DHANALAKSHMI SRINIVASAN

COLLEGE OF ARTS & SCIENCE FOR WOMEN (AUTONOMOUS)

Perambalur-621 212

(Reaccredited with "A++" Grade by NAAC in Third Cycle)

(44th Rank in National Institutional Ranking Frame work)

(Affiliated to Bharathidasan University)

(M.Sc., Chemistry Course Structure under CBCS-LOCF)

DEPARTMENT OF CHEMISTRY 2024-2025

SEM	COURSE	COURSE	COURSE CODE	Hrs	Credit	Exam Hours	Marks		Final
							CIA	SE	
I	Core Course –I	Organic Chemistry-I	24PCH1C1	6	6	3	25	75	100
	Core Course –II	Inorganic Chemistry- I	24PCH1C2	5	5	3	25	75	100
	Core Course–III	Physical Chemistry-I	24PCH1C3	5	5	3	25	75	100
	Core Practical -I	Inorganic Chemistry Practical	24PCH1C1P	6	3	6	40	60	100
	Core Elective Course –I	A)Analytical Chemistry	24PCH1E1A	5	3	3	25	75	100
		B)Supramolecular Chemistry	24PCH1E1B						
	Value added course -I	Pharmaceutical Chemistry	24PCH1VAC	3	2	3	25	75	100
			Total	**30**	**24**	**-**	**165**	**435**	**600**
II	Core Course –IV	Organic Chemistry-II	24PCH2C4	5	5	3	25	75	100
	Core Course –V	Inorganic Chemistry -II	24PCH2C5	5	5	3	25	75	100
	Core Course –VI	Physical Chemistry-II	24PCH2C6	4	4	3	25	75	100
	Core Course –VII	Physical Methods in Chemistry	24PCH2C7	4	4	3	25	75	100
	Core Practical -II	Organic Chemistry Practical	24PCH2C2P	6	3	6	40	60	100
	Industrial Based Course	Industrial Chemistry	24PCH2I1	3	3	3	25	75	100
	Non Major Elective	A) Chemistry of Pollution, Food and Cosmetics	24PCH2N1A	3	2	3	25	75	100

	Course –I	B) Agricultural Chemistry	24PCH2N1B						
	Self-Paced learning- I-Online course			-	2*	-	-	-	-
			Total	**30**	**26(2)**	**-**	**190**	**510**	**700**
III	Core Course -VIII	Organic Chemistry -III	24PCH3C8	6	6	3	25	75	100
	Core Course –IX	Physical Chemistry-III	24PCH3C9	5	5	3	25	75	100
	Core Course –X	Bioinorganic and Biophysical Chemistry	24PCH3C10	5	5	3	25	75	100
	Core Practical-III	Physical Chemistry Practical	24PCH3C3P	6	3	6	40	60	100
	Core Elective Course –II	A)Solid State Chemistry	24PCH3E2A	5	3	3	25	75	100
		B)Kinetics of Polymerization	24PCH3E2B						
	Non major Elective Course –II	A) Nanomaterials	24PCH3N2A	3	2	3	25	75	100
		B) Chemistry In Day-To-Day Life	24PCH3N2B						
	Internship/Field Study/ Industrial Visit		24P3IV	-	1	-	-	-	100*
	Self-Paced learning- I-Online course			-	2*	-	-	-	-
			Total	**30**	**25(2)**	**-**	**165**	**435**	**600**
IV	Core Course –XI	Inorganic Spectroscopy	24PCH4C11	6	6	3	25	75	100
	Core Elective Course –III	A) Green Chemistry	24PCH4E3A	6	3	3	25	75	100
		B)Catalysis	24PCH4E3B						
	Project	Project Work	24PCH4PW	18	6	-	40	60	100
Total				**30**	**15**		**90**	**210**	**300**
Grand Total				**120**	**90**	**-**	**610**	**1590**	**2200**
Extra Credit Course					**90(4*)**				**2200**

PROGRAMME OUTCOMES

PO1	**Problem solving**: Develop problem-solving skills using chemical principles
PO2	**Analytical skills**: Use sophisticated instruments to synthesize, separate, and characterize chemical compounds
PO3	**Research skills**: Develop research skills through project work in various fields of chemistry
PO4	**Communication**: Communicate scientific information clearly and concisely, both orally and in writing
PO5	**Critical thinking**: Develop critical thinking skills and the ability to draw logical conclusions

PROGRAMME SPECIFIC OUTCOMES

PSO1	Gains complete knowledge about all fundamental aspects of all branches of chemistry
PSO2	Understands the basic concepts behind complex chemical structures, reagents in organic syntheses, reactive intermediates, important organic reactions and its mechanisms, naming reactions, molecular rearrangements, stereochemistry, instrumental method of chemical analysis and natural products etc.
PSO3	Identify the importance of various elements present in the periodic table, coordination chemistry and structure of molecules, properties of compounds, structural determination of complexes using theories and instruments, complex metal drugs and catalysts, role of metal ions in biological processes and organometallic chemistry
PSO4	Gathers attention about the physical aspects of atomic structure, quantum chemistry, thermodynamics, reaction pathways with respect to time, various energy transformations, significance of electrochemistry, molecular spectroscopy, role of catalysts in reactions, polymer chemistry, materials chemistry and bio-physical chemistry.
PSO5	Carry out experiments in the area of organic analysis, estimation, separation, derivative process, inorganic semi micro analysis, preparation, conductometric and potentiometric analysis

CORE COURSE-I
ORGANIC CHEMISTRY-I

Semester	**: I**	**Max. Marks**	**: 75**
Course Code	**: 24PCH1C1**	**Credit**	**: 06**
Total Periods	**:90**	**Exam Hrs**	**: 03**

OBJECTIVES

- To understand the concept of aromaticity
- To understand the feasibility and the mechanism of various organic reactions.
- To comprehend the techniques in the determination of reaction mechanisms.
- To understand the concept of stereochemistry involved in organic compounds.
- To correlate and appreciate the differences involved in the various types of organic reaction mechanisms.

