	**0**	**2**	**2**

1 – Low, 2 – Medium & 3- High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**Cos**	**K – Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Open Choice**
			No. of Questions	**K-Level**	**No. of Questions**	**No. of Questions**
1	CO1	Up to K2	2	K1 & K2	2(K2& K2)	1(K2)
2	CO2	Up to K4	2	K1 & K2	2(K3& K3)	1(K4)
3	CO3	Up to K3	2	K1 & K2	2(K2& K2)	1(K3)
4	CO4	Up to K4	2	K1 & K2	2(K3& K3)	1(K4)
5	CO5	Up to K4	2	K1 & K2	2(K2& K2)	1(K4)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems
K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or Choice)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-	-	5	5%	5%
K2	5	24	10	39	39%	39%
K3	-	16	10	26	26%	26%
K4	-	-	30	30	30%	30%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit	Description	Hours	Mode
Unit I	Nomenclature of organometallic compounds – Definition	4	Chalk and talk, Power Point presentation
	Classificatin of ligands on the basic of the number of electrons contributed by the ligand for the metal	3	
	carbon bond –Inert gas rule or 18 electron rule	3	
	Counting of effectives numbers of electrons-Basis for the 18 electron rule -Explanation for exceptions to the 18- electron rule.	5	
Unit II	Synthesis, Structure and Bonding-PSOly nuclear carbonyls –nitrosyl-dinitrogen complexes	4	Chalk and talk, Power Point presentation
	metal carbenes-carbynes-alkenes-alkynes-allyl complexes	3	
	ferrocene-uses of organo metallic compounds .	3	
	Reaction of organometallic complexes Mechanism of substitution reaction in carbonyl complexes –ligand cone angles –Mechanism oxidative addition reductive elimination reactions reactions and insertion reaction.	5	
Unit III	Reactivity and Catalysis- Hydrogenation of olefins(Wilkinson's Catalyst)	3	Chalk and talk, Power Point presentation
	hydroformylation of olefins using cobalt or rhodium catalysts(The oxo Process)	3	
	oxidation of olefins to aldehydes and ketones (Wacker's Process)	3	
	PSOlymerization of olefins(Zeiglar-Natta Catalyst).	3	
	Cyclooligomerization of acetylenes(Reppe Wilke's catalysts).	3	
Unit IV	Structure of solids-Crystalline and Amorphous solids-size and shape of crystals	4	Chalk and talk, Power Point presentation
	space lattice and unit cell-Types of crystals	4	
	Structure of diamond-Close packing of identical solid sphere	3	

	Limiting radius ratio-radius ratio rule and shape of ionic crystal-structure of NaCl-ZnS crystals (Zinc blende and Wurtzite Structure)-CsCl crystal –TiO_2 Crystal(Rutile).	4	
Unit V	Crystal Defects-Defects-Structures of crystals –schottky defect –Frenkel defect –Metal excess defects-Metal deficiency defects-Thermal defects	6	Chalk and talk, Power Point presentation, Group Discussion
	Band theory, Hall Effect	4	
	Semiconductors-types of Semiconductors-Photovoltoic effect Semiconductors in solar energy conservation	3	
	Fabrication of transistors.	2	

Course Designed by 1. Dr.M.S.Dheenadayalan 2. Mrs.A.Mariammal

Programme	M.Sc Chemistry	Programme Code	PCH
Course Code	20PCHC23	Number of Hours/Cycle	5
Semester	II	Max. Marks	100
Part	III	Credit	5
Core Course VII			
Course Title	Physical Chemistry – II		
Cognitive level Up to K4			

Preamble

This course provides the fundamentals of quantum chemistry and quantum Mechanics. This course also focus the concepts of quantum theory and electrochemistry. The Importance of ionics to electrochemistry and applications are discussed. Basic concepts of Phase rule and preparation of colloids and applications of micelles for various fields.

Unit 1- Quantum Chemistry-I **15 Hours**

Exponential functions, vectors, matrices, determinants, and differentiation, Integration and differential equations. Introduction to quantum mechanics - Black body radiation, photoelectric effect, de Broglie equation and its verification, Interpretation of Bohr's Postulate in terms of wave nature of electron, Heisenberg Uncertainty principle; Setting up the Schrödinger equation, operators, algebra of operators, linear operators.

Unit 2- Quantum Chemistry-II **15 Hours**

Setting up operators of linear momentum, angular momentum, kinetic energy and total energy of systems. Writing the Hamiltonian for H and He atoms-Eigen functions and eigen values, proving that linear momentum and angular momentum operators are linear, Hermitian operator and its properties, commutator theorem and its converse, Expansion theorem; Postulates of quantum mechanics.

Unit 3- Quantum Chemistry-III **15 Hours**

The Schrödinger wave equation- particles in 1D and 3D boxes, harmonic oscillator, rigid rotator- Time dependent Schrödinger wave equation- Approximation methods - Perturbation Theory (first order and non-degenerate), The Variation method, linear variation principle, Helium - Hartree-Fock self-consistent field method**.**

Unit 4- Quantum Chemistry-IV **15 Hours**

Approximate methods of solving the Schrodinger equation – The perturbation and variation methods – Angular momentum– spin orbit interaction – vector model of the atom – term symbols - Pauli Exclusion Principle Slater determinant. Atomic Structure Calculation - distortion of the box and Jahn-Teller effect, quantum numbers, zero-point energy, finite potential barrier – tunneling.

Unit 5- Phase rule **15 Hours**

Three component systems – representation by triangular diagrams, systems of three liquids – formation of one pair of partially miscible liquids, formation of two pairs of partially miscible liquids, formation of three pairs of partially miscible liquids – solid-liquid phases, Eutectic systems.

Pedagogy

Class Room Lectures, Power Point presentation, Group Discussion, Seminar, Quiz, Assignments, Experience Sharing, Case Study.

Text Books

1. Puri B.R, Sharma L.R and Pathania M.S, "*Principles of Physical Chemistry"* (Millennium Edition.) Vishal Publishing Co. (2003).
2. N. Levine*, "Quantum Chemistry*" Ira; Prentice Hall; (2000).
3. D.A. McQuarrie, "*Quantum chemistry"*, University Science Books, Mil Valley California (1983).

Reference Books

1. Atkins P.W (1986), "*Molecular Quantum Mechanics"*, 2nd Edition, Oxford University

Press.
2. Chandra A.K (1998), "*Introductory Quantum Chemistry"*, 3rd Edition, Tata McGraw Hill Publishing Co., New Delhi.
3. Hanna M.W (1969), *Quantum Mechanics in Chemistry*, 2nd Edition, The Benjamin Cummings Publishing Co., London.

E-Resources

- Lange's Handbook of Chemistry.
- Nature Physical Chemistry.
- Annual Review of Physical Chemistry.
- Smithsonian Physical Tables.
- Hawley's Condensed Chemical Dictionary.

Course Outcomes

On successful completion of the course, the student will be able to

CO1	Recall Fundamentals of quantum chemistry
CO2	Apply Basic Mathematics to Quantum Chemistry
CO3	Analyze and distinguish Quantum theory with classical theory
CO4	Summarizing the Equations and its verifications and conclude the answers
CO5	Compare and discover the fundamentals of Phase rule and examine colloids and micelles

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**2**	**2**	**-**	**2**	**2**	**-**
CO2	**2**	**-**	**2**	**2**	**-**	**2**
CO3	**-**	**3**	**3**	**2**	**-**	**2**
CO4	**2**	**-**	**3**	**-**	**3**	
CO5	**2**	**2**	**3**	**2**	**2**	**2**

1 – Low, 2 – Medium & 3- High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**Cos**	**K – Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Open Choice**
			No. of Questions	**K-Level**	**No. of Questions**	**No. of Questions**
1	CO1	Up to K2	2	K1 & K2	2(K2&K2)	1(K2)
2	CO2	Up to K2	2	K1 & K2	2(K2&K2)	1(K2)
3	CO3	Up to K3	2	K1 & K2	2(K3&K3)	1(K3)
4	CO4	Up to K4	2	K1 & K2	2(K3&K3)	1(K4)
5	CO5	Up to K4	2	K1 & K2	2(K4&K4)	1(K3)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems
K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or Questions)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-	-	5	5%	5%
K2	5	16	20	41	41%	41%
K3	-	16	20	36	36%	36%
K4	-	8	10	18	18%	18%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit	Description	Hours	Mode
Unit I	Exponential functions, vectors, matrices, determinants, and differentiation	4	Chalk and talk, Power Point presentation
	Integration and differential equations. Introduction to quantum mechanics - Black body radiation	3	
	photoelectric effect, de Broglie equation and its verification, Interpretation of Bohr's Postulate in terms of wave nature of electron, Heisenberg Uncertainty principle;	5	
	Setting up the Schrödinger equation, operators, algebra of operators, linear operators.	3	
Unit II	Setting up operators of linear momentum, angular momentum	4	Chalk and talk, Power Point presentation
	kinetic energy and total energy of systems. Writing the Hamiltonian for H and He atoms- Eigen functions and eigen values	4	
	proving that linear momentum and angular momentum operators are linear, Hermitian operator and its properties, commutator theorem and its converse	5	
	Expansion theorem; Postulates of quantum mechanics.	2	
Unit III	The Schrödinger wave equation- particles in 1D and 3D boxes	4	Chalk and talk, Power Point presentation, Group Discussion.
	harmonic oscillator, rigid rotator- Time dependent Schrödinger wave equation	4	
	Approximation methods - Perturbation Theory (first order and non-degenerate),	3	
	The Variation method, linear variation principle, Helium - Hartree-Fock self-consistent field method**.**	4	
Unit IV	Approximate methods of solving the Schrodinger equation	4	Chalk and talk, Power Point presentation
	The perturbation and variation methods – Angular momentum– spin orbit interaction	3	
	vector model of the atom – term symbols - Pauli Exclusion Principle Slater determinant.	3	
	Atomic Structure Calculation - distortion of the box and Jahn-Teller effect, quantum numbers,	5	

	zero-Point energy, finite Potential barrier – tunneling.		
Unit V	Three component systems – representation by triangular diagrams	4	Chalk and talk, Power Point presentation.
	systems of three liquids – formation of one pair of partially miscible liquids	3	
	formation of two pairs of partially miscible liquids, formation of three pairs of partially miscible liquids	5	
	solid-liquid phases, Eutectic systems.	3	

Course Designed by 1. Dr.S.K.Selvaraj 2. Dr.S.Ignatius Arockiam

Programme	**M.Sc Chemistry**	**Programme Code**	**PCH**
Course Code	**20PCHC24**	**Number of Hours/Cycle**	**5**
Semester	**II**	**Max. Marks**	**100**
Part	**III**	**Credit**	**5**
Core Course VIII			
Course Title	**Analytical Method - II**		
Cognitive Level Up to K4			

Preamble:

This course deals with the basic introduction about chromatography and to learn the different chromatographic Techniques like column, paper, thin layer, Gas Liquid, High Performance Liquid and Ion Exchange chromatographic Techniques and discussed its applications.

Unit I Paper Chromatography **15 Hours**

Principle, papers as a chromatographic medium, modified papers, solvent systems, mechanism of paper chromatography, experimental technique, different development methods-ascending, descending, horizontal, circular spreading, multiple development, two dimensional development, reverse phase paper chromatographic technique-visualization and evaluation of chromatograms, applications.

Unit II Thin Layer Chromatography **15 Hours**

Thin layer chromatography: principle, chromatographic media-coating materials, applications, activation of adsorbent, sample development, solvent systems, development of chromatoplate, types of development, visualization methods, documentation, applications in the separation.

Unit III Gas Liquid Chromatography **15 Hours**

Gas-liquid Chromatography, Principles, Retention Volumes, Instrumentation, Carrier Gas, Columns, Stationary Phase, types of Detectors, Thermal Conductivity, Flame Ionization, Electron Capture, Retention time, Application of G.L.C.

Unit IV High Performance Liquid chromatography **15 Hours**

High Performance Liquid chromatography: Scope, Column efficiency, Instrumentation, Pumping Systems, Columns, Column packing, Detectors, Applications. Ion exchange and gel – permeation chromatography. Application of HPLC.

Unit V Ion Exchange Chromatography **15 Hours**

Ion Exchange: principles of ion-exchange systems, synthetic ion-exchange resins, properties of anion and cation exchange resins, ion-exchange mechanism, ion exchange equilibria, selectivity, ion-exchange capacity, applications of ion exchangers in different fields.

Ion exchange chromatography: Principle, Equipment, Application Specifically Separations of Lanthanides, Actinides, amino acids.

Pedagogy

Class Room Lectures, Power Point presentation, Group Discussion, Seminar, Quiz, Assignments, Experience Sharing, Case Study.

Text Books

1. J. Huheey, (1983), "*Inorganic Chemistry"*, Harper and Collins, NY.4th Edition.
2. B.K. Sharma, (2000),"*Instrumental methods of chemical analysis"*, Goel publishing House, 19thEdition.
3. F.A. Cotton and G. Wilkinson,(1998), "*Advanced Inorganic Chemistry"*- A Comprehensive Text, John Wiley and Sons, 5thEdition.

Reference Books

1. H.J. Arnikar, 1987, *Nuclear Chemistry*, Wiley Eastern Co. II Edition.
2. M.C. Day and J. Selbin, 1974, *Theoretical Inorganic Chemistry*, Van Nostrand Co., New York.

3. D.F. Shrivers, P.W. Atkins and C.H. Langfor, 1990,*Inorganic Chemistry*,Freeman, New York.

E-Resources:

- Encyclopedia of Industrial Chemistry.
- Annual Review of Analytical Chemistry.
- Substance searching.
- Reaction searching.
- ChemSpider.

Course Outcomes

On successful completion of the course, the student will be able to

CO1	Apply the basic concepts of Paper Chromatography into the chemical industry.
CO2	Organize the basic concepts of Thin layer Chromatography and to apply various field.
CO3	Examine the gas liquid chromatography and to develop the various fields.
CO4	Simplify and Analyze the HPLC and utilize in to the research sides.
CO	Investigate the ion exchange chromatography and to apply various field.

Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**2**	**2**	**0**	**3**	**3**	**0**
CO2	**2**	**2**	**3**	**0**	**3**	**0**
CO3	**0**	**3**	**0**	**2**	**0**	**3**
CO4	**2**	**0**	**3**	**0**	**3**	**0**
CO5	**2**	**3**	**0**	**2**	**3**	**2**

1 – Low, 2 – Medium & 3- High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**COs**	**K – Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Open Choice**
			No. of Questions	**K-Level**	**No. of Questions**	**No. of Questions**
1	CO1	Up to K3	2	K1 & K2	2(K2&K2)	1(K2)
2	CO2	Up to K3	2	K1 & K2	2(K3&K3)	1(K3)
3	CO3	Up to k3	2	K1 & K2	2(K3&K3)	1(K3)
4	CO4	Up to K4	2	K1 & K2	2(K3&K3)	1(K4)
5	CO5	Up to K4	2	K1 & K2	2(K4&K4)	1(K4)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented

K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section –wise Marks with K Levels

K Levels	**Section A (No Choice)**	**Section B (Either/or Choice)**	**Section C (Open Choice)**	**Total Marks**	**% of Marks without choice**	**Consolidated (Rounded off)**
K1	5	-	-	5	5%	5%
K2	5	8	10	23	23%	23%
K3	-	24	20	44	44%	44%
K4	-	8	20	28	28%	28%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit	Description	Hours	Mode
Unit I	a) Principle, papers as a chromatographic medium, modified papers, solvent systems b) Mechanism of paper chromatography, experimental technique, different development methods-ascending, descending, horizontal, circular spreading, c) Multiple development, two dimensional development, reverse phase paper chromatographic technique-visualization and evaluation of chromatograms, applications.	5 5 5	Chalk and talk, Power Point presentation, Group Discussion
Unit II	a) Thin layer chromatography: principle, chromatographic media-coating materials, applications. b) Activation of adsorbent, sample development, solvent systems, development of chromatoplate. c) Types of development, visualization methods, documentation, applications in the separation.	5 5 5	Chalk and talk, Power Point presentation, Group Discussion
Unit III	a) Principles, Retention Volumes, Instrumentation. b) Gas-liquid Chromatography, Carrier Gas, Columns, Stationary Phase c) Types of Detectors, Thermal Conductivity, Flame Ionization, Electron Capture, Retention time, Application of G.L.C.	5 5 5	Chalk and talk, Power Point presentation, Group Discussion
Unit IV	a) High Performance Liquid chromatography: Scope, Column efficiency, b) Instrumentation, Pumping Systems, Columns, Column packing, Detectors, Applications. c) Ion exchange and gel – permeation chromatography. Application of HPLC.	5 5 5	Chalk and talk, Power Point presentation, Group Discussion
Unit V	a) Ion Exchange: principles of ion-exchange systems, synthetic ion-exchange resins, properties of anion and cation exchange resins. b) Ion-exchange mechanism, ion exchange equilibria, selectivity, ion-exchange capacity, applications of ion exchangers in different fields. c) Ion exchange chromatography: Principle, Equipment, Application Specifically Separations of Lanthanides, Actinides, amino acids.	5 5 5	Chalk and talk, Power Point presentation, Group Discussion

Course Designed by 1. Mr.S.Philip Arockiaraj 2. Mrs.M.Shanmugapriya

Programme	M.Sc Chemistry	Programme Code	PCH
Course Code	20PCHC2P	Number of Hours/Cycle	10
Semester	II	Max. Marks	100
Part	III	Credit	5
Core Practical II			
Course Title	Inorganic Chemistry Practical		

Preamble

This is a laboratory course that deals with the principles and methods of qualitative analysis of common and less common cations present in a mixture and various analytical methods of quantitative analysis of cations present in a mixture.

Component 1

Theoretical principles

1. Classification of cations into analytical groups and classification with in each analytical group.
2. Confirmatory and spot test for cations – Chemistry of reactions. Semimicro qualitative analysis mixtures of four simple salts containing two common cations and two less common cations with non-interfering anions.

Common cations of

Group I : Pb and Hg;
Group II : Hg, Cu, Cd, Bi, Sb, As, and Sn;
Group III : Al, Fe, and Cr;
Group IV : Mn, Zn, Co, and Ni
Group V : Ca, Sr, and Ba
Group VI : Mg, K, and NH4

Less common cations of

Group I : W and Tl;
Group IA : Se and Te;
Group II : Mo;
Group III : Be, Tl, Ce, Ti, Th, Zr, V, and U;
GroupVI : Li - Systematic separation of cations into analytical groups followed by identification of individual cations.

Component 2

1. Estimation of Copper and Nickel by gravimetric method
2. Estimation of Copper and Zinc by gravimetric method
3. Estimation of Barium and Calcium by gravimetric method

Pedagogy

Demonstration, Experience Sharing, Laboratory experiments/teaching aids, Self-learning such as use of NPTEL materials and internets, Simulation.

Text Books

1. Ramanujam V.V, *Inorganic Semimicro qualitative analysis*, 3rd Edition, National Publishing company, (1974)

Reference Books

1. Arthur I.Vogel, *Elementary Practical Organic Chemistry (Part 1, 2 and 3)*, CBS Publishers and Distributors, New Delhi,5th Edition, (1989).
2. Mukhopadhyay R. &Chatlerjee P, "*Advanced Practical Chemistry"*,Book & Allied (p) ltd (2007).
3. J.Men dham, R.C Denney, M.J.K Thomas Darid & J Bares, Vogels quantitative chemical analysis, 6th edition prentice hall (2000).

E-Resources

- Inorganic syntheses.
- Science of synthesis.
- Nature Inorganic Chemistry.
- Annual Review of Inorganic Chemistry
- International Union of Pure and Applied Chemistry.

Internal: 40 Marks **and External** 60 Marks **- 6 Hours Practical**

Course Outcomes

On successful completion of the course, the student will be able to

CO1	Summarise the principle of distribution of common and less common cations in different groups
CO2	Demonstrate reactions for identification of cations
CO3	Identify the principle of methods of cation estimation
CO4	Develop analytical skill in the field of separation of cations from mixture.
CO5	Examine the principle of methods of cation estimation

Course Designed by 1. Dr.A.Pandiarajan 2. Dr.M.S.Dheenadayalan

Programme	M.Sc Chemistry	Programme Code	PCH
Course Code	20PCHC31	Number of Hours / Cycle	4
Semester	III	Max. Marks	100
Part	III	Credit	4

Core Course IX

Course Title	Organic Chemistry III	L	T	P
Cognitive Level	K3	60		

L- Lecture Hour, T – Tutorial Hour, P – Practical Hour

Preamble

This course deals the concepts of various Spectroscopic techniques and its applications in organic molecules, Characterization of organic compounds by UV and IR, and also has advanced knowledge in NMR spectroscopy, to know the basic principles involved in mass spectrometry, to know the structure and synthesis of antibiotics.

Unit I	**UV-Visible Spectroscopy and IR Spectroscopy**	**12 Hours**
	Beer- Lambert Law, Effect of solvent on electronic transitions, Fisher - Woodward rules for conjugated dienes and carbonyl compounds, ultra violet spectra of aromatic and heterocyclic compounds. Applications of UV- visible spectroscopy in organic chemistry. Molecular vibrations- factors influencing vibrational frequencies, Applications of IR spectroscopy to organic compounds – group frequency concept- hydrogen bonding- effect of inductive and mesomeric effects.	
Unit II	**Nuclear Magnetic Resonance Spectroscopy (^{1}H NMR)**	**12 Hours**
	Origin of NMR spectra, chemical shift, spin coupling, coupling constant, spin decoupling, shift reagents, Simplification of complex spectra, nuclear magnetic double resonance, Karplus equation, Spin systems (AX, AX2, AX3), Rate processes, Nuclear Overhauser effect (NOE).	
Unit III	**Nuclear Magnetic Resonance Spectroscopy (^{13}C NMR)**	**12 Hours**
	Chemical shifts, Effect of substituent on chemical shifts, Off-resonance decoupling, Two dimensional NMR spectroscopy - COSY, HETCOR, ROESY, NOESY, and TOCSY, Inadequate techniques. Pulse sequences of various 2D NMR spectroscopic techniques.	
Unit IV	**Mass Spectroscopy and Chiro Optical Methods**	**12 Hours**
	Principle – type of ions, fragmentation of different functional groups, molecular ion peak, isotopic peaks, metastable peak, Nitrogen rule, McLafferty rearrangement, Retro-Diels-Alder reaction. ORD and CD, Principle, Cotton effect, type of ORD curves, α-haloketone rule, Octant rule, comparison of ORD and CD.	
Unit V	**Oxidation And Reduction**	**12 Hours**
	Oxidation reaction involving – SeO_2, OsO_4, Lead tetra acetate, Oppenaver oxidation. Reduction reaction involving – sodium borohydride, Brich reduction, Meerwein Pondorf-Verely reduction – Wolf-krishner reduction, Huang-Minlon modification, Hydroboration. Reagents in organic synthesis – Merrified resin, phase transfer catalysts, Peterson's synthesis, Baker yeast.	

Pedagogy

Lecture by use of boards, LCD projectors, Assignments, Seminars, Group Discussion, Self- learning such as use of NPTEL materials and internets, Simulation.

Text Book

1. Jeg Mohan, (2014), "Organic Spectroscopy Principles and Applications", Alpha Science International Ltd, Harrow, U.K, Second Edition.
2. Banwell C.N, Mccash E.M, (2010), "Fundamentals of Molecular Spectroscopy", Tata Mcgraw-Hill Publishing Company Ltd, New Delhi, Fourth Edition.
3. Kalsi P.S, (2016) "Spectroscopy of Organic Compounds", New Age International Publishers, New Delhi, 6th Edition.

Reference Books

1. Silverstein R.M, Webster F.X, Kiemle D.J, (2015), "Spectrometric identification of organic compounds", John Wiley & Sons, New Delhi. 6th Edition.
2. Kemp W, (2017), "Organic Spectroscopy", ELBS London, 2nd Edition.
3. Jerry March, John Wiley & Sons, 7th edn., 2015, Advanced Organic Chemistry,.

E-Resources

- https://en.wikipedia.org/wiki/Spectroscopy#
- https://www.youtube.com/watch?v=MW4PwJxxyt0
- https://www.youtube.com/watch?v=a2FgqSPGLSg
- https://www.youtube.com/watch?v=H6_GgJN39vY
- https://www.cif.iastate.edu/mass-spec/ms-tutorial#
- https://www.youtube.com/watch?v=dF5lB7gRtcA

Course Outcomes

On successful completion of the course, the student will be able to

No.	Course Outcome
CO1	Elucidate the structure of organic compounds by using UV-Visible Spectroscopy & IR spectroscopy
CO2	Interpretation of the Nuclear Magnetic Resonance Spectroscopy (^{1}H NMR)
CO3	Details of ^{13}C Nuclear Magnetic Resonance Spectroscopy
CO4	Explain fragmentation of different functional group in Mass spectroscopy
CO5	Inference the Mechanism of oxidation and reduction reaction

Mapping of Course OutcomesMapping of Bloom's Taxonomy – Programme Outcome with Course Outcome

	PSO1	PSO 2	PSO3	PSO4	PSO5	PSO6
CO1	2	3	2	2	2	1
CO2	2	2	3	2	1	2
CO3	2	2	2	2	1	2
CO4	3	3	3	1	2	1
CO5	2	2	2	2	3	3

1. Low, 2. Medium & 3. High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Upto K3	2	K1 & K2	2(K2&K2)	1(K3)
2	CO2	Upto K3	2	K1 & K2	2(K3&K3)	1(K2)
3	CO3	Upto K3	2	K1 & K2	2(K2&K2)	1(K3)
4	CO4	Upto K3	2	K1 & K2	2(K3&K3)	1(K2)
5	CO5	Upto K3	2	K1 & K2	2(K2&K2)	1(K3)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-	-	5	5	5%
K2	5	24	20	49	49	49%
K3	-	16	30	46	46	46%
Total Marks	10	40	50	100	100	100%

Lesson Plan

Unit I	UV-Visible Spectroscopy and IR Spectroscopy	12 Hours	Mode
	a) Beer- Lambert Law, Effect of solvent on electronic transitions, Fisher- Woodward rules for conjugated dienes and carbonyl compounds. b) Ultra violet spectra of aromatic and heterocyclic compounds. Applications of UV-visible spectroscopy in organic chemistry. c) Molecular vibrations. Factors influencing vibrational frequencies, Applications of IR spectroscopy to organic compounds. Group frequency concept- hydrogen bonding- effect of inductive and mesomeric effects.	4 4 4	Chalk and talk, Power point presentation
Unit II	**Nuclear Magnetic Resonance Spectroscopy (^{1}H NMR)**	**12 Hours**	**Mode**
	a) Origin of NMR spectra, chemical shift, spin coupling, coupling constant, Spin decoupling, shift reagents, b) Simplification of complex spectra, Nuclear magnetic double resonance, Karplus equation, c) Spin systems (AX, AX2, AX3), Rate processes, Nuclear Overhauser effect (NOE).	4 4 4	Chalk and talk, Power point presentation

Unit III	**Nuclear Magnetic Resonance Spectroscopy (^{13}C NMR)**	**12 Hours**	
	a) Chemical shifts, Effect of substituent on chemical shifts, Off-resonance decoupling, b) Two dimensional NMR spectroscopy - COSY, HETCOR, ROESY, NOESY, and TOCSY c) Inadequate techniques. Pulse sequences of various 2D NMR spectroscopic techniques.	4 4 4	Chalk and talk, Power point presentation
Unit IV	**Mass Spectroscopy and Chiro Optical Methods**	**12 Hours**	
	a) Principle – type of ions, fragmentation of different functional groups, molecular ion peak b) Isotopic peaks, metastable peak, Nitrogen rule, McLafferty rearrangement, Retro-Diels-Alder reaction. c) ORD and CD, Principle, Cotton effect, type of ORD curves, α- haloketone rule, Octant rule, comparison of ORD and CD.	4 4 4	Chalk and talk, Power point presentation, Group Discussion
Unit V	**Oxidation And Reduction**	**12 Hours**	
	a) Oxidation reaction involving – SeO_2, OsO_4, Lead tetra acetate, Oppenaver oxidation. b) Reduction reaction involving – sodium borohydride, Brich reduction, Meerwein Pondorf-Verely reduction – Wolf-krishner reduction, Huang-Minlon modification, Hydroboration. c) Reagents in organic synthesis – Merrified resin, phase transfer catalysts, Peterson's synthesis, Baker yeast.	4 4 4	Chalk and talk, Power point presentation, Group Discussion

Course Designed by Dr.A.Pandiarajan and Dr.M.S.Dheenadayalan

Programme	M.Sc Chemistry	Programme Code	PCH
Course Code	20PCHC32	Number of Hours / Cycle	4
Semester	III	Max. Marks	100
Part	III	Credit	4

Core Course X				
Course Title	Inorganic Chemistry III	L	T	P
Cognitive Level	K4	60	-	-

L- Lecture Hour, T – Tutorial Hour, P – Practical Hour

Preamble

The course was enabled the students to Analyze the inorganic compounds using various spectroscopic techniques and to have the knowledge on understand the types of spectroscopy.

Unit I	**Infrared Spectroscopy**	**12 Hours**
	Spectroscopy in the structural elucidation of simple molecules like N_2O, ClF_3, NO_3^-, ClO_4^- – effect of coordination on ligand vibrations – uses of groups vibrations in the structural elucidation of metal complexes of urea, thiourea, cyanide, thiocyanate, nitrate, sulphate and dimethyl sulfoxide	
Unit II	**NMR Spectroscopy**	**12 Hours**
	Examples for different spin systems – chemical shifts and coupling constants (spin-spin coupling) involving different nuclei (^1H, ^{19}F, ^{31}P, ^{13}C) interpretation and applications to inorganic compounds-NMR spectra of P_4S_3,H_3PO_3,H_3PO_2 and HPF_2. ^{19}F NMR spectra of ClF_3, BrF_3 and equimolar mixture of TiF_6 and TiF_4 in ethanol – Effect of quadrupolar nuclei on the ^1H NMR spectra, Satellite spectra. Systems with chemical exchange - study of fluxional behavior of molecules NMR of paramagnetic molecules – isotropic shifts contact and pseudo-contact interactions – Lanthanide shift reagents.	
Unit III	**EPR Spectroscopy**	**12 Hours**
	Theory of EPR spectroscopy - Spin densities and McConnell relationship –presentation of the spectrum-hyperfine splitting, Applications of ESR to some simple systems such as CH_3,*p*-benzosemiquinone, Xe^{2+} - Factors affecting the magnitude of g and A tensors in metal species - Zero-field splitting and Kramers degeneracy – Spectra of VO(II), Mn(II), Fe(III), Co(II), Ni(II) and Cu(II) complexes	
Unit IV	**Photoelectron spectroscopy (PES)**	**12 Hours**
	Theory – XPS. UV-PES – instrumentation evaluation of Ionization potential – Chemical identification of elements – Koopmann's theorem – chemical shift – UPS – XPES of N_2, O_2 and HCL - evaluation of vibrational constants from UPS – spin orbit coupling – Auger spectroscopy – Principle and its applications.	
Unit V	**Mossbauer Spectroscopy**	**12 Hours**
	Theory - Mossbauer effect resonance absorption – Doppler effect – Doppler velocity – Experimental technique of measuring resonance absorption – isomer shift – magnetic hyperfine splitting, quadruple splitting – application of Mossbauer spectroscopy in the study of iron complexes (Fe_2O_3), $FeSO_4.7H_2O$, $FeCl_3$.	

Pedagogy

Class Room Lectures, Power point presentation, Group Discussion, Seminar, Quiz, Assignments, Experience Sharing, Brain storming, Activity, Case Study

Text Book

1. R.S. Drago, Physical Methods in Inorganic Chemistry, 3rd Ed., Wiley Eastern Company
2. E.A.V. Ebsworth, Structural Methods in Inorganic Chemistry, 3rd Ed., ELBS, 1987.
3. J. E. Huheey, Ellen A. Keiter, Richard L. Keiter, 2004.Inorganic Chemistry, Pearson Education (Singapore) Pte. Ltd., IV Edn., Delhi.

Reference Books

1. R. S. Drago, Physical Methods in Chemistry, W. B. Saunders Company, 1992.
2. R. S. Drago, Physical Methods in Chemistry, Saunders Golden Sunburst, London, 1977
3. Khulbe KC, Matsuura T, Singh S, Lamarche G, Noh SH. Study on fouling of ultra filtration membrane by electron spin resonance. J Membr Sci 2000; 167:263e73.

E-Resources

- https://edu.rsc.org/resources/spectroscopy-in-a-suitcase-ir-students-resources/283.artcle
- http://mriquestion.com/who-discover-nmr.html
- https://en.m.wikipedia.org/wiki/Electron_Paramagnetic_Resonance
- https://chem.libretexts.org/Bookshelves/Inorganic_chemistry/
- https://en.m.wikipedia.org/wiki/M%C3%B6SSbauer_spectroscopy

Course Outcomes

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

CO1	Illustrate the structural elucidation of metal complexes and its uses.
CO2	Identify the different spin systems of NMR spectra involving different nuclei (^{1}H, ^{19}F, ^{31}P, ^{13}C) interpretation and applications to inorganic compounds.
CO3	Construct the Theory of EPR spectroscopy to some simple systems of metal complexes and its Applications.
CO4	Classify the Theories of XPS, UV,PES its Principle, instrumentation evaluation of Ionization potential ,vibrational constants from UPS and its applications
CO5	Analyze the Experimental technique of measuring resonance absorption and application of Mossbauer spectroscopy in the study of iron complexes.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	1	3	2	2
CO2	2	2	2	3	2	3
CO3	2	3	2	2	3	2
CO4	3	2	2	2	2	2
CO5	2	2	1	2	1	2

1.Low, 2.Moderate & 3.High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Up to K3	2	K1&K2	2(K2&K2)	1(K3)
2	CO2	Up to K3	2	K1&K2	2(K3&K3)	1(K2)
3	CO3	Up to K3	2	K1&K2	2(K2&K2)	1(K3)
4	CO4	Up to K4	2	K1&K2	2(K3&K3)	1(K4)
5	CO5	Up to K4	2	K1&K2	2(K3&K3)	1(K4)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems
K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section - wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-	-	5	5	5%
K2	5	16	10	31	31	31%
K3	-	24	20	44	44	44%
K4	-	-	20	20	20	20%
Total Marks	10	40	50	100	100	100%

Lesson Plan

Unit-I	Infrared Spectroscopy	12 Hours	MODE
	a) Spectroscopy in the structural elucidation of simple molecules like N_2O, ClF_3. b) Spectroscopy in the structural elucidation of simple molecules like NO_3^-, ClO_4^- effect of coordination on ligand vibrations c) Uses of groups vibrations in the structural elucidation of metal complexes of urea, thiourea, d) Uses of groups vibrations in the structural elucidation of metal complexes of cyanide, thiocyanate, nitrate e) Uses of groups vibrations in the structural elucidation of metal complexes of nitrate, sulphate and dimethyl sulfoxide	2 2 2 3 3	Chalk and talk, Power point presentation
Unit-II	**NMR Spectroscopy**	**12 Hours**	
	a)Examples for different spin systems – chemical shifts and coupling constants (spin-spin coupling) involving different nuclei (^1H, ^{19}F, ^{31}P, ^{13}C) interpretation and applications to inorganic compounds	3	Chalk and talk, Power point presentation

	b)NMR spectra of P_4S_3,H_3PO_3,H_3PO_2 and HPF_2 c)^{19}F NMR spectra of ClF_3, BrF_3 and equimolar mixture of TiF_6 and TiF_4 in ethanol d) Effect of quadrupolar nuclei on the ^1H NMR spectra, Satellite spectra. Systems with chemical exchange e) Study of fluxional behavior of molecules NMR of paramagnetic molecules – isotropic shifts contact and pseudo-contact interactions – Lanthanide shift reagents.	2 2 2 3	
Unit-III	**EPR Spectroscopy**	**12 Hours**	
	a)Theory of EPR spectroscopy ,Spin densities and McConnell relationship, presentation of the spectrum-hyperfine splitting b) Applications of ESR to some simple systems such as CH_3, *p*-benzosemiquinone, Xe^{2+} c) Factors affecting the magnitude of g and A tensors in metal species, Zerofield splitting and Kramers degeneracy d) Zero-field splitting and Kramers degeneracy, Spectra of VO(II), Mn(II), Fe(III), e) Zero-field splitting and Kramers degeneracy, Spectra of Co(II), Ni(II) and Cu(II) complexes	3 2 2 2 3	Chalk and talk, Power point presentation
Unit -IV	**Photoelectron spectroscopy (PES)**	**12 Hours**	
	a) Theory – XPS. UV - PES – instrumentation evaluation of Ionization potential b) Chemical identification of elements – Koopmann's theorem c) Chemical shift –UPS – XPES of N_2, O_2 and HCL d) Evaluation of vibrational constants from UPS e) Spin orbit coupling, Auger spectroscopy Principle and its applications.	3 2 3 2 2	Chalk and talk, Power point presentation
Unit-V	**Mossbauer Spectroscopy**	**12 Hours**	
	a) Theory Mossbauer effect resonance absorption, Experimental technique of measuring resonance absorption b) Doppler effect, Doppler velocity c) isomer shift, magnetic hyperfine splitting, quadruple splitting d) Application of Mossbauer spectroscopy in the study of iron complexes. e) Application of Mossbauer spectroscopy in the study of iron complexes (Fe_2O_3), $FeSO_4.7H_2O$, $FeCl_3$.	3 2 2 2 3	Chalk and talk, Power point presentation

Course designed by Dr.M.S.Dheenadayalan and Mrs.A.Mariammal

Programme	M.Sc Chemistry	Programme Code	PCH
Course Code	20PCHC33	Number of Hours / Cycle	4
Semester	III	Max. Marks	100
Part	III	Credit	4

Core Course XI				
Course Title	Physical Chemistry III	L	T	P
Cognitive Level	Up to K4	60	-	-

L- Lecture Hour, T – Tutorial Hour, P – Practical Hour

Preamble

This course brings forth various concepts of group theory and different principles of in it. It can provide the applications of group theory. The course provide discussed about various concepts instrumentations of spectroscopy in chemistry and application.

Unit I	**Group Theory I**	**12 Hours**
	Molecular symmetry elements and symmetry operations – vector and matrix algebra – symmetry operations and transformation matrices – Group – definition and properties of a group– symmetry point groups- representation of a group – reducible and irreducible representations-Great orthogonality theorem- characters – construction of character tables- C_4V, C_2h and D_2d – Direct product concept.	
Unit II	**Group Theory II**	**12 Hours**
	Symmetry of normal modes of vibration, application of group theory to normal modes of vibrations and analysis – symmetry properties of integrals – application for spectral selection rules of vibration spectra. Symmetry of molecular orbital and symmetry selection rule for electronic transitions in simple molecules like ethylene, formaldehyde and benzene. Wave functions as the basis of irreducible and delocalization energy for cyclopropenyl, butadiene and benzene system.	
Unit III	**Spectroscopy I**	**12 Hours**
	Electromagnetic spectrum – Types of molecular energies – Absorption and emission of radiation – Einstein‘s coefficient – induces emission and absorption – Rotational spectra of rigid diatomic molecules – isotope effect in rotational spectra – Microwave spectrometer – Informations derives from rotational spectra. Infrared spectroscopy – Vibrational energy of a diatomic molecule – infrared selection rules – diatomic vibration rotator – vibrations of polyatomic molecules – overtone, combination and difference bands – concept of group frequencies – coupling interaction- Fermi resonance Fourier transform infrared spectroscopy.	
Unit IV	**Spectroscopy II**	**12 Hours**
	Raman spectroscopy – Theories of Raman scattering – Rotational Raman spectra – Vibrational Raman spectra. Mutual exclusion principle – Laser Raman spectra – Electronic spectra of diatomic and polyatomic molecules- intensity of Vibrational electronic spectra – Franck– Condon principle rotation fine structure of electronic Vibrational spectra- the Fortratprapbola – Dissociation	

	and pre-dissociation spectra.	
Unit V	**Spectroscopy III**	**12 Hours**
	Magnetic properties of nuclei-resonance condition- NMR instrumentation – Relaxation processes – chemical shift – spin-spin splitting- quadrupole moment and electrical field nuclear quadrupole resonance, NQR – principles and applications –nuclear quadrupole coupling in atoms and molecules – identification of ionic character and hybridization- ENDOR, Overhauser effect , FT-NMR spectroscopy , Lanthanide shift reagents – NMR imaging. ESR – principles– hyperfine structure – ESR spectra of free radicals in solutions – Anisotropic systems – systems in triplet state Zero fields splitting in ESR and Krammers degeneracy.	

Pedagogy

Lecture by use of boards, LCD projectors, Assignments, Seminars, Group Discussion, Self- learning such as use of NPTEL materials and internets, Simulation.

Text Book

1. Peter Atkins and Julio de Paula (2018) Physical Chemistry, (11th edition) Oxford University Press.
2. Hofmann, and Andreas (2018) Physical Chemistry Essentials, springer publications.
3. Anatol Malijevsk´y, CSc., et al. (2010) Physical Chemistry In Brief, Institute of Chemical Technology, Prague Faculty of Chemical Engineering.

References Books

1. Aruldhas. G (2011), -Molecular Structure and Spectroscopy, Prentice Hall of India Pvt., Ltd New Delhi.
2. Gopinathan M.S & Ramakrishnan V (2013), Group Theory Applications to Quantum Chem, Spectroscopy & Ligand Field Theory
3. Soni, P. L. (2011) Text Book of Physical Chemistry, sulthan chand & sons.

E-Resources

- Annual Review of Physical Chemistry.
- Smithsonian Physical Tables.
- Lange's Handbook of Chemistry.
- Nature Physical Chemistry.
- Hawley's Condensed Chemical Dictionary.
- Chem.Libretexts.Org

Course Outcomes

On successful completion of the course, the student will be able to

CO1	Infer the fundamentals of group theory
CO2	Apply the Principles of group theory to various compounds
CO3	Analyze the Applications of molecular spectroscopy
CO4	Categorize the various instrumental techniques in molecular spectroscopy
CO5	Interpret the various functions of spin resonance spectroscopy.