UNIT-I: Aromaticity **(18 Periods)**

Aromaticity: Aromatic character- Five, six, seven, and eight membered rings-other systems with aromatic sextets – Huckel's theory of aromaticity, Craig's rule- concept of homoaromaticity and antiaromaticity. NMR concept of aromaticity and antiaromaticity on benzenoid aromatic compounds- systems with 2,4,8 and 10 electrons, systems of more than 10 electrons (annulenes), Mobius aromaticity. Alternant and non-alternant hydrocarbons (azulene type) – aromaticity in heterocyclic molecules. Syndnones and fullerenes.

UNIT – II: Nucleophilic Substitution Reactions **(18 Periods)**

Aliphatic nucleophilic substitution –S_N1, S_N2, S_Ni mechanisms – ion-pair in S_N1 mechanisms – neighboring group participation- non-classical carbocations – substitutions at allylic and vinylic carbons. Reactivity–effect of structure, nucleophile, solvent effects, leaving group and stereochemical factors.

Aromatic nucleophilic substitutions – S_N1, S_NAr and Benzyne mechanism. Ullmann, Sandmeyer and Chichibabin reaction. Rearrangements involving nucleophilic substitution – Stevens – Sommelet-Hauser and von-Richter rearrangements.

UNIT – III :Electrophilic Substitution Reactions **(18 Periods)**

Aromatic electrophilic substitution reaction – orientation, reactivity and mechanisms based on

transition state theory with suitable reactions – substitutions in thiophene and pyridine – N-oxide – quantitative treatment of the structural effects on reactivity.

Substituent effects – origins of Hammett equation – principles of Hammett correlation – effect of structure on reaction mechanisms Hammett parameters, modified forms of Hammett equation, Taft Equation.

Aliphatic electrophilic substitution – S_E1, S_E2 and S_Ei mechanisms – diazonium coupling reactions – metals as electrophile in substitution reactions and decomposition of diazonium salts.

UNIT-IV: Stereochemistry **(18 Periods)**

Introduction to molecular symmetry and chirality – axis, plane, center, alternating axis of symmetry. Optical isomerism due to asymmetric and dissymmetric molecules with C, N based chiral centers. Optical purity, prochirality, enantiotopic and diastereotopic atoms(or groups).

Configurations of allenes, spiranes, biphenyls, binaphthyls, and cyclophanic compounds, exo-cyclic, alkylidene-cycloalkanes.Topicity and prostereoisomerism. Criteria for optical purity. Resolution of racemic modifications, Stereoselective and stereospecific synthesis.

UNIT-V: Rearrangements electron deficient C, N and O **(18 Periods)**

Rearrangements to electron deficient carbon: Pinacol-pinacolone Wagner-Meerwein, , Baker-Venkataraman, Benzilic acid and Wolff rearrangements.

Rearrangements to electron deficient nitrogen: Hofmann, Curtius, Schmidt, Lossen, Beckmann rearrangements.

Rearrangements to electron deficient oxygen: Baeyer-Villiger oxidation and Dakin rearrangements.

Intramolecular rearrangements – Claisen, Cope, Oxy-Cope Benzidine rearrangements.

UNIT-VI: Rearrangements to electron rich atom ((For Continuous Internal Assessment Only)

Rearrangements to electron rich atom: Favorskii, Stevens, [1,2]-Wittig and [2,3]-Wittig rearrangements. Fries and Photo Fries rearrangement. Intramolecular rearrangements – Claisen, Cope, oxy-Cope Benzidine rearrangements.

Text books

1.J. March and M. Smith, Advanced Organic Chemistry, 5th edition, John-Wiley and Sons.2001.

2.E. S. Gould, Mechanism and Structure in Organic Chemistry, Holt, Rinehart and Winston Inc., 1959.

3.P.S.Kalsi, Stereochemistry of carbon compounds, 8th edition, New Age International Publishers, 2015.

4.P. Y. Bruice, Organic Chemistry, 7th edn, Prentice Hall, 2013.

5.J.Clayden, N. Greeves, S. Warren, Organic Compounds, 2nd edition, Oxford University Press, 2014

6.Morrison Boyed and Bhattacharjee,7th edition ,,Organic Chemistry.

7.P.L.Soni 29TH EDITION, Text book of Organic Chemistry.

Reference Books

1.F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part-A and B, 5th edition, Kluwer Academic / Plenum Publishers, 2007.

2.D. G. Morris, Stereochemistry, RSC Tutorial Chemistry Text 1, 2001.

3.N.S. Isaacs, Physical Organic Chemistry, ELBS, Longman, UK, 1987.

4.E. L. Eliel, Stereochemistry of Carbon Compounds, Tata-McGraw Hill, 2000.

5.I. L. Finar, Organic chemistry, Vol-1&2, 6th edition, Pearson Education Asia, 2004.