Mapping of Bloom's Taxonomy – Programme Outcome with Course Outcome

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	3	1	1
CO2	3	3	2	1	3	3
CO3	2	1	3	1	2	2
CO4	2	3	1	3	1	1
CO5	3	3	2	3	3	3

1. Low, 2.Medium & 3.High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	Cos	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Upto K2	2	K1 & K2	2(K2&K2)	1(K2)
2	CO2	Upto K3	2	K1 & K2	2(K3&K3)	1(K2)
3	CO3	Upto K4	2	K1 & K2	2(K2&K2)	1(K4)
4	CO4	Upto K4	2	K1 & K2	2(K3&K3)	1(K4)
5	CO5	Upto K3	2	K1 & K2	2(K2&K2)	1(K3)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems
K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-	-	5	5	5%
K2	5	24	20	49	49	49%
K3	-	16	10	26	26	26%
K4	-	-	20	20	20	20%
Total Marks	10	40	50	100	100	100%

Lesson Plan

Unit I	**Group Theory I**	**12 Hours**	**Mode**
	a) Molecular symmetry elements and symmetry operations – vector and matrix algebra b) Symmetry operations and transformation matrices – Group – definition and properties of a group c) Symmetry point groups- representation of a group – reducible and irreducible representations- Great orthogonality theorem- characters – construction of character tables- C_2V, C_3V, C_4V. d) Construction of character tables C_2h and D2d Direct product concept.	3 3 3 3	Chalk and talk, Power point presentation
Unit II	**Group Theory II**	**12 Hours**	**Mode**
	a) Symmetry of normal modes of vibration, application of group theory to normal modes of vibrations and to normal ,mode analysis — b) Symmetry properties of integrals – application for spectral selection rules of vibration spectra. c) Symmetry of molecular orbital and symmetry selection rule for electronic transitions in simple molecules like ethylene, formaldehyde and benzene. d). Wave functions as the basis of irreducible and delocalization energy for cyclopropenyl, butadiene and benzene system.	3 3 3 3	Chalk and talk, Power point presentation
Unit III	**Spectroscopy I**	**12 Hours**	**Mode**
	a) Electromagnetic spectrum – Types of molecular energies – Absorption and emission of radiation – Einstein‘s coefficient – induces emission and absorption. b) Rotational spectra of rigid diatomic molecules – isotope effect in rotational spectra – Microwave spectrometer c) Information’s derives from rotational spectra. Infrared spectroscopy – Vibrational energy of a diatomic molecule – infrared selection rules d) Diatomic vibration rotator – vibrations of polyatomic molecules – overtone, combination and difference bands – concept of group frequencies – coupling interaction- Fermi resonance Fourier transform infrared spectroscopy.	3 3 3 3	Chalk and talk, power point presentation
Unit IV	**Spectroscopy II**	**12 Hours**	**Mode**
	a) Raman spectroscopy – Theories of Raman scattering – Rotational Raman spectra – Vibrational Raman spectra. Mutual exclusion principle – Laser Raman spectra – Electronic spectra of diatomic and polyatomic molecules- intensity of vibrational electronic spectra b) Franck– Condon principle rotation fine structure of electronic vibrational spectra- the Fortratprapbola c) Dissociation and predissociation spectra. NQR –	3 3 3	Chalk and talk, power point presentation

	principles and applications – quadrupole moment and electrical field nuclear quadrupole resonance d) Nuclear quadrupole coupling in atoms and molecules – identification of ionic character and hybridization.	3	
Unit V	**Spectroscopy III**	**12 Hours**	**Mode**
	a) Magnetic properties of nuclei – Resonance condition – NMR instrumentation – Relaxation processes – Bloch equations b) Chemical shift – spin – spin splitting , relaxation times , line shape and line width experimental technique- c) END OR, Overhauser effect, FT-NMR spectroscopy, Lanthanide shift reagents – NMR imaging. ESR – principles of ESR – total Hamiltonian – hyperfine structure – d) ESR spectra of free radicals in solutions – Anisotropic systems – systems in triplet state Zero fields splitting in ESR and Krammers degeneracy.	3 3 3 3	Chalk and talk, power point presentation, Group Discussion

Course Designed by Dr.S.Ignatius Arockiam and Mrs.G.Benitta

Programme	M.Sc Chemistry	Programme Code	PCH
Course Code	20PCHE31	Number of Hours / Cycle	4
Semester	III	Max. Marks	100
Part	III	Credit	4

Core Elective Course – I A				
Course Title	Pharmaceutical Chemistry	L	T	P
Cognitive Level	Up to K4	60	-	-

L- Lecture Hour, T – Tutorial Hour, P – Practical Hour

Preamble

This course gives knowledge about metabolic drug development in anesthetics, sedatives, hypnotics, analgesics and antibiotics.

Unit I	**Fundamental of Pharmaceutical Chemistry**	**12 Hours**
	Definitions of Medicinal Chemistry, Pharmacology and molecular pharmacology – major process involved in drug action – pharmacokinetics phase – Quantitative structure Activity Relationship (QSAR) – Hansch approach – concept of bio isomerism – pharmacodynamics phase – receptors and classification of membrane bound receptors – enzyme inhibitors as drugs.	
Unit II	**Classification of drugs**	**12 Hours**
	Classification of drugs- Chemotherapeutic Agents - (5-fluorouracil, Cisplatin, Carnplatin), Antitubercular Drugs (Isoniazid, Rifampicin, Pyrazinamine) - Antimalarial Drugs (Chloroquin, Primaguine, Amaodiaquine) Antihypertensive Drugs (Nifedipine Captopril Hydralazine sodium nitropruside, clonidine methyldopa and guanothidine) –Antihistamines (Antagonists pheniramine, chlorpheniramine, Diphenylhydramine Mepyramine promethazine)	
Unit III	**Anti – Inflammatory Drugs**	**12 Hours**
	The fundamentals actions of Antipyrefics - fundamentals actions of Non- narcotic analgestics- Classification and synthesis of Aspirin, Sodium salicylate- synthesis of paracetamol and phenylbuttazone- Oxyphenlibutaxone and Ibuprofen- synthesis of Mephenamic acid and Diclofenac sodium	
Unit IV	**Antimalerials, Antiamoebic and Anti-infective agents**	**12 Hours**
	Antimalerials: Mechanism of action and SAR of Quinolone antimalarials, Synthesis of Chloroquin, Primaquin and Quinacrine. Antiamoebic agents: Introduction, Classification, and Mechanism of action and Synthesis of Metronidazole, Iodoquinol and Dimercaprol Anti-infective agents: Introduction, Classification, Mechanism of action, Synthesis and SAR of Nitrofurazone and Furazolidos	
Unit V	**Antibiotics and Steroids**	**12Hours**
	Structural features and mode of action of the following antibiotics – penicillin G, cephalosphorin and their semisynthetic analogsw (β-lactum), streptomycin (aminoglycoside), terramycine (tetracylin) , erythromycin (macrolide) and chloromphenicol. Physiologically active steroids – their structural features and therapeutic use. Oral contraceptive, anabolic steroids anti – inflammatory steroids.	

Pedagogy

Lecture by use of boards, LCD projectors, Assignments, Seminars, Group Discussion, Self- learning such as use of NPTEL materials and internets, Simulation.

Text Books

1. William O. Foye, Thomas L. Lemke, David A. Williams, Principles of Medicinal Chemistry, Lippincott Williams & Wilkins, 4th Edition, 1995.
2. Wilson & Gisvold's Textbook of Organic Pharmaceutical and Medicinal Chemistry, John.M. Beale and John. H. Block, Lippincott Williams & Wilkins, 10th Edition, 1998.
3. J.B Taylor and P.D. Kennewell, Introductory Medicinal Chemistry Ellisworth Publishers, 1985.

Reference Books

1. M.E. Wolf, Burger's Medicinal Chemistry and Drug Discovery: Therapautic Agents, Wiley Blackwell; 5th Edition edition, 1997.
2. G. L. Patrick, An introduction to Medicinal Chemistry II edn., Oxford University Press, 2001.
3. T. Nagradi Medicinal Chemistry – A Biochemical Approach, Oxford University Press 2004.

E-Resources

- https://en.wikipedia.org/wiki/Medicinal_chemistry
- https://www.nature.com/subjects/medicinal-chemistry
- https://en.m.wikipedia.org/wiki/Antibiotics and Steroids
- https:// en.m.wikipedia.org/wiki/ Anti – Inflammatory Drugs
- https://chem.libretexts.org/Bookshelves/Pharmacetical_chemistry

Course Outcomes

On successful completion of the course, the student will be able to

No.	Course Outcome
CO1	Learn about the fundamentals of the Pharmaceutial Chemistry
CO2	Learn about the Classification of drugs.
CO3	To know about the synthesis of Anti – Inflammatory Drugs
CO4	Examine the Antimalerials, Antiamoebic and Anti-infective agents
CO5	Explain about the synthesis of antibiotics and Steroids.

Mapping of Bloom's Taxonomy – Programme Outcome with Course Outcome

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	3	2	2	1
CO2	2	1	2	2	2	1
CO3	2	1	2	3	1	2
CO4	2	2	2	2	2	1
CO5	2	1	1	2	3	2

1. Low, 2. Medium & 3. High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	Cos	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Upto K2	2	K1 & K2	2(K2&K2)	1(K2)
2	CO2	Upto K3	2	K1 & K2	2(K2&K2)	1(K3)
3	CO3	Upto K3	2	K1 & K2	2(K2&K2)	1(K3)
4	CO4	Upto K4	2	K1 & K2	2(K3&K3)	1(K4)
5	CO5	Upto K3	2	K1 & K2	2(K3&K3)	1(K3)
No of Questions to be asked			10		10	05
No of Questions to be answered			10		05	03
Marks for each Question			01		04	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems
K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-	-	5	5%	5%
K2	5	24	10	39	39%	39%
K3	-	16	30	46	46%	46%
K4	-	-	10	10	10%	10%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit I	Fundamental of Pharmaceutical Chemistry	12 Hours	Mode
Unit I	a)Definitions of Medicinal Chemistry, Pharmacology and molecular pharmacology b) Major process involved in drug action – pharmacokinetics phase – Quantitative structure Activity Relationship (QSAR) c) Hansch approach – concept of bio isomerism – pharmacodynamics phase – receptors and classification of membrane bound receptors .Enzyme inhibitors as drugs.	3 4 5	Chalk and talk, Power point presentation, Group Discussion
Unit II	**Classification of drugs**	**12 Hours**	**Mode**

	a) Classification of drugs - Chemotherapeutic Agents- (5-fluorouracil, Cisplatin, Carnplatin) b) Antitubercular Drugs (Isoniazid, Rifampicin, Pyrazinamine)- Antimalarial Drugs (Chloroquin, Primaguine, Amaodiaquine) c) Antihypertensive Drugs (Nifedipine Captopril Hydralazine sodium nitropruside, clonidine methyldopa and guanothidine) d) Antihistamines (Antagonists pheniramine, chlorpheniramine, Diphenyl hydramine Mepyramine promethazine)	3 3 3 3	Chalk and talk, Power point presentation
Unit III	**Anti – Inflammatory Drugs**	**12 Hours**	**Mode**
	a)Fundamentals actions of Antipyrefics. The fundamentals actions of Non- narcotic analgestics. b) Classification and synthesis of Aspirin, Sodium salicylate. Synthesis of paracetamol and phenylbuttazone. c) Oxyphenlibutaxone and Ibuprofen. Synthesis of Mephenamic acid and Diclofenac sodium.	4 4 4	Chalk and talk, Power point presentation
Unit IV	**Antimalerials, Antiamoebic and Anti-infective agents**	**12 Hours**	**Mode**
	a) Antimalerials: Mechanism of action and SAR of Quinolone antimalarials, Synthesis of Chloroquin, Primaquin and Quinacrine. b) Antiamoebic agents: Introduction, Classification, and Mechanism of action and Synthesis of Metronidazole, Iodoquinol and Dimercaprol. c) Anti-infective agents: Introduction, Classification, Mechanism of action, Synthesis and SAR of Nitrofurazone and Furazolidos.	4 4 4	Chalk and talk, Power point presentation
Unit V	**Antibiotics and Steroids**	**12 Hours**	**Mode**
	a) Structural features and mode of action of the following antibiotics – penicillin G, cephalosphorin and their semi synthetic analogs (β-lactum) b) Streptomycin (aminogly coside), terramycine (tetracylin), erythromycin (macrolide) and chloromphenicol. c) Physiologically active steroids – their structural features and therapeutic use. d) Oral contraceptive, anabolic steroids anti – inflammatory steroids.	3 3 3 3	Chalk and talk, Power point presentation,

Course Designed by Mr.S.Philip Arockiaraj and Mrs.M.Shanmuga Priya

Programme	M.Sc Chemistry	Programme Code	PCH
Course Code	20PCHE32	Number of Hours / Cycle	4
Semester	III	Max. Marks	100
Part	III	Credit	4

Core Elective Course I B				
Course Title	Macromolecular Chemistry	L	T	P
Cognitive Level	Up to K4	60	-	-

L- Lecture Hour, T – Tutorial Hour, P – Practical Hour

Preamble

This course leads to know the concepts of polymerization and its techniques, crystallinity of polymers and its applications and also know about additives for polymeric products.

Unit I	**Concepts of Monomer**	**12 Hours**
	Basic concepts of Monomer ,Types of Monomer , Functionality of Monomer ,Purification of Monomer, Repeat unit, degree of polymerization. Classification of polymers, Stereochemistry of polymer, nomenclature of stereo regular polymers. Chain polymerization, free radical polymerization and ionic polymerization.	
Unit II	**Concepts of Polymer**	**12 Hours**
	Basic concepts of Polymer. Effect of functionality on Polymer Structure. Chemical and geometric structure of polymer. Configuration and conformation, Linear, branched and cross-linked structure, Random, alternating, block and graft polymers, Stereo regular polymer. Classification of Polymer based on: Structure, Repeating unit, Source, Nature and Processing.	
Unit III	**Polymerization Reactions**	**12 Hours**
	Addition Polymerization reactions, Free radical polymerization, Ionic polymerization, Co-ordination polymerization, Condensation Polymerization, Poly condensation polymerization, Poly addition polymerization, Rearrangements and Stereo Polymerization, Co-Polymerization, Free radical polymerization, Ionic polymerization, Co-poly condensation polymerization	
Unit IV	**Molecular Weight and Polymer Crystallization**	**12 Hours**
	Measurement of molecular weight and size; number average and weight average molecular weights. Glass transition temperature, concepts of glass transition temperature and associated properties. Glassy solids and glass transition, factors influencing glass transition temperature (Tg). Crystallinity in polymers; Polymer crystallization, structural and other factors affecting crystallisability, effect of crystallinity on the properties of polymers.	
Unit V	**Types of Polymers and Polymer Degradation**	**12 Hours**
	Synthetic resins and plastics; Manufacture and applications of polyethylene, PVC, Teflon, poly styrene, polymethylmethacrylate, poly urethane, phenol – formaldehyde resins, urea- formaldehyde resins and epoxy polymers. Polymer degradation: Types of degradation- thermal, mechanical, photo, hydrolytic and oxidative degradations. Additives for polymers: Fillers, plasticizers, thermal stabilizers, photo stabilizers, anti oxidants and colourants.	