COURSE OUTCOMES

CO number	CO statement	Knowledge level
	On the Successful completion of the course the student would be able	
CO1	To recall the basic principles of organic chemistry.	K3
CO2	To understand the formation and detection of reaction intermediates of organic reactions	K4
CO3	To predict the reaction mechanism of organic reactions and stereochemistry of organic compounds.	K4
CO4	To apply the principles of kinetic and non-kinetic methods to determine the mechanism of reactions.	K5
CO5	To design and synthesize new organic compounds bycorrelating the stereochemistry of organic compounds.	K6

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course					Hours	Credits			
I	24PCH1C1	ORGANIC CHEMISTRY-I					6	6			
Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	2	3	3	2	3	2	2.7
CO2	2	3	3	3	3	3	3	3	3	3	2.9
CO3	3	3	3	2	2	3	2	2	2	2	2.4
CO4	2	2	3	3	3	3	3	3	3	2	2.7
CO5	2	3	3	2	2	3	2	2	3	3	2.5
Mean overall score											2.6 (High)

CORE COURSE-II

INORGANIC CHEMISTRY-I

Semester	**: I**	**Max. Marks**	**:75**
Course Code	**: 24PCH1C2**	**Credit**	**:05**
Total Periods	**:75**	**Exam Hrs**	**:03**

OBJECTIVES

- o understand the concepts of bonding and identify the structure and bonding of simple molecules
- To gain fundamental knowledge on the structural aspects of ionic crystals.
- To understand the various types of solid-state packing, types of chemical forces and defects in crystals
- To gain knowledge on the structural properties of main group compounds and structure

UNIT-I: Covalent Bonding **(15 Periods)**

Valance Bond Theory (VBT) - Concept of hybridization and structure of molecules ($BeCl_2$, BCl_3 and CCl_4, SF_4, ClF_3, BrF_3 , BrF_5 , IF_5, IF_7). VSEPR theory- Shapes of molecules. Molecular Orbital Theory (MOT) of covalent bonding– symmetry and overlap of atomic orbitals – symmetry of molecular orbitals – sigma, pi and delta bonding – energy levels in homo and hetero nuclear diatomic systems (N_2,O_2,NO,CO) – bond length, bond order and bond energy.

UNIT – II: Main Group Chemistry **(15 Periods)**

Chemistry of boron – borane, higher boranes, carboranes, borazines and boron nitrides. Chemistry of silicon – Classification of silicates- silanes- silicon nitrides- silicones. P-N compounds, linear and cyclophosphazenes . S-N compounds – S_2N_2, S_4N_4, (SN)x, polythiazyl compounds, S-N cations and anions, S-P compounds – molecular sulphides such as P_4S_3, P_4S_7, P_4S_9 and P_4S_{10}.

UNIT-III:Interhalogens , Pseudo halogens and Noble gas Compounds **(15 Periods)**

Pseudo halogens-$(CN)_2$,$(SCN)_2$,$(SeCN)_2$,$(SCSN_3)_2$-Pseudohalide ion.Inter halogen Compounds-Structure and bonding in ClF_3, BrF_3 , BrF_5 , IF_5, IF_7 etc . Isopoly and heteropoly acids – Structure and bonding of 6- and 12-isopoly and heteropoly anions.

Structure and Bonding in Noble gas compounds – XeF_2, XeF_4, $XeOF_2$, $XeOF_4$, XeF_6.

UNIT-IV: Solid state-Structure **(15 Periods)**

Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing, voids in crystal lattice, Radius ratio, Lattice energy – Born Haber Cycle– Born-Lande equation - Kapustinski equation, Madelung constant.

Structural features of the crystal systems: Rock salt, zinc blende & wurtzite, fluorite and anti-fluorite, cadmium iodide and nickel arsenide. Spinel's -normal and inverse types and perovskite structures-examples.

UNIT-V: Metallic Bonding and defects in solids **(15 Periods)**

Band theory – features and its application of conductors, insulators and semiconductors, Intrinsic and extrinsic (N&P type) semiconductors; Superconductivity. Defects in crystals – point defects (Schottky, Frenkel, metal excess and metal deficient) and their effect on the electrical and optical property- laser and phosphors- Linear defects and its effects due to dislocations, Plane defects.

UNIT-VI: Inorganic Photochemistry **(For Continuous Internal Assessment Only)**

Photochemistry of cobalt (III) complexes – mechanism of CTTM, photoreduction – ligand-field photochemistry of chromium (III) complexes – Adamson's rules, photoactive excited states, V-C model – photo physics and photochemistry of ruthenium – polypyridine complexes, emission and redox properties.

Text books

1 A R West, Solid state Chemistry and its applications, 2ndEdition (Students Edition), John Wiley & Sons Ltd., 2014.
2. A K Bhagi and G R Chatwal, A textbook of inorganic polymers, Himalaya Publishing House, 2001.
3. L Smart, E Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2012.
4. K. F. Purcell and J. C. Kotz, Inorganic Chemistry; W.B. Saunders company: Philadelphia, 1977.
5. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry; 4th ed.; Harper and Row: NewYork, 1983.
6. J.D.Lee ,fifth edition, Inorganic Chemistry .
7. Puri ,Sharma , Kaliya 33rd edition , Principles of Inorganic Chemistry.

Reference books

1. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, 1994.
2. R J D Tilley, Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication, 2013.
3. C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press, 199.

4. T. Moeller, Inorganic Chemistry, A Modern Introduction; John Wiley: New York, 1982.
5. D. F. Shriver, P. W. Atkins and C.H. Langford; Inorganic Chemistry; 3rd ed.; Oxford University Press: London, 2001.

COURSE OUTCOMES

CO number	CO statement On the Successful completion of the course the student would be able	Knowledge level
CO1	To Predict the geometry of main group compounds and clusters	K3
CO2	To Explain about the packing of ions in crystals and apply the radius ratio rule to predict the coordination number of cations	K4
CO3	To Understand the various types of ionic crystal systems and analyze their structural features.	K4
CO4	To analyze the crystal growth methods.	K5
CO5	To analyze the principles of diffraction techniques and microscopic techniques	K6

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course					Hours				Credits
I	24PCH1C2	INORGANIC CHEMISTRY-I					5				5
Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	3	3	2	2	3	3	2	3	2	2.5
CO2	3	3	3	3	3	3	2	3	3	3	2.9
CO3	3	3	1	2	2	3	2	2	2	2	2.2
CO4	2	2	3	3	3	3	3	3	3	2	2.7
CO5	2	3	3	2	3	2	3	2	3	2	2.5
Mean overall score											2.56 (High)

CORE COURSE-III
PHYSICAL CHEMISTRY-I

Semester	**: I**	**Max. Marks**	**: 75**
Course Code	**: 24PCH1C3**	**Credit**	**: 05**
Total Periods	**: 75**	**Exam Hrs**	**: 03**

OBJECTIVES

- To understand the kinetics of chemical kinetics and explore the reaction kinetics of fast reactions.
- To learn the various techniques and mechanism of involved in catalysis.
- To gain on understanding of the Ionic activity, ionic interactions, Debye-Hückel-Bjerrum model, Debye-Hückel limiting law.
- To study the Debye-Hückel theory of strong electrolytes.
- The design and applications of the batteries and Fuel Cells, Corrosion and its Protection.

UNIT-I: Chemical Kinetics and Catalysis (15 Periods)

Absolute reaction rate theory -Thermodynamic terms-Significance of entropy and volume of activation. Reactions in solution- factors determining reaction rates in solutions, effect of dielectric constant and ionic strength. Bronsted –Bjerrum equation-Primary and Secondary salt effect, influence of solvent on reaction rates.

Acid base catalysis-Bronsted relations, catalytic coefficients and their determination. Enzyme catalysis and its mechanism, Michaelis-Menten equation, effect of pH and temperature on enzyme catalysis, unimolecular reactions-Bimolecular reactions-Langmuir Hinshelwood and Elay-Rideal mechanism.

UNIT-II: Chemical Dynamics (15 Periods)

Potential energy surfaces-Dynamics of unimolecular reactions-Lindemann Hinshelwood, Rice-Ramsperger- Kassel(RRK) theory. Rice-Ramsperger-Kassel -Marsus (RRKM) theory.

Study of fast reactions by stopped flow techniques- relaxation method, flash photolysis and the nuclear magnetic resonance method.

Linear free energy relationship-Hammett equation, Taft equation-Separation of polar, resonance and steric effects.

UNIT-III: Photochemistry **(15 Periods)**

Jablonski diagram, Primary and Secondary Processes, quantum yield and its determination-Chemical actinometer. Excimers and exciplexes-Kinetics of collisional quenching- Stern Volmer equations. Photosensitization, Chemiluminescence. Photosynthesis, solar energy conversions. Semiconductor photo catalysis, lasers.

Radiation Chemistry-linear energy transfer, G-value, dosimeters, radiolysis of water, solvated electrons.

UNIT- IV: Electrochemistry – I **(15 Periods)**

Deviation from ideal behaviour - ion-solvent and ion-ion interactions. Bjerrum model, Ion association and triple ion formations. Mean activity coefficient-Debye-Hückel limiting law and its applications -Diverse ion effect. Debye-Hückel theory of strong electrolytes. Debye-Hückel length and potential around a central ion, its interpretation. Transport of ions in Solution: Electrolytic conduction-Debye - Hückel-Onsager treatment of strong electrolytes- ionic atmosphere- Anomalous conductance of non aqueous electrolytes.

UNIT -V: Electrochemistry- II **(15 Periods)**

Electrical double layer - Electrocapillary phenomena - Surfactants - Lipmann's equation, Electrokinetic phenomena. Zeta potential and its applications.Structure of electrical double layer – Helmholtz-Perrin, Guoy-Chapmann and Stern models. Butler-Volmer equation for one electron transfer reaction - equilibrium and exchange current densities- and symmetry factor - transfer coefficient.Cyclic voltammetry and Stripping voltammetry - principle – instrumentation- Corrosion and passivation of metals - Pourbaix diagram - Evans diagram –Batteries and Fuel cells-Ion selective electrodes.

UNIT – VI: Colloids and Micelles **(For Continuous Internal Assessment Only)**

Colloids: Distinction between suspension, colloidal solutions and true solutions – lyophilc and lyophobic colloids – Tyndall effect – stability of colloids – coagulation – emulsions – various types. Micelles: Surfactant (amphipathic molecules) – micellization - critical micelle concentration – size of micelle – aggregation number – Thermodynamics of micellization– reverse micelles.

Reference

1. R. G. Frost and Pearson, Kinetics and Mechanism, Wiley New York, 1961.

2. C. Capellos and B. H. J. Bielski, Kinetic Systems, Wiley Interscience, New York, 1968.
3. K. J. Laidler, Chemical Kinetics, Harper and Row, New York, 1987.
4. Samuel Glasstone and David Lewis 2nd edition ,Elements of Physical Chemistry.
5. G. M. Harris, Chemical Kinetics, D. C. Health and Co, 1966.
6. A. W. Anderson, Physical Chemistry of Surfaces, Wiley – Inter Science, Network, 1990.
7. Paula, Peter Atkins and Julio de, Elements of Physical chemistry, 5th Ed, Oxford U. P, 2012.
8. John O'M Bockris, Amula K. N. Reddy, and Maria Gamboa–Aldeco, Modern Electrochemistry 2A, 2nd Ed, Kluwer Academic / Plenuim Publishers, NewYork, 2000.
9. Mordechay Schlesinger, Modern Aspects of Electrochemistry: Issue 43, Springer, Netherlands, 2009.
10. Philip H. Rieger, Electrochemistry ,2nd Edition, 2010.
11. Keith Oldham, Jan Myland and Alan Bond, Electrochemical Science and Technology: Fundamentals and Applications, John Wiley and Sons, New York, 2012.
12. G. L. Agarwal, Basic Chemical Kinetics, Tata McGraw Hill, 1990.
13. K. J. Laidler, Chemical Kinetics, Tata Mc Graw Hill, 1990.
14. Robert J Silbey, Robert A Alberty and Moungi G Bawendi, Physical Chemistry 4th Ed,NJ Hoboken: Wiley, 2015.
15. N. J. Turro, Modern molecular photochemistry, Benjamin/Cummings, Menlo Park, California, 1978.
16. Revise G. W. Castellan, Physical Chemistry, Narosa publishing House, New Delhi, Ed, 2011.
17. Gordon. M. Barrow, Physical Chemistry, Tata McGraw Hill Edition, New York, 2011.
18. L. R. Puri, Y. R. Sharma and R. S. Pathania, Principles of Physical Chemistry 46th Ed, 2012.
19. J. N. Gurtu and A. Gurthu, Advanced Physical Chemistry, Pragathi Prakashan, Meerut, Revised, 2014.