Pedagogy

Lecture by use of boards, LCD projectors, Assignments, Seminars, Group Discussion, Self- learning such as use of NPTEL materials and internets, Simulation.

Text Books:

1. Fred. W. Billmeyer, Text Book of Polymer Science, John Wiley & Sons, Third Edition, 2007.
2. R. V. Gowariker, Polymer Science, New Age International Publication, 2006.
3. Arora & Singh, Polymer Chemistry, Anmol Publications Pvt.2002.

Reference Books:

1. A. Ravve, Principles of Polymer Chemistry, Springer New York, Third Edition, 2012.
2. R. J. Young and P. A. Powell, Introduction to Polymers, CRC Press, Third Edition, 1991.
3. Charles E. Carraher Jr, Introduction to polymer chemistry, Boca Raton, Forth Edition, 2017

E-Resources

- https://www.miltonroy.com/en-in/packaged-systems/polypack-polymer-preparation-units.
- https://en.wikipedia.org/wiki/Polymer.
- https://www.britannica.com/science/polymer.
- https://sciencing.com/natural-polymers-8707376.html.
- https://chemed.chem.purdue.edu/genchem/topicreview/bp/1polymer/types.html

Course Outcomes

On successful completion of the course, the student will be able to

No.	Course Outcome
CO1	Learn about the basic concepts of monomers.
CO2	Explain the various types polymerization reactions.
CO3	Examine the various measurements of polymerization technique.
CO4	Importance of polymer crystalline.
CO5	Analyze the types of polymers.

Mapping of Bloom's Taxonomy – Programme Outcome with Course Outcome

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	1	2	2	1
CO2	2	2	1	1	2	1
CO3	2	1	2	1	3	2
CO4	2	2	1	1	2	1
CO5	2	1	1	3	2	2

1. Low, 2. Medium & 3. High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	Cos	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Upto K2	2	K1 & K2	2(K2&K2)	1(K2)
2	CO2	Upto K3	2	K1 & K2	2(K2&K2)	1(K3)
3	CO3	Upto K3	2	K1 & K2	2(K2&K2)	1(K3)
4	CO4	Upto K4	2	K1 & K2	2(K3&K3)	1(K4)
5	CO5	Upto K4	2	K1 & K2	2(K3&K3)	1(K4)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems
K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-	-	5	5%	5%
K2	5	24	10	39	39%	39%
K3	-	16	20	36	36%	36%
K4	-	-	20	20	20%	20%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit	Description	Hours	Mode
Unit I Concepts of Monomer	a) Basic concepts of Monomer, Types of Monomer, Functionality of Monomer, Purification of Monomer	3	Chalk and talk, Power point presentation, Group Discussion
	b) Monomer, Repeat unit, degree of polymerization.	3	
	c) Classification of polymers, Stereochemistry of polymer, nomenclature of stereo regular polymers.	3	
	d) Chain polymerization, free radical polymerization and ionic polymerization	3	

Unit II Concepts of Polymer	a)Basic concepts of Polymer. Effect of functionality on Polymer Structure. Chemical and geometric structure of polymer. b) Configuration and conformation, Linear, branched and cross-linked structure, Random, alternating, block and graft polymers, Stereo regular polymer. c) Classification of Polymer based on: Structure, Repeating unit, Source, Nature and Processing.	4 4 4	Chalk and talk, Power point presentation
Unit III Polymerization Reactions	a) Addition Polymerization reactions, Free radical polymerization, Ionic polymerization, Co-ordination polymerization, Condensation Polymerization. b) Polycondensation - polymerization-Polyaddition-polymerization, Rearrangements and Stereo Polymerization c) Co-Polymerization, Free radical polymerization, Ionic polymerization, Co-poly condensation polymerization	4 4 4	Chalk and talk, Power point presentation
Unit IV Molecular Weight and Polymer Crystallization	a) Measurement of molecular weight and size; number average and weight average molecular weights. b) Glass transition temperature, concepts of glass transition temperature and associated properties. Glassy solids and glass transition, factors influencing glass transition temperature (Tg). c) Crystallinity in polymers; Polymer crystallization, structural and other factors affecting crystallisability, effect of crystallinity on the properties of polymers.	4 4 4	Chalk and talk, Power point presentation
Unit V Types of Polymers and Polymer Degradation	a) Synthetic resins and plastics; Manufacture and applications of polyethylene, PVC, Teflon, poly styrene, polymethyl methacrylate, poly urethane, phenol. b) Formaldehyde resins, urea-formaldehyde resins and epoxy polymers. Polymer degradation: Types of degradation- thermal, mechanical, photo, hydrolytic and oxidative degradations. c) Additives for polymers: Fillers, plasticizers, thermal stabilizers, photo stabilizers, anti oxidants and colourants.	4 4 4	Chalk and talk, Power point presentation,

Course Designed by Mr.S.Philip Arockiaraj and Mrs.M.Shanmuga Priya

Programme	M.Sc Chemistry	Programme Code	PCH
Course Code	20PCHN31	Number of Hours / Cycle	6
Semester	III	Max. Marks	100
Part	III	Credit	5

Non Major Elective Course I				
Course Title	Environmental Science	L	T	P
Cognitive Level	Up to K4	90	-	-

L- Lecture Hour, T – Tutorial Hour, P – Practical Hour

Preamble

This course gives information about the various types of pollutions analysis of pollutants and its effects and control methods.

Unit I	**Fundamentals of Environmental Science**	**18 Hours**
	Introduction – Environmental science – Environmental chemistry – Ecology - Definition- Eco – System – Cycling of mineral elements and gases – Phosphate cycle-carbon cycle Hydrogen cycle – Nitrogen cycle – Hydrological cycle Environmental segments – pollution and its types: Air pollution –water pollution – soil pollution – radioactive pollution thermal pollution – noise pollution – marine pollution other types of pollution – and its effects and control – remedial measures.	
Unit II	**Air Pollution**	**18 Hours**
	Introduction- sources of air pollution – air pollutants – classification and effects of air pollutants – Oxides of nitrogen, sulphur and carbon – acid rain –effects and control – hydrogen sulphide – effects and control – carbon mono oxide effects and control- photo chemical smog-effects and control fly ash- effects and control – green house effect – global warming- effects and control – ozone layer – ozone depletion – cholorofluroro carbons – effects and control.	
Unit III	**Water Pollution**	**18 Hours**
	Introduction – types of water – water pollution – water pollutants – classification – physical, chemical and biological inorganic pollutants and toxic metals – organic pollutants – radioactive polluntants in water – pesticides and fertilizers – suspended particles – water, quality – water quality index – ill effects of water pollutants fluorosis – water pollution control – water treatment – primary, secondary and tertiary treatment – desalination – reverse osmosis – sewage and industrial waste water treatment.	
Unit IV	**Soil Pollution**	**18 Hours**
	Introduction- types of soil- soil pollution – types – indicators of soil pollution – plants as indicators of pollution – sources of soil pollution – fertilizers and pesticides – radioactive pollutants – solid wastes – soil sediments as pollutant – soil erosion – treatment of soil pollutants –solid wastes – thermal methods – land filling composting – land protection – remedial measure for soil pollution.	
Unit V	**Analysis of Pollutants**	**18 Hours**
	Introduction analysis of air pollutants – units – sampling –devices and methods for sampling – measurements: UV –visible spectrometry IR spectrometry – emission spectrometry – turbidimetry nephelometry – gas chromatography – HPLC – chemiluminescence of nitrogen oxides – IR photometry –	

	conductometry – analysis of water pollutants units sampling – devices and methods for sampling measurement : UV –Visible spectrometry titration – analysis of different water quality parameters – BOD-COD – analysis and monitoring of pesticids caroiongens and industrial pollutants.	

Pedagogy

Lecture by use of boards, LCD projectors, Assignments, Seminars, Group Discussion, Self- learning such as use of NPTEL materials and internets, Simulation.

Text Books

1. B.K. Sharma and H.Kaur , Environmental Chemistry Krishna Prakashan, Meerut, 1997
2. A.K. De, Enviroonmental Chemistry , Wiley Eastern Ltd.,Meerut,1994
3. A.K.Mukherjee , Environmental pollution and health hazards – Causes and Control Galgotia Press , New Delhi,1986

Reference Books

1. N.Manivasakam, physic chemical examination of water sewage and Industrial effluents, Pragati Prakashan Publ., Meerut, 1985
2. Bhatia SC,. Environmental chemistry. CBS publishers and Distributors, New Delhi, 2002.
3. Chatwal A,. Instrumental methods of chemical analysis. Himalaya publishing House, Mumbai, 1999.

E-Resources

- https://en.wikipedia.org/wiki/Environmental_science
- https://www.sciencedirect.com/topics/earth-and-planetary sciences/environmental-pollution.
- https://businessjargons.com/environmental-analysis.html.
- https://en.wikipedia.org/wiki/Environmental_analysis.
- https://en.wikipedia.org/wiki/Pollutant

Course Outcomes

On successful completion of the course, the student will be able to

CO1	Learn about the fundamentals of the Environmental Science
CO2	Explain about the air pollution.
CO3	Examine the various effects of water pollution.
CO4	Learn about the types of soil pollution.
CO5	To know the principles of various analysis methods in environmental science.

Mapping of Bloom's Taxonomy – Programme Outcome with Course Outcome

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	1	2	3	1
CO2	2	2	2	2	2	2
CO3	2	1	2	1	3	2
CO4	2	2	2	1	2	1
CO5	2	1	1	2	2	2

1. Low, 2. Medium & 3. High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	Cos	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Upto K2	2	K1 & K2	2(K2&K2)	2(K2)
2	CO2	Upto K2	2	K1 & K2	2(K2&K2)	2(K2)
3	CO3	Upto K3	2	K1 & K2	2(K2&K2)	2(K3)
4	CO4	Upto K3	2	K1 & K2	2(K3&K3)	2(K3)
5	CO5	Upto K4	2	K1 & K2	2(K3&K3)	2(K4)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		04	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems
K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5			5	5%	5%
K2	5	24	20	49	49%	49%
K3		16	20	36	36%	36%
K4			10	10	10%	10%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit	Description	Hours	Mode
Unit I Fundamentals of Environmental Science	a) Introduction – Environmental science – Environmental chemistry – Ecology - Definition- Eco – System – Cycling of mineral elements and gases b) Phosphate cycle-carbon cycle Hydrogen cycle – Nitrogen cycle – Hydrological cycle Environmental segments c) Pollution and its types: Air pollution – water pollution – soil pollution – radioactive pollution thermal pollution – noise pollution – marine pollution other types of pollution – and its effects and control – remedial measures.	6 6 6	Chalk and talk, Power point presentation, Group Discussion

Unit II **Air Pollution**	a) Introduction- sources of air pollution – air pollutants – classification and effects of air pollutants – Oxides of nitrogen, sulphur and carbon b) Acid rain – effects and control – hydrogen sulphide – effects and control – carbon mono oxide effects and control- photo chemical smog-effects and control fly ash- effects and control c) Green house effect – global warming-effects and control – ozone layer – ozone depletion – cholorofluroro carbons – effects and control	6 6 6	Chalk and talk, Power point presentation
Unit III **Water Pollution**	a) Introduction – types of water – water pollution – water pollutants – classification – physical , chemical and biological inorganic pollutants and toxic metals – organic pollutants – radioactive pollutants in water – pesticides and fertilizers b) suspended particles – water , quality – water quality index – ill effects of water pollutants fluorosis – water pollution control –water treatment c) primary , secondary and tertiary treatment – desalination – reverse osmosis – sewage and industrial waste water treatmen	6 6 6	Chalk and talk, Power point presentation
Unit IV **Soil Pollution**	a) Introduction- types of soil- soil pollution – types – indicators of soil pollution – plants as indicators of pollution b) sources of soil pollution – fertilizers and pesticides – radioactive pollutants – solid wastes – soil sediments as pollutant – soil erosion – treatment of soil pollutants c) Solid wastes – thermal methods – land filling composting – land protection – remedial measure for soil pollution.	6 6 6	Chalk and talk, Power point presentation
Unit V **Analysis of Pollutants**	a) Introduction analysis of air pollutants – units – sampling –devices and methods for sampling – measurements: UV –visible spectrometry IR spectrometry b)Emission spectrometry – turbidimetry nephelometry – gas chromatography – HPLC – chemiluminescence of nitrogen oxides –IR photometry – conductometry – analysis of water pollutants units sampling – devices and methods for sampling measurement . c) UV –Visible spectrometry titration – analysis of different water quality parameters – BOD-COD – analysis and monitoring of pesticids caroiongens and industrial pollutants	6 6 6	Chalk and talk, Power point presentation,

Course Designed by Mr.S.Philip Arockiaraj and Mrs.M.Shanmuga Priya

Programme	M.Sc Chemistry	Programme Code		PCH	
Course Code	20PCHC3P	Number of Hours / Cycle		8	
Semester	III	Max. Marks		100	
Part	III	Credit		4	
Core Practical III					
Course Title	Physical Chemistry Practical		L	T	P
Cognitive Level	Up to K3		-	-	120

L- Lecture Hour, T – Tutorial Hour, P – Practical Hour

Preamble

Motivate the students to understand the principles of chemical kinetics, potentiometric and conduct metric titrations. To impart knowledge with respect to the phase transformation of different systems.

1. Adsorption Experiments

i. Adsorption of oxalic acid/Acetic acid on Charcoal

2. Potentiometric Methods

i. Precipitations titration Ag+ vs Halide mixture

ii. Redox titrations ceric ammonium sulphate vs ferrous ammonium sulphate

iii. Permagnate vs iodide ion

iv. Determination of dissociation constant of weak acids and pH of buffer solution

v. Determination of solubility product of sparingly soluble salts.

vi. Determination of dissociation constant of weak acids.

3. Conductometric Experiments

i. NH_4Cl — NaOH — Mixture of NH_4Cl & HCl.

ii. CH_3 COOH — NaOH — Mixture of CH_3COOH & HCl

iii. Na_2CO_3 — $Pb(NO_3)_2$ — Na_2CO_3

iv. K_2SO_4 — $BaCl_2$ — K_2SO_4

Text Books

1. Yadav, J. B (2005): Advanced Practical Physical Chemistry, 22ndedition, Goel publishing House, Krishna Prakashan Media Ltd.
2. Venkatesan, V,Veeraswamy, R and Kulandaivelu, A.R (1997): Basic Principles of Practical Chemistry", 2nd edition, Sultan Chand and Sons Publication, New Delhi.