COURSE OUTCOMES

CO number	CO statement On the Successful completion of the course the student would be able	Knowledge level
CO1	To understand and explore the reaction kinetics of fast reactions	K3
CO2	To learn the theory, kinetics and mechanism of enzyme catalysis	K4
CO3	Understand concepts of Ionic interactions, theory of electrolytes, double layer models, Debye Hückel limiting law.	K4
CO4	To analyze the designs of Batteries, Fuel cells and ion selective electrodes	K5
CO5	To learn theories of electrochemistry	K6

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course	Hours	Credits
I	**24PCH1C3**	**PHYSICAL CHEMISTRY-I**	**5**	**5**

Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	3	2	2	3	2	2	3	3	2.4
CO2	3	1	3	3	3	3	2	3	2	3	2.6
CO3	2	3	1	2	2	3	2	2	2	2	2.1
CO4	2	2	3	3	2	3	3	2	3	3	2.6
CO5	3	3	3	2	1	2	3	2	3	2	2.4
Mean overall score											**2.4 (High)**

CORE PRACTICAL -I
INORGANIC CHEMISTRY PRACTICAL

Semester	**: I**	**Max. Marks**	**: 75**
Course Code	**: 24PCH1C1P**	**Credit**	**: 03**
Total Periods	**: 90**	**Exam Hrs**	**: 06**

OBJECTIVES

- To perform the semi-micro qualitative
- To carry out colorimetric analysis.

1. Semi-micro qualitative analysis

Analysis of mixture of cations: Analysis of a mixture of four cations containing two common cations and two rare cations. Cations to be tested.

Group-I : W, Tl and Pb.

Group-II : Se, Te, Mo, Cu, Bi and Cd.

Group-III : Tl, Ce, Th, Zr, V, Cr, Fe, Ti and U.

Group-IV : Zn, Ni, Co and Mn.

Group-V : Ca, Ba and Sr.

Group-VI : Li , Mg & $NH4^{+}$

2.Estimation of copper, ferric, nickel, chromium and manganese ions using photoelectric colorimeter

Text and Reference Books

1. V. V. Ramanujam, Inorganic Semimicro Qualitative Analysis; 3rd Ed., National Pubs, London, 1988.

2. G. Svehla, Text Book of Macro and Semimicro Qualitative Inorganic Analysis; 5th Ed., Longman group Ltd, London, 1987.

3. A. I. Vogel, Text Book of Quantitative Inorganic Analysis; 6th Ed., Longman, New Delhi, 2000.

COURSE OUTCOMES

CO number	CO statement	Knowledge level
	On the Successful completion of the course the student would be able	
CO1	To analyze common and rare cations present in a mixture	**K3**
CO2	To do colorimetric analysis	**K5**
CO3	To Demonstrate and understand the applications of colorimetry analysis in Industries.	**K6**

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course							Hours	Credits
I	24PCH1C1P	INORGANIC CHEMISTRY PRACTICAL							6	3
Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	3	2	2	3	2	2	1	3	2.2
CO2	3	1	3	2	3	2	2	3	2	2	2.3
CO3	3	3	1	2	2	3	2	2	3	2	2.3
Mean overall score											2.3 (High)

CORE ELECTIVE COURSE-I
ANALYTICAL CHEMISTRY

Semester	**: I**	**Max. Marks**	**: 75**
Course Code	**: 24PCH1E1A**	**Credit**	**: 03**
Total Periods	**: 75**	**Exam Hrs**	**: 03**

OBJECTIVES

- To learn the instrumental methods
- To learn the nature of errors and their types.
- To understand the various techniques in chromatography.
- To understand the principles and instrumentation of thermo analytical and fluorescence techniques.
- To studying detail the electroanalytical techniques.

UNIT – I :Data and Error Analysis (15 Periods)

Various types of error – accuracy, precision, significant figures – frequency distributions, the binomial distribution, the Poisson distribution and normal distribution – describing data, population and sample, mean, variance, standard deviation, way of quoting uncertainty, robust estimators, repeatability and reproducibility of measurements.

Hypothesis testing, levels of confidence and significance, test for an outlier, testing variances, means T-Test, paired t-Test – analysis of variance (ANOVA) – correlation and regression.

UNIT – II: Chromatography (15 Periods)

Solvent extraction – principles of Thin layer, Paper, Column and ion exchange chromatography techniques – columns, adsorbents, methods, $R_f$values, McReynold's constants and their uses – HPTLC, HPLC techniques – adsorbents, columns, detection methods, GC, GC-MS techniques – methods, principles and uses.

UNIT – III: Thermo Analytical Methods and Fluorescence Spectroscopy (15 Periods)

Principles – instrumentations and applications of thermogravimetry analysis (TGA), Differential Thermal Analysis (DTA) and Differential Scanning Calorimetry (DSC) – thermometric titrations – types – advantages. Basic aspects of synchronous fluorescence spectroscopy – spectral hole burning – flow cytometry – fluorometers (quantization) – instrumentation – applications.

UNIT – IV: Electroanalytical Techniques (15 Periods)

Polarography – principles and instrumentation – dropping mercury electrode – advantages –Ilkovic equation – applications of polarography – polarographic maxima – oscillographic polarography, AC polarography – cyclic voltammetry – advantages over polarographic techniques – chronopotentiometry – advantages – controlled potential coulometry – amperometry titrations: principles – techniques – applications – estimation of lead.

UNIT – V: Instrumental Methods of Analysis (15 Periods)

Principles and applications of extended X-ray absorption fine structure (EXAFS) – surface extended X-ray absorption (SEXAFS) – atomic absorption spectroscopy (AAS) – flame emission spectroscopy (FES) – turbidimetry – theory and applications. Instrumentation and sampling techniques in UV-visible and IR spectroscopy.

UNIT – VI: Types of Titrations (For Continuous Internal Assessment Only)

Redox titration: Redox potentials, theory and feasibility of redox titration, calculation of potentials at different stages of titrations, redox indicators, their choice and applications. Precipitation titrations: Theory and types, Mohr, Volhard and Fajan's methods. Adsorption indicators: theory, choice and applications. Complexometric titrations: Theory, Stepwise and overall formation constants, Titrations involving chelates (EDTA). Metallochromic indicators: Theory and Choice, Masking and demasking methods and applications.

References

1. D. B. Hibbert and J. J. Gooding, Data Analysis for Chemistry; Oxford University Press, UK, 2006.
2. J. Topping, Errors of Observation and Their Treatment; 4th Ed., Chapman Hall, London, 1984.
3. A. Braithwaite and J. F. Smith, Chromatographic Methods; 5th Ed., Springer, Germany; 1995.
4. V. K. Srivastava and K. K. Srivastava, Introduction to Chromatography; 2nd Ed., Holden Day, New York, 1985.
5. H. H. Willard, L. L. Merritt, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis; 6th Ed., CBS Publishers and Distributors, Chennai, 1986.
6. D. A. Skoog, D. M. West and D. J. Holler, Fundamentals of Analytical Chemistry, 7th Ed., Harcourt College Publishers, Singapore, 2004.

7. A. Sharma, S. G. Schulman, Introduction to Fluorescence Spectroscopy; WileyInterscience, New York, 1999.
8. C. N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy; 4th Ed., Tata McGraw-Hill, New Delhi, 1994.
9. A. I. Vogel, Text Book of Quantitative Inorganic Analysis; 6th Ed., Longman, New Delhi, 2000.
10. D. C. Harris, Quantitative Chemical Analysis; 4th Ed., W. H. Freeman Publications, New York, 1995.
11. S. C. Gupta, Fundamentals of Statistics; 6th Ed., Himalaya Publications, Delhi, 2006.

COURSE OUTCOMES

CO number	CO statement On the Successful completion of the course the student would be able	Knowledge level
CO1	To get the capability to explain the spectroscopy techniques.	K3
CO2	To understand the mathematical applications of data and error analysis	K4
CO3	To explain the different chromatographic methods.	K4
CO4	To analyses theoretically and instrumentation techniques of fluorescence spectra.	K5
CO5	To develop Capacity to analyze the electro analytical techniques.	K6

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course					Hours				Credits
I	24PCH1E1A	ANALYTICAL CHEMISTRY					5				3
Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	3	2	2	3	2	3	3	2	2.5
CO2	2	2	3	2	3	3	2	3	2	3	2.5
CO3	3	3	3	2	2	3	2	3	2	3	2.6
CO4	2	2	3	3	2	2	3	2	3	3	2.5
CO5	3	2	3	2	3	2	2	2	2	2	2.3
Mean overall score											2.5(High)

CORE ELECTIVE COURSE-I
SUPRAMOLECULAR CHEMISTRY

Semester	**: I**	**Max. Marks**	**: 75**
Course Code	**: 24PCH1E1B**	**Credit**	**: 03**
Total Periods	**: 75**	**Exam Hrs**	**: 03**

OBJECTIVES

- To know the fundamentals of supramolecules.
- To learn about Metallo Organic Frameworks
- To learn co-receptor molecules and multiple recognition
- To study the supramolecular reactivity and catalysis.
- To understand Supramolecular devices and sensors

UNIT – I: Concepts Of Supramolecular Chemistry (15 Periods)

Concepts and languages of supramolecular chemistry – various types of noncovalent interactions – hydrogen bonds, C-H···X interactions, halogen bonds – π-π interactions, non–bonded interactions – various types of molecular recognition.

Crystal engineering of organic solids – hydrogen bonded supramolecular patterns involving water / carboxyl / halide motifs – concepts of different types of synthons based on non-covalent interactions .

UNIT – II :Metallo Organic Frameworks (15 Periods)

M.O.F (Metallo Organic Frameworks) – organometallic systems – combinations of different interactions to design molecular rods, triangles, ladders, networks, etc. – design of nano porous solids – inter ligand hydrogen bonds in metal complexes – implications for drug design – crystal engineering of NLO materials, OLED.

UNIT – III :Co-Receptor Molecules and Multiple Recognition (15 Periods)

Dinuclear and polynuclear metal ion cryptates– linear recognition of molecular length by ditopic co-receptors – heterotopic co-receptors – cyclophane receptors, amphiphilic receptors and large molecular cages – multiple recognition in metallo receptors – supramolecular dynamics.

UNIT – IV: Supramolecular Reactivity and Catalysis (15 Periods)

Catalysis by reactive macro cyclic cation receptor molecules – catalysis by reactive anion receptor molecules – catalysis with cyclophane type receptors – supramolecular metallo catalysis– cocatalysts– catalysis of synthetic reactions – biomolecular and abiotic catalysis.

Supramolecular chemistry in solution – cyclodextrin, micelles, dendrimers, gelators– classification and typical reactions – applications.