Reference Books

1. Findlay's (1985): Practical Physical Chemistry, Revised and edited by B.P. Levitt 9th edition, Longman, London.
2. Chatwal, G.R. andAnand,S.K (2000): Instrumental Methods of Chemical Analysis, Himalaya Publishing House, Delhi.

E-Resources

- Adsorption Experiments.
- Potentiometric Methods
- Conductometric Experiments
- Chemlibtext.org

Course Outcomes

Upon completion of this course, the students will be able to:

CO1	Design, conduct, analyze and interpret results of an experiment, and effectively communicate these in written reports
CO2	Develop interdisciplinary solutions to a variety of chemical problems,
CO3	Communicate effectively in a variety of forms
CO4	Use terminology appropriate to the field of study correctly and contextually.
CO5	Extend knowledge and understanding of a variety of chemical concepts in a range of contexts.

Programme	M.Sc Chemistry	Programme Code	PCH
Course Code	20PCHC41	Number of Hours / Cycle	5
Semester	IV	Max. Marks	100
Part	III	Credit	5

Core Course XII				
Course Title	Organic Chemistry IV	L	T	P
Cognitive Level	Up to K3	75	-	-

L- Lecture Hour, T – Tutorial Hour, P – Practical Hour

Preamble

The course deals the concepts of electrocyclic reactions, cycloaddition and sigmatropic reactions, and also to know about the mechanism of organic photochemistry reaction, synthetic methods of transition metal complexes in organic chemistry, to know the mechanism and synthetic uses of molecular rearrangements.

Unit I	**Pericyclic Reactions**	**15 Hours**
	Concerted reactions – orbital symmetry and correlation diagram approach – FMO and PMO approach, Woodward-Hofmann rules – Electrocyclic reactions (1,3-butadiene-cyclobutene and 1,3,5-hexatriene-cyclohexadiene systems) – cycloadditions [2+2] and [2+4] systems (ethylene-cyclobutane, ethylene and 1,3-butadiene-cyclohexene systems), sigmatropic reaction (1,3 hydrogen shift, 1,3 carbon shift, 1,5 hydrogen shift, 1,5 carbon shift).	
Unit II	**Organic Photochemistry**	**15 Hours**
	Characteristics of photo reactions – photo reductions and photo oxidation – photoreactions of carbonyl compounds – Norrish type I and Norrish type II reactions, di-pi methane rearrangement – photochemistry of arenes, photochemistry of alkenes, cis-trans isomerisation – rearrangements of cyclic α,β – unsaturated ketones and 2,5-cyclohexadienone – Barton reaction – Paterno Buchi reaction.	
Unit III	**Retro Synthetic Methods**	**15 Hours**
	Planning a synthesis – Relay approach and convergent approach to total synthesis, functional group inter conversions – use of activating and blocking groups in synthesis, Transition metal complexes in organic chemistry, Homogeneous hydrogenation, Umpolung synthesis, Robinson annelation, A schematic analysis of the total synthesis of the following compounds: 2,4 –dimethyl-1,2 –hydroxypentanoic acids, trans-9-metyl-1-decalone and isonootkatone.	
Unit IV	**Addition to Multiple Bonds**	**15 Hours**
	Addition to carbonyl groups – mechanism –Aldol condensation – Perkin reaction –Knoevenagel reaction – Mannion reaction – Cannizaro reaction – Benzoin condensation – Reformatsky reaction – Witting reaction – Grignard reactions. Addition to α, β-unsaturated carbonyl groups – addition of Grignard reagent to α, β-unsaturated carbonyl compounds – Michael addition – Diels – Alder reaction – addition to carbenes and carbeniods to double and triple bonds.	
Unit V	**Molecular Rearrangements**	**15 Hours**

	General mechanistic consideration, nature of migration, migratory aptitude, memory effect, 1,2- shifts in carbocations – Bayer Villiger, Demzanov, Hoffman, Curtius, pinacole-pinacolone, Benzil–Bezilic acid, Beckmann, Lossen, Favorski, Benzidine, Fries, Cope rearrangements.	

Pedagogy

Lecture by use of boards, LCD projectors, Assignments, Seminars, Group Discussion, Self- learning such as use of NPTEL materials and internets, Simulation.

Text Book

1. McMurry, J.E, (2013), "Fundamentals of Organic Chemistry", Cengage Learning, Seventh edition.
2. Reinhard Bruckner, (2012), "Advanced Organic Chemistry, Reaction Mechanisms", Academic Press.
3. Vitomir, S, Vesna, P.P, (2016), "Organic Chemistry from Retrosynthesis to Asymmetric Synthesis, Springer.

References

1. Sunil Kumar, Vinod Kumar, Singh, V.P, (2015), "Pericyclic Reactions: A Mechanistic and problem solving approach" Elsevier Science.
2. Morrison R.T, Boyd R.N, (2011), "Organic Chemistry", Prentice Hall, 6th edition.
3. Sykes P, "Guidebook to Mechanism in Organic Chemistry", Orient Longman.

E-Resources

- https://en.wikipedia.org/wiki/Pericyclic_reaction.
- https://chem.libretexts.org/Bookshelves/Organic_Chemistry/
- https://www.youtube.com/watch?v=xH9ltFxRCXc
- https://www.slideshare.net/AlexRamaniVincent/addition-to-cc-multi-bonds
- https://en.wikipedia.org/wiki/Rearrangement_reaction#

Course Outcomes

On successful completion of the course, the student will be able to

No.	Course Outcome
CO1	Evaluate concerted reactions via FMO and PMO approach, Electrocyclic reactions, cycloadditions and sigmatropic rearrangements
CO2	Identify the mechanism of various photochemical reactions
CO3	Details of synthetic methods of transition metal complexes in organic chemistry
CO4	Clarify the various types of addition and multiple bond reactions
CO5	Assess the mechanism and synthetic uses of selected reagents and reactions

Mapping of Bloom's Taxonomy – Programme Outcome with Course Outcome

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	2	2	2	2
CO2	2	2	3	2	2	3
CO3	1	3	2	2	1	2
CO4	3	1	1	1	3	2
CO5	2	2	2	3	2	3

1 – Low, 2 – Medium & 3- High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Upto K3	2	K1 & K2	2(K2&K2)	1(K3)
2	CO2	Upto K3	2	K1 & K2	2(K2&K2)	1(K3)
3	CO3	Upto K3	2	K1 & K2	2(K3&K3)	1(K2)
4	CO4	Upto K3	2	K1 & K2	2(K2&K2)	1(K3)
5	CO5	Upto K3	2	K1 & K2	2(K3&K3)	1(K2)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems
K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-	-	05	5	5%
K2	5	24	20	49	49	49%
K3	-	16	30	46	46	46%
Total Marks	10	40	50	100	100	100%

Lesson Plan

Unit	Description	Hours	Mode
Unit I Pericyclic Reactions	a) Concerted reactions – orbital symmetry and correlation diagram approach – FMO and PMO approach, Woodward-Hofmann rules b) Electrocyclic reactions (1,3-butadiene-cyclobutene and 1,3,5-hexatriene-cyclohexadiene systems) cycloadditions [2+2] and [2+4] systems (ethylene-cyclobutane, ethylene and 1,3-butadiene-cyclohexene systems) c) Selection rules – sigmatropic reaction (1,3 hydrogen shift, 1,3 carbon shift, 1,5 hydrogen shift, 1,5 carbon shift).	5 5 5	Chalk and talk, Power point presentation

Unit II **Organic Photochemistry**	a) Characteristics of photo reactions – photo reductions and photo oxidation – photoreactions of carbonyl compounds b) Norrish type I and Norrish type II reactions, di-pi methane rearrangement – photochemistry of arenes c) Photochemistry of alkenes, cis-trans isomerisation – rearrangements of cyclic α,β – unsaturated ketones and 2,5-cyclohexadienone – Barton reaction – Paterno Buchi reaction.	5 5 5	Chalk and talk, Power point presentation
Unit III **Retro Synthetic Methods**	a) Planning a synthesis – Relay approach and convergent approach to total synthesis, functional group inter conversions - use of activating and blocking groups in synthesis, b) Transition metal complexes in organic chemistry, Homogeneous hydrogenation, Umpolung synthesis, Robinson annelation, c) A schematic analysis of the total synthesis of the following compounds: 2,4 –dimethyl-1,2–hydroxypentanoic acids, trans-9-metyl-1-decalone and isonootkatone.	5 5 5	Chalk and talk, Power point presentation
Unit IV **Addition to Multiple Bonds**	a) Addition to carbonyl groups, mechanism, Aldol condensation, Perkin reaction, knoevenagel reaction, Mannion reaction, Cannizaro reaction. b) Benzoin condensation, Reformatsky reaction, Witting reaction, Grignard reactions. Addition to α, β-unsaturated carbonyl groups. c) Addition of Grignard reagent to α, β-unsaturated carbonyl compounds – Michael addition – Diels –Alder reaction – addition to carbenes and carbeniods to double and triple bonds.	5 5 5	Chalk and talk, Power point presentation, Group Discussion
Unit V **Molecular Rearrangements**	a) General mechanistic consideration, nature of migration, migratory aptitude, b) memory effect, 1,2- shifts in carbocations c) Bayer Villiger, Demzanov, Hoffman, Curtius, pinacole-pinacolone, Benzil–Bezilic acid, Beckmann, d) Lossen, Favorski, Benzidine, Fries, Cope rearrangements.	4 2 5 4	Chalk and talk, Power point presentation, Group Discussion

Course Designed by Dr. A. Pandiarajan and Dr. M.S. Dheenadayalan

Programme	M.Sc Chemistry	Programme Code	PCH		
Course Code	20PCHC42	Number of Hours / Cycle	5		
Semester	IV	Max. Marks	100		
Part	III	Credit	5		
Core Course XIII					
Course Title	Inorganic Chemistry IV		L	T	P
Cognitive Level	Up to K4		75	-	-

L- Lecture Hour, T – Tutorial Hour, P – Practical Hour

Preamble

The course are enables the students to gain knowledge on concepts of Nuclear chemistry, Bioinorganic chemistry, inorganic chains, rings and cages compound and, acquire the detailed knowledge on Non aqueous solvents.

Unit I	Nuclear Chemistry –I	15 Hours
	Nuclear magnetic resonance, BLOCH'S NMR Setup, nuclear configuration – Nuclear stability and Binding energy-parity and its conservation – nuclear forces Theory. Types of radioactive rays, Detection and measurement of radioactivity - GM counter method and Wilson cloud chamber method, Laws of radioactive disintegration - average life and half-life period (related simple problems).	
Unit II	**Nuclear Chemistry-II**	**15 Hours**
	Fission and Fusion reaction –energy release in nuclear fission – mass distribution of fission products – theory of nuclear fission fissile and fertile isotopes – energy from nuclear fusion – thermonuclear reaction in stars – classification of reactors – power nuclear reactor – breeder reactor – nuclear reactions in India. Application of radioactive isotopes: isotope dilution analysis – Carbon dating –Assessing the volume of blood in a patient - Brain tumour location and bone fracture healing- Optimum use of fertilizers - Control of predatory insects- neutron activation analysis.	
Unit III	**Bio-Inorganic Chemistry**	**15 Hours**
	Metal Ions in Biological Systems – Essential and Trace Metals – Na^+/K^+ Pump - metalloporphyrins – the porphyrine ring system – chlorophylls – Heme Proteins – Structure and Function of Haemoglobin, Myoglobin, Haemocyanins, Iron storage and transport proteins. Cytochromes – Iron – Sulphur Proteins – Oxygen carriers – Copper Proteins – Metals in Medicines – Metal Deficiency Diseases – Metals used for Diagnosis and Chemotherapy – Toxic Effect of Metals.	
Unit IV	**Inorganic Chains – Rings And Cages Compounds**	**15 Hours**
	Silicates: Various silicate structures – Structure, property, correlation – Silicones. Poly acids: Classification – isopoly acids like polymolybdate, polyvanadate and polytungstate – their structures – heteropolyacids: 9 and 6. Heteropolyacids- preparation and structures. Phosphazenes and its polymer – Phosphonitrilic compounds- S_4N_4- Polymeric sulphur nitride (polythiazyl) Cage compounds: Nomenclature of Boranes and carboranes – Wade's rule – Styx	

	number- preparation and structures of B_4H_{10}, $C_2B_{10}H_{12}$, $(B_{12}H_{12})^{2-}$ - borazine.	
Unit V	**Non-Aqueous Solvents**	**15 Hours**
	Chemistry of Non – Aqueous Solvents, classification of solvents, types of chemical reactions in solvents Acid-base, Metathetical, Solvolysis and Redox reactions in liquid ammonia – Hydrogen fluoride - Sulphuric acid and acetic acid solvents- Metal-ammonia solutions – Chemical reactions in liquid sulphur dioxide	

Pedagogy

Class Room Lectures, Power point presentation, Group Discussion, Seminar, Quiz, Assignments, Experience Sharing, Brain storming, Activity, Case Study

Text Book

1. U.N.Dash, Nuclear Chemistry, Sultan Chand and Sons, New Delhi, 1991.
2. Wahid U. Malik, G.D. Tuli and R. D. Madan, 2006. Selected Topics in Inorganic Chemistry, S. Chand & Co. Ltd., New Delhi.
3. G.R.Chatwal and A.K.Bhagi, Bioinorganic Chemistry Himalaya Publishing House

Reference Books

1. G.Friedlander, J.W. Kannedy, E.S.Macias and J.M.Miller, Nuclear and Radiochemistry , John Wiley & Sons Inc., New York 1981.
2. H.I.Arnidar, Essintials of Nuclear Chemistry, 3rd edn., Wiley Eastern Ltd., New Delhi,1987
3. BertiniH.B.Gray, S.J.Leppard and J.S. Valentine , Bioinorganic Chemistry Viva Books Pvt., Ltd., 1998.