UNIT – V :Supramolecular Devices (15 Periods)

Supramolecular devices and sensors – various types of supramolecular devices – an overview – supramolecular photochemistry – molecular and supramolecular photonic devices – light conversion and energy transfer devices – molecular and supramolecular electronic devices – electronic conducting devices – molecular wires, modified and switchable molecular wires – molecular and supramolecular ionic devices – tubular mesophases, molecular protonics– switching devices – electro-photo switch – ion and molecule sensors – role of supramolecular chemistry in the development of nanoscience and technology.

UNIT – VI : Biological Supramolecular Systems (For Continuous Internal Assessment Only)

Ionophores, Porphyrin and other Tetrapyrrolic Macrocycles, Coenzymes, Neurotransmitters, DNA and Biochemical Self-assembly. Supramolecular reactivity. Biomimetic systems and Artificial receptors.

References

1. J. M. Lehn, Supramolecular Chemistry; VCH, Weinheim, Germany, 1995.
2. G. R. Desiraju, Crystal Engineering: The Design of Organic Solids; Elsevier, United States, 1989.
3. G. R. Desiraju, and T. Steiner, The Weak Hydrogen Bond in Structural Chemistry and Biology; Oxford University Press, Oxford, 1999.
4. G. A Jeffrey, Introduction to Hydrogen Bonding; Oxford University Press: UK, 1997.
5. J. M. Lehn, Transition Metals in Supramolecular Chemistry; John Wiley and Sons: New York, 1999.
6. G. R. Desiraju, Current Science; 2001, 81, 1038.
7. Web source:
   (i) Crystal Growth and Design,http://www.pubs.acs.org/journals/cgdefu/index.html
   (ii) Crystal Engineering Communication http://www.rsc.org/Publishing/Journals/ce/index.asp

COURSE OUTCOMES

CO number	CO statement	Knowledge level
	On the Successful completion of the course the student would be able	
CO1	To know the fundamentals of supramolecules.	K3
CO2	To learn about Metallo Organic Frameworks	K4
CO3	To learn co-receptor molecules and multiple recognition	K4
CO4	To study the supramolecular reactivity and catalysis.	K5
CO5	To analyses Supramolecular devices and sensors	K6

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course					Hours				Credits
I	24PCH1E1B	SUPRAMOLECULAR CHEMISTRY					5				3
Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	3	2	2	3	2	3	3	3	2.5
CO2	2	2	3	2	3	3	3	3	2	3	2.6
CO3	3	3	3	2	3	3	2	3	2	3	2.7
CO4	3	2	3	3	2	2	3	2	3	3	2.6
CO5	3	2	3	2	3	3	3	3	3	3	2.8
Mean overall score											2.64(High)

VALUE ADDED COURSE
PHARMACEUTICAL CHEMISTRY

Semester	**: I**	**Max. Marks**	**: 75**
Course Code	**: 24PCH1VAC**	**Credit**	**: 02**
Total Periods	**: 45**	**Exam Hrs**	**: 03**

OBJECTIVE

- To study the anesthetics, sedatives, hypnotics, analgesics, antibiotics, enzymes, coenzymes, vitamin and photo transfer catalysis.

UNIT – I: Classification of Drugs **(9 Periods)**

Classification of drugs- Definition, examples and uses of general and local anesthetics, Sedatives and hypnotics. Definition and uses of narcotics, non-narcotics' drugs. Anti-inflammatory drugs.

UNIT – II: Antibiotics **(9 Periods)**

Antibiotics – structure and synthesis of Chloramphenicol, penicillin's and streptomycin.

UNIT – III: Enzymes **(9 Periods)**

Enzymes- co enzymes- Enzymes structure – primary, secondary, tertiary and quaternary. Enzyme kinetics, Enzyme inhibitors, irreversible and reversible inhibitions, Kcat inhibitors.

Enzyme Inhibitors as drugs like cytochrome P450 inhibitors, Aromatase, lipoxygenases. Protein and peptide drugs – insulin, somatostatin, Relaxin.

UNIT – IV: Vitamins **(9 Periods)**

Vitamins –Definition, classification – water – soluble vitamins (B1,B2,B3,B6,B12 and vitamin – C) and fat soluble vitamins (A,D,E and K) – occurrence, structure, deficiency diseases, biochemical rules and daily requirements, role of vitamins in the metabolism.

UNIT – V: Development of new drugs **(9 Periods)**

Introduction-Procedure followed in drug design. Structure-Activity Relationship (SAR).Factors effecting bioactivity – resonance and inductive effect. Theories of drug activity, occupancy theory, rate theory, induced-fit .

UNIT – VI: Anti septic **(For Continuous Internal Assessment Only)**

Antiseptics-Mechanism and action

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.

Reference Books

1. M.E. Wolf, Burger's Medicinal Chemistry and Drug Discovery: Therapautic Agents,Wiley Blackwell. 5th Edition, 1997.
2. G.L. Patrick, Introduction to medicinal Chemistry, Oxford University Press. 1995

Websites

1. https://nptel.ac.in/courses/104/105/104105032/

COURSE OUTCOMES

CO number	CO statement	Knowledge level
	On the Successful completion of the course the student would be able	
CO1	To familiarize the basic classification of drugs.	**K3**
CO2	To learn about the structure and synthesis of antibiotics.	**K3**
CO3	To know the classification of enzymes.	**K3**
CO4	To classify the protein and peptide drugs.	**K4**
CO5	To learn the Procedure followed in drug design	**K4**

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course					Hours	Credits			
I	24PCH1VAC	PHARMACEUTICAL CHEMISTRY					3	2			
Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	2	2	2	3	2	3	2	2	2.2
CO2	2	2	3	2	3	3	3	3	2	3	2.6
CO3	3	3	2	2	2	3	2	3	2	3	2.5
CO4	2	2	3	3	2	2	3	2	3	2	2.4
CO5	2	2	2	2	3	2	3	3	2	2	2.3
Mean overall score											2.4(High)

CORE COURSE-IV
ORGANIC CHEMISTRY-II

Semester : II **Max. Marks : 75**

Course Code : 24PCH2C4 **Credit : 05**

Total Periods : 75 **Exam Hrs : 03**

OBJECTIVES

- To understand the concept of aromaticity in benzenoid, non-benzenoid, heterocyclic and annulene compounds.
- To understand the mechanism involved in various types of organic reactions with evidences.
- To understand the applications of synthetically important reagents.