E-Resources

- yukawa theory of nuclear forces
- application of radioisotopes in biology
- application of radioisotopes in medicine
- copper containing proteins example
- classification of silicates
- reaction in non aqueous solvents with reference to liquid ammonia

Course Outcomes

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

CO1	Infer the Nuclear force theory and types of radioactive rays.
CO2	Interpret the Nuclear fission, fusion reaction and applications of radioactive isotopes.
CO3	Identify the following metalloporphyrins, heme proteins and its structures and functions, blue copper proteins, metals in medicines and its toxic effects.
CO4	Classify the various structures of silicates, classifications of polyacids, preparation and structure of cage compounds.
CO5	Simplify the chemistry of Non aqueous solvents and its reactions

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	3	3	2	3
CO2	3	2	2	3	2	3
CO3	2	3	2	1	2	1
CO4	2	2	2	2	1	2
CO5	3	2	2	2	1	2

1. High, 2. Medium, 3. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/ or Choice**	**Open choice**
			No. of Questions	**K-Level**	**No. of Questions**	**No. of Questions**
1	CO1	Up to K3	2	K1&K2	2(K2&K2)	1(K3)
2	CO2	Up to K3	2	K1&K2	2(K2&K2)	1(K3)
3	CO3	Up to K3	2	K1&K2	2(K3&K3)	1(K2)
4	CO4	Up to K4	2	K1&K2	2(K3&K3)	1(K4)
5	CO5	Up to K4	2	K1&K2	2(K4&K4)	1(K3)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems
K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section - wise Marks with K Levels

K Levels	**Section A (No Choice)**	**Section B (Either/or)**	**Section C (Open Choice)**	**Total Marks**	**% of Marks without Choice**	**Consolidated (Rounded off)**
K1	5			05	5	5%
K2	5	16	10	31	31	31%
K3		16	30	46	46	46%
K4		8	10	18	18	18%
Total Marks	10	40	50	100	100	100%

Lesson Plan

Unit	Description	Hours	Mode
Unit I	a. Nuclear magnetic resonance, BLOCH'S NMR Setup, nuclear configuration	3	Chalk and talk, Power point presentation, NPTEL Video
	b. Nuclear stability and Binding energy, parity and its conservation, nuclear forces Theory	3	
	c. Types of radioactive rays, Detection and measurement of radioactivity	3	
	d. GM counter method and Wilson cloud chamber method, Laws of radioactive disintegration	3	
	e. Average life and half-life period (related simple problems).	3	
Unit II	a. Fission and Fusion reaction – energy release in nuclear fission, mass distribution of fission products	3	Chalk and talk, Power point presentation, eLearning videos
	b. Theory of nuclear fission fissile and fertile isotopes, energy from nuclear fusion	2	
	c. Thermonuclear reaction in stars, classification of reactors, power nuclear reactor, breeder reactor, nuclear reactions in India.	3	
	d. Application of radioactive isotopes: isotope dilution analysis, Carbon dating, Assessing the volume of blood in a patient	4	
	e. Brain tumour location and bone fracture healing - Optimum use of fertilizers, Control of predatory insects, neutron activation analysis.	3	
Unit III	a. Metal Ions in Biological Systems, Essential and Trace Metals, Na^+/K^+ Pump	3	Chalk and talk, Power point presentation, NPTEL Video
	b. Metalloporphyrins, the porphyrine ring system, chlorophylls, Cytochromes	3	
	c. Hemeproteins, Structure and Function of Haemoglobin, Myoglobin, Haemocyanins, Iron storage and transport proteins.	3	
	d. Iron , Sulphur Proteins – Oxygen carriers – Copper Proteins	2	
	e. Metals in Medicines, Metal Deficiency Diseases, Metals used for Diagnosis and Chemotherapy, Toxic Effect of Metals.	4	
Unit IV	a. Silicates: Various silicate, Structure, property, correlation – Silicones	3	Chalk and talk, Power point presentation, eLearning videos
	b. Poly acids: Classification – isopoly acids like polymolybdate, polyvanadate and polytungstate – their structures	3	
	c. Heteropolyacids: 9 and 6 Heteropolyacids - preparation and structures. Phosphazenes and its polymer	3	
	d. Phospho nitrilic compounds - S_4N_4- Polymeric sulphur nitride (polythiazyl)	2	
	e. Cage compounds: Nomenclature of Boranes and carboranes – Wade's rule – Styx number-preparation and structures of B_4H_{10}, $C_2B_{10}H_{12}$, $(B_{12}H_{12})^{2-}$ - borazine.	4	

Unit V	a. Chemistry of Non – Aqueous Solvents, classification of solvents, types of chemical reactions in solvents b. Acid-base, Metathetical, Solvolysis and Redox reactions in liquid ammonia c. Redox reactions in Hydrogen fluoride d. Redox reactions in Sulphuric acid e. Redox reactions in acetic acid, Metal-ammonia solutions – Chemical reactions in liquid sulphur dioxide	4 3 2 2 4	Chalk and talk, Power point presentation, DVD presentation

Course designed by Dr.M.S.Dheenadayalan and Mrs.A.Mariammal

Programme	M.Sc Chemistry	Programme Code		PCH
Course Code	20PCHC43	Number of Hours / Cycle		5
Semester	IV	Max. Marks		100
Part	III	Credit		5
Core Course XIV				
Course Title	Physical Chemistry – IV	L	T	P
Cognitive Level	Up to K4	75	-	-

L- Lecture Hour, T – Tutorial Hour, P – Practical Hour

Preamble

This course provides various concepts of chemical kinetics and different principles of kinetics and also provides the applications. Various aspects of surface chemistry are to be discussed.

Unit I	**Chemical Kinetics – I**	**15 Hours**
	Potential energy surface- Chain reactions – general characteristics Steady state approximations – study of kinetics of chain reactions like H_2-Br_2 reaction – decomposition of acetaldehyde and N_2O_5 – study of H_2-O_2 explosive reactions. Unimolecular reaction rate theories – the simple Lindermann treatment – Hishelwood's theory – RRK theory – Advanced unimolecular theory - Marcus theory or Rice, Ramsperger, Kassel and Marcus (RRKM) theory – Slater's theory. Principle of mictroscopic reversibility and detailed balancing – Kinetic isotope effect – Reactions in solution influence of solvent dielectric constant, ionic strength (Bronsted- Bjerrum – equation – primary and secondary salt effects) and pressure on reaction rates in solution – significance of volume of activation	
Unit II	**Chemical Kinetics – II**	**15 Hours**
	Fast reactions techniques – chemical relaxation methods, temperature and pressure jump methods – Flash photolysis – Spin resonance technique in the study of reaction kinetics. Catalysis in biological systems – Enzyme catalysis – Michaelis Menten kinetics – Lineweaver and Burk plot – Eadie's plot – influence of pH on the enzyme catalysis. Heterogeneous catalysis – chemical reaction on solid surfaces – kinetics, and mechanism of unimolecular and biomolecular – reactions – Langmuir – Heinshelwood and Langmuir – Rideal – mechanism – ARRT of surface reactions – NH_3 synthesis, hydrogenation of C_2H_4 and cracking of hydrocarbons.	
Unit III	**Surface Chemistry**	**15 Hours**
	Introduction – Adsorption of gases on solids – physisorption and chemisorptions isotherms – Freundlish – Langmuir – BET – Temkin adsorption isotherms. Adorption on liquid surface – surface tension – Gibbs adsorption isotherm – Surface area determination – Electrokinetic phenomena at interfaces- including electro-osmosis and electrophoresis – Spreading of a liquid on another surfactant – monolayers – preparation of LB films – Micelles – Critical micellar concentration (CMC) – structure – biomolecular reaction occurring in a micellar solution – reverse micelles – micro emulsion – Application of photoelectron spectroscopy – ESCA and Auger spectroscopy to the study of surfaces.	

Unit IV	**Biophysical Chemistry**	**15 Hours**
	Basic concept of non – equilibrium thermodynamics – Onsager reciprocal relationship – Its application to biological systems – High energy metabolies – ATP and its role in bioenergetics-transfer of potential and coupled reaction – Biological energy conversion in catabolism and anabolism – Role of singlet oxygen in biology – Biophysical applications of Mossbauer recognition – An introduction to super – molecular chemistry and photochemistry.	
Unit V	**Radiation Chemistry**	**15 Hours**
	Radiation chemistry – primary stage-secondary stage- Interaction of high energy radiation with matter – radiolysis of water – radiolysis of redox systems using energy transfer from irradiated alkali halides –hydrated electrons – Radiation dosimetry-Rad-Gray-Rontgen-Experimental techniques of radiation chemistry – Frieck Dosimeter and Ceric sulphate dosimeter	

Pedagogy

Lecture by use of boards, LCD projectors, Assignments, Seminars, Group Discussion, Self- learning such as use of NPTEL materials and internets, Simulation.

Text Book:

1. Peter Atkins and Julio de Paula (2018) Physical Chemistry, (11th edition) Oxford University Press.
2. Hofmann, and Andreas (2018) Physical Chemistry Essentials, springer publications.
3. Anatol Malijevsk´y, CSc., et al.(2010) Physical Chemistry In Brief, Institute of Chemical Technology, Prague Faculty of Chemical Engineering.

Reference Books:

1. LaidlerK.J (1987), Chemical Kinetics 3rdedn., Harper International edn., London
2. LaidlerK.J (1969), Theories of Chemical Reaction Rates, McGraw Hill Book Co., London.
3. Kalidas.C (1996), Chemical Kinetics Methods New Age International

E-Resources

- Annual Review of Physical Chemistry.
- Smithsonian Physical Tables.
- Lange's Handbook of Chemistry.
- Nature Physical Chemistry.
- Hawley's Condensed Chemical Dictionary.
- Chem.Libretexts.Org

Course Outcomes

On successful completion of the course, the student will be able to

CO1	Infer the fundamentals of electrochemistry and develop the knowledge in electro chemistry
CO2	Apply the Principles of electrochemical cell models
CO3	Analyze the Applications of electrochemical cell models
CO4	Categorize the various instrumental techniques in photochemistry
CO5	Interpret the various functions of Nanoscience and nanotechnology.

Mapping of Bloom's Taxonomy – Programme Outcome with Course Outcome

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	3	1	1
CO2	3	3	2	1	3	3
CO3	2	1	3	1	2	2
CO4	2	3	1	3	1	1
CO5	3	3	2	3	3	3

1. Low, 2. Medium & 3. High

Articulation Mapping - K Levels with Course Outcomes (COs)

Unit	**CO'S**	**K – Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Open Choice**
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Upto K2	2	K1 & K2	2(K2&K2)	1(K2)
2	CO2	Upto K3	2	K1 & K2	2(K2&K2)	1(K2)
3	CO3	Upto K4	2	K1 & K2	2(K3&K3)	1(K4)
4	CO4	Upto K4	2	K1 & K2	2(K3&K3)	1(K2)
5	CO5	Upto K3	2	K1 & K2	2(K2&K2)	1(K3)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems
K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section –wise Marks with K Levels

K Levels	**Section A (No Choice)**	**Section B (Either/or)**	**Section C (Open Choice)**	**Total Marks**	**% of Marks without choice**	**Consolidated (Rounded off)**
K1	5	-	-	05	5	5%
K2	5	24	30	59	59	59%
K3	-	16	10	26	26	26%
K4	-	-	10	10	10	10%
Total Marks	10	40	50	100	100	100%

Lesson Plan

Unit	Description	Hours	Mode
Unit I	a) Potentialenergy surface. Chain reactions – general characteristics Steady state approximations – study of kinetics of chain reactions like H_2-Br_2 reaction – b) Decomposition of acetaldehyde and N_2O_5 – study of H_2-O_2 explosive reactions. Unimolecular reaction rate theories – the simple Lindermann treatment – Hishelwood's theory – Rice, Ramsperer and Kassel (RRK) theory c) Advanced unimolecular theory - Marcus theory or Rice, Ramsperger, Kassel and Marcus (RRKM) theory – Slater's theory. Principle of mictroscopic reversibility and detailed balancing – Kinetic isotope effect – Reactions in solution influence of solvent dielectric constant, ionic strength (Bronsted- Bjerrum – equation d) Primary and secondary salt effects) and pressure on reaction rates in solution – significance of volume of activation.	4 4 5 2	Chalk and talk, Power point presentation
Unit II	a) Fast reactions techniques – chemical relaxation methods, temperature and pressure jump methods, ultrasonic absorption technique, reactions in flow system, continuous and stopped flow, shock wave tube methods; b) Chemical kinetics in crossed molecular beams – Flash photolysis – Spin resonance technique in the study of reaction kinetics. Catalysis in biological systems – Enzyme catalysis – Michaelis – Menten kinetics- Lineweaver and Burk plot – Eadie's plot – influence of pH on the enzyme catalysis. Heterogeneous catalysis c) Chemical reaction on solid surfaces – kinetics, and mechanism of unimolecular and biomolecular – reactions d) Langmuir – Heinshelwood and Langmuir – Rideal – mechanism – ARRT of surface reactions – NH_3 synthesis , hydrogenation of C_2H_4 and cracking of hydrocarbons	4 6 2 3	Chalk and talk, Power point presentation
Unit III	a) Introduction – Adsorption of gases on solids – physisorption and chemisorptions isotherms – Freundlish – Langmuir – BET – Temkin adsorption isotherms. Adsorption on liquid surface. b) Surface tension – Gibbs adsorption isotherm – Surface area determination – Electro kinetic phenomena at interfaces- including electro-osmosis and electrophoresis c) Spreading of a liquid on another surfactant – monolayers – preparation of LB films – Micelles – d) Critical micellar concentration (CMC) – structure – biomolecular reaction occurring in a micellar solution – reverse micelles – micro emulsion – Application of photoelectron spectroscopy – ESCA and Auger spectroscopy to the study of surfaces.	4 3 3 5	Chalk and talk, Power point presentation

Unit IV	a) Basic concept of non – equilibrium thermodynamics – Onsager reciprocal relationship – Its application to biological systems b) High energy metabolies – ATP and its role in bioenergetics- transfer of potential and coupled reaction c) Biological energy conversion in catabolism and anabolism – Role of singlet oxygen in biology – d) Biophysical applications of Mosshauer recognition – An introduction to super – molecular chemistry and photochemistry.	5 4 3 3	Chalk and talk, Power point presentation
Unit V	a) Radiation chemistry – source energy – interaction of high energy radiation with matter b) radiolysis of water – definition of G-value – mode of reaction of hydrated electrons OH and H c) Experimental techniques of radiation chemistry – Dosimetry d) Elementary aspects of radiation chemistry in biology and industry.	4 4 4 3	Chalk and talk, Power point presentation, Group Discussion

Course Designed by:1.Dr.S.Ignatius Arockiam and Mrs.G.Benita

Programme	M.Sc Chemistry	Programme Code	PCH
Course Code	20PCHE41	Number of Hours / Cycle	5
Semester	IV	Max. Marks	100
Part	III	Credit	5
Core Elective Course – II A			

Course Title	Nano Chemistry	L	T	P
Cognitive Level	up to K4	75	-	-

L- Lecture Hour, T – Tutorial Hour, P – Practical Hour

Preamble:

This course deals with the knowledge of nanochemistry. Understand the various process techniques available for nano structured material analysis. Impart knowledge on the exotic properties of nano structured material at their size based effect.

Unit I	**Fundamentals of nanoscience**	**15 Hours**
	Definition of a nano system – Basic concepts of nanoscience and technology - Scientific revolutions of nanotechnology - atomic & molecular size – Time and length at nanoscale - Scope of nanoscience and technology – Commercial Applications of Nanotechnology.	
Unit II	**Nanostructures and Dimensions**	**15 Hours**
	Definition of Nanostructure materials - Classification of nanostructures - zero, one, two and three dimensional nanostructures. Size Dependency in Nanostructures -quantum size effects in nanostructures.	
Unit III	**Nanomaterial Synthesis**	**15 Hours**
	Synthesis of nanomaterials - top down and bottom up approach - Method of nanomaterials preparation – Physical methods – Inert gas condensation and evaporation, chemical synthesis - sol-gel and chemical reduction – Biological methods – nanoparticles using plant extracts, bacteria, fungi.	
Unit IV	**Nanomaterial Properties**	**15 Hours**
	Surface properties of nanoparticles - Surface to volume ratio-mechanical - optical, - electronic – magnetic - thermal and chemical properties of nanomaterials. Size dependent properties-size dependent absorption spectra - self-assembly in nanotechnology - Types of SAMs, Methods of self-assembly, Applications of self assembled monolayers	
Unit V	**Applications of Nanomaterials**	**15 Hours**
	Applications of metal nanoparticles in technologically imperative fields like sensors,- Nanomaterials for energy storage - Batteries and fuel cells - photovoltaic devices -solar cells - optical memory devices - Quantum nanoelectronic devices -quantum computing.	

Pedagogy

Class Room Lectures, Power point presentation, Group Discussion, Seminar, Quiz, Assignments, Experience Sharing, Brain storming, Activity, Case Study

Text Books

1. C. P. Poole and J.F. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2014.
2. M. A. Ratner and D. Ratner, "Nanotechnology: A Gentle Introduction to the Next Big Idea", Prentice Hall PTR, First Edition, 2002.
3. T. Pradeep, "Nano: The Essential Nanoscience and Nanotechnology", Tata McGraw hill, 2007.

Reference Books

1. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties &Applications", Imperial College Press, 2004
2. C. N. R. Rao, A. Muller and A. K. Cheetham, "The Chemistry of nanomaterials: Synthesis, Properties and Applications", Wiley-VCH verlag GmBH & Co.KGA, 2004.
3. Ventra M.D, Evoy S, Heflin J.R , Introduction to nanoscale science and technology, Kluwer academic.,2004

E-Resources

- https://en.wikipedia.org/wiki/Nanotechnology
- https://en.wikipedia.org/wiki/Nanomaterials
- https://www.twi-global.com/technical-knowledge/faqs/what-is-a-nanomaterial
- https://old.taltech.ee/public/m/Mehaanikateaduskond/
- https://en.wikipedia.org/wiki/Nanoparticle**.**

Course Outcomes

On successful completion of the course, the student will be able to

CO1	Apply the basic concepts of nanoscience and technology.
CO2	Organize the Classification of nanostructures
CO3	Examine the Synthesis of nanomaterials.
CO4	Simplify and Analyze the Nanomaterial Properties.
CO	Investigate the various Applications of Nanomaterials.

Mapping of Bloom's Taxonomy – Programme Outcome with Course Outcome

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	2	2	1	2	3	1
CO2	2	2	2	1	2	1
CO3	1	2	1	2	1	1
CO4	2	1	2	1	3	1
CO5	2	2	1	2	2	2

1. Low, 2. Medium & 3. High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Upto K2	2	K1 & K2	2(K2&K2)	1(K2)
2	CO2	Upto K3	2	K1 & K2	2(K3&K3)	1(K3)
3	CO3	Upto K4	2	K1 & K2	2(K3&K3)	1(K4)
4	CO4	Upto K3	2	K1 & K2	2(K2&K2)	1(K3)
5	CO5	Upto K2	2	K1 & K2	2(K2&K2)	1(K2)
No of Questions to be asked			10		10	05
No of Questions to be answered			10		05	03
Marks for each Question			01		04	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented
K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	05	-	-	05	5	5%
K2	05	24	20	49	49	49%
K3	-	16	20	36	36	36%
K4	-	-	10	10	10	10%
Total Marks	10	40	50	100	100	100%

Lesson Plan

Unit	Description	Hours	Mode
Unit I	a) Definition of a nano system – Basic concepts of nanoscience and technology b)Scientific revolutions of nanotechnology c) Atomic & molecular size – Time and length at nanoscale d) Scope of nanoscience and technology – Commercial Applications of Nanotechnology.	4 4 3 4	Chalk and talk, Power point presentation, Group Discussion
Unit II	a) Definition of Nanostructure materials - Classification of nanostructures b) Zero, one, two and three dimensional nanostructures. c) Size Dependency in Nanostructures -quantum size effects in nanostructures.	5 5 5	Chalk and talk, Power point presentation, Group Discussion
Unit III	a) Synthesis of nanomaterials - top down and bottom up approach b) Method of nanomaterials preparation – Physical methods – Inert gas condensation and evaporation, chemical synthesis c) sol-gel and chemical reduction – Biological methods d) Nanoparticles using plant extracts, bacteria, fungi.	5 4 3 3	Chalk and talk, Power point presentation, Group Discussion
Unit IV	a) Surface properties of nanoparticles - Surface to volume ratio- mechanical - optical b) Electronic – magnetic - thermal and chemical properties of nanomaterials. C) Size dependent properties-size dependent absorption spectra - self-assembly in nanotechnology d) Types of SAMs, Methods of self-assembly, Applications of self assembled monolayers	4 3 4 4	Chalk and talk, Power point presentation, Group Discussion
Unit V	a) Applications of metal nanoparticles in technologically imperative fields like sensors, b) Nanomaterials for energy storage - Batteries and fuel cells - photovoltaic devices c) Solar cells - optical memory devices - Quantum nanoelectronic devices -quantum computing.	5 5 5	Chalk and talk, Power point presentation, Group Discussion

Course Designed by Mr.S.Philip Arockiaraj and Mrs.M.Shanmuga Priya

Programme	M.Sc Chemistry	Programme Code	PCH
Course Code	20PCHE42	Number of Hours / Cycle	5
Semester	IV	Max. Marks	100
Part	III	Credit	5

Core Elective Course – II B				
Course Title	Green Chemistry	L	T	P
Cognitive Level	Up to K4	75	-	-

L- Lecture Hour, T – Tutorial Hour, P – Practical Hour

Preamble:

This course deals to train the students to use eco-friendly approaches in synthesizing agro-based chemicals like insecticides, fungicides, herbicides, bactericides acaricides, weedicides and to emphasize green chemistry approach in crop protection which help to reduce global warming.

Unit I	**Introduction to Green Chemistry**	**15 Hours**
	Current status of chemistry and the Environment-Evolution of the Environmental movement: Public awareness - Dilution is the solution to pollution-Pollution prevention	
Unit II	**Principles of Green Chemistry**	**15 Hours**
	Definition – Principles of Green Chemistry - Why is this new area of Chemistry getting to much attention - Why should chemist pursue the Goals of Green Chemistry - The roots of innovation – Limitations.	
Unit III	**Green Chemistry using Bio Catalytic Reactions**	**15 Hours**
	Introduction - Fermentation and Bio transformations - Production of Bulk and fine chemicals by microbial fermentation- Antibiotics – Vitamins - Bio catalyses synthesis of industrial chemicals by bacterial constructs - Future Tends.	
Unit IV	**Green House Effect and Global Warming**	**15 Hours**
	Introduction - How the green house effect is produced - Major sources of green house gases - Emissions of CO2 - Impact of green house effect on global climate - Control and remedial measures of green house effect - Global warming a serious threat - Important points.	
Unit V	**Future Trends in Green Chemistry**	**15 Hours**
	Green analytical methods, Redox reagents, Green catalysts; Green nano-synthesis, Green polymer chemistry, Exploring nature, Biomimetic, Proliferation of solvent-less reactions; Noncovalent derivatization, Biomass conversion, emission control.	

Pedagogy

Lecture by use of boards, LCD projectors, Assignments, Seminars, Group Discussion, Self- learning such as use of NPTEL materials and internets, Simulation.

Text Books

1. M. Lancaster, "Green Chemistry: an Introductory Text", RSC, 2002
2. Sheldon, Arends, Hanefeld, "Green Chemistry and Catalysis", Wiley, New York, 2007.
3. Ahluwalia .V.K, Green chemistry, Ane books Pvt Ltd., second Edition ,New Delhi.,2016.

Reference Books

1. Anastas & Warner, Green Chemistry: Theory & Practice, Oxford Univ. Press, New York, 1998.
2. S. E. Park, J. S. Chang, S. H. Jhung, "The Role of Catalyst for Green Chemistry", Chemworld, Vol. 44 (8), 38, 2004.
3. Narosa., Green chemistry, Narosa publishing house, New Delhi,2007.

E-Resources

- https://www.acs.org/content/acs/en/greenchemistry/principles/12-principles-of-green-chemistry.
- https://www.betterworldsolutions.eu/event/green-chemistry-technology.
- https://en.wikipedia.org/wiki/Greenhouse_effect.
- https://onlinelibrary.wiley.com/doi/pdf/10.1002/9781118828083.ch1.
- https://en.wikipedia.org/wiki/Climate_change**.**

Course Outcomes

On successful completion of the course, the student will be able to

CO1	The connection between common atoms and complex molecules.
CO2	Explain and analyzing simple chemical reactions
CO3	Explore best practices related to organic farming and resource management
CO4	Explain the green house effects.
CO5	About the advance technology in green chemistry

Mapping of Bloom's Taxonomy – Programme Outcome with Course Outcome

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	2	2	1	2	3	1
CO2	2	2	2	1	2	1
CO3	2	2	1	2	1	1
CO4	2	1	2	2	3	1
CO5	2	2	1	1	2	2

1. Low, 2. Medium & 3. High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K – Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Upto K2	2	K1 & K2	2(K2&K2)	1(K2)
2	CO2	Upto K3	2	K1 & K2	2(K3&K3)	1(K3)
3	CO3	Upto K4	2	K1 & K2	2(K3&K3)	1(K4)
4	CO4	Upto K3	2	K1 & K2	2(K2&K2)	1(K3)
5	CO5	Upto K2	2	K1 & K2	2(K2&K2)	1(K2)
No of Questions to be asked			10		10	05
No of Questions to be answered			10		05	03
Marks for each Question			01		04	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented
K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section –wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	05			05	5	5%
K2	05	24	20	49	49	49%
K3		16	20	36	36	36%
K4			10	10	10	10%
Total Marks	10	40	50	100	100	100%

Lesson Plan

Unit	Description	Hours	Mode
Unit I	a) Current status of chemistry and the Environment b) Evolution of the Environmental movement: Public awareness c) Dilution is the solution to pollution- Pollution prevention	5 5 5	Chalk and talk, Power point presentation, Group Discussion
Unit II	a) Definition – Principles of Green Chemistry b) Why is this new area of Chemistry getting to much attention c) Why should chemist pursue the Goals of Green Chemistry d) The roots of innovation – Limitations.	3 4 4 4	Chalk and talk, Power point presentation, Group Discussion
Unit III	a) Introduction - Fermentation and Bio transformations b) Production of Bulk and fine chemicals by microbial fermentation- Antibiotics c) Vitamins - Bio catalyses synthesis of industrial chemicals by bacterial constructs - Future Tends.	4 5 6	Chalk and talk, Power point presentation, Group Discussion
Unit IV	a) Introduction - How the green house effect is produced b) Major sources of green house gases - Emissions of CO_2 c) Impact of green house effect on global climate d) Control and remedial measures of green house effect d) Global warming a serious threat - Important points.	3 3 3 3 3	Chalk and talk, Power point presentation, Group Discussion
Unit V	a) Green analytical methods, Redox reagents, Green catalysts; b) Green nano-synthesis, Green polymer chemistry, Exploring nature, Biomimetic, Proliferation of solvent-less reactions; c) Non-covalent derivation, Biomass conversion, emission control.	4 6 5	Chalk and talk, Power point presentation, Group Discussion

Course Designed by Mr.S.Philip Arockiaraj and Mrs.M.Shanmuga Priya

Programme	M.Sc Chemistry	Programme Code		PCH
Course Code	20PCHC4P	Number of Hours / Cycle		10
Semester	IV	Max. Marks		100
Part	III	Credit		5
Core Project				
Course Title	Project Work	L	T	P
Cognitive Level	Up to K4	-	-	150

L- Lecture Hour, T – Tutorial Hour, P – Practical Hour

Preamble

This course is designed to reinforce the concepts with analytical techniques. It will provide a platform for students to have a hands-on training and present a report on research topic..

Course Requirements and Evaluation:

1. The duration of the experimental project is for one semester.
2. The students shall submit the project work done in the laboratory in a prescribed format on or before a specified date.
3. The student shall work under supervision and consultation with the faculty guide appointed for the purpose at every stage of the research work regularly and get approved.
4. The faculty guide shall be responsible for the continuous assessment of the course and his/her recommendation for final evaluation of the project shall be mandatory.
5. Students have to submit their project report (2 bounded copies) in the prescribed format (70 to 100 pages) in A4 size. The Project work has to be duly recommended by the faculty guide and the Head of the Department for appearing in the final Viva Voce. The Viva-Voce shall be conducted by an External examiner. The marks will be allotted on the prescribed basis as given below:

A. Continuous Internal Assessment

Selection of the problem	5 Marks
Analysis of samples collected	5 Marks
Attending project review meeting	10 Marks
Analysis, Conclusion and Reporting	10 Marks
Project report	10 Marks
Total	**40 Marks**

B. End Semester Examination (Viva Voce)

Individual Presentation	30 Marks
Answering the queries	30 Marks
Total	**60 Marks**