UNIT-I: Conformational analysis of acyclic and cyclic systems (15 Periods)

Definition-restricted rotation about carbon-carbon single bonds- conformation of ethane and n-butane-conformational free energy -conformational isomers and atropisomers- population of conformers-influence of dipole-dipole repulsion, van der Waals attractive force, intramolecular , H-bonding on stability. Conformers- Conformational analysis of cyclohexane systems-stability and isomers in mono and di-substituted cyclohexane.

UNIT-II: Dynamic stereochemistry conformation and reactivity (15 Periods)

Conformation and reactivity in acyclic systems -simple examples illustrating E2 and cis eliminations, intramolecular rearrangements, Winstein Elliel Equation, Steric assisted and steric hindered reaction. Simple reactions illustrating stereo and stereo-electronic factors – esterification, oxidation, nucleophilic substitution at ring carbons and elimination reactions - reactions involving intramolecular rearrangements – formation and cleavage of epoxides and neighboring group participation.

UNIT-III: Oxidation and Reduction Reactions (15 Periods)

Dehydrogenation by quinones- selenium dioxides, mercuric acetate lead tetraacetate, permanganate, peroxides, peracids, osmium tetroxide, oxidation of saturated hydrocarbons, alkyl groups, alcohols, halides and amines. Reduction of organic compounds with reagents based on $LiAlH_4$, $NaBH_4$, Raney Ni hydrazine, formic acid and dissolving metals. Clemmenson reaction, Wolf Kishner reduction, Birch Reduction.

UNIT-IV: Reagents and Modern Synthetic Reactions **(15 Periods)**

Use of the following reagents in organic synthesis and functional group transformation. Dicyclohexylcarbodiimide, 1,3 dithiane (reactive umpolung), trimethylsilyl iodide, tri-n-butyltin hydride, Woodward and Prevost hydroxylation, DDQ Wilkinson's Catalyst – Wittig reaction.- Lithium diisopropylamine (LDA),Copper diacetyl acetonate($Cu(acac)_2$). Pd Catalyzed reactions (Suzuki coupling, Heck reaction).

UNIT-V:.Asymmetric Synthesis **(15 Periods)**

Importance of asymmetric synthesis – problems with resolution methods – optical purity - enantiomeric excess – diastereomeric excess – chiral, substrate controlled, auxiliary controlled, catalyst controlled and solvent controlled asymmetric synthesis, example for each case, synthesis of longifolene by EJ Corey method.

UNIT – VI: Reagents for selective Oxidation (For Continuous Internal Assessment Only)

Oxidation with Cr (including PCC, PDC, Jones) and Mn (including MnO_2 and $BaMnO_4$) reagents. Oxidation with LTA, DDQ and SeO_2.

Text Books

1. J. March and M. Smith, Advanced Organic Chemistry, 5th ed., John-Wiley and Sons.2001.
2. E. S. Gould, Mechanism and Structure in Organic Chemistry, Holt, Rinehart and Winston Inc.,1959.
3. P. S. Kalsi, Stereochemistry of carbon compounds, 8thedn, New Age International Publishers,2015.
4. P. Y.Bruice, Organic Chemistry, 7thedn.,Prentice Hall, 2013.
5. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee Organic Chemistry, 7th edn., Pearson Education,2010.
6. Ahluwalia.V.K ,4th edition , Organic Reaction Mechanisms.

Reference Books

1. S. H. Pine, Organic Chemistry, 5thedn, McGraw Hill International Editionn,1987.
2. L. F. Fieser and M. Fieser, Organic Chemistry, Asia Publishing House, Bombay,2000.
3. E.S. Gould, Mechanism and Structure in Organic Chemistry, Holt, Rinehart and Winston Inc.,1959.

4. T. L. Gilchrist, Heterocyclic Chemistry, Longman Press, 1989.
J. A. Joule and K. Mills, Heterocyclic Chemistry, 4th ed., John- Wiley,2010.

COURSE OUTCOMES

CO number	CO statement	Knowledge level
	On the Successful completion of the course the student would be able	
CO1	To recall the basic principles of aromaticity of organic and heterocyclic compounds.	K3
CO2	To understand the mechanism of various types of organic reactions.	K3
CO3	To predict the suitable reagents for the conversion of selective organic compounds.	K4
CO4	To correlate the principles of substitution, elimination, and addition reactions.	K5
CO5	To design new routes to synthesis organic compounds.	K6

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course					Hours	Credits	
II	24PCH2C4	ORGANIC CHEMISTRY-II					5	5	
Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	3	3	2	3	2	3	3	3	2.7
CO2	3	2	3	2	3	3	3	3	2	3	2.7
CO3	3	3	2	2	3	3	3	3	2	3	2.7
CO4	3	3	3	3	2	3	3	2	3	3	2.8
CO5	3	3	2	3	3	2	3	3	3	2	2.7
Mean overall score											2.7(High)

CORE COURSE-V
INORGANIC CHEMISTRY-II

Semester	**: II**	**Max. Marks**	**: 75**
Course Code	**: 24PCH2C5**	**Credit**	**: 05**
Total Periods	**: 75**	**Exam Hrs**	**: 03**

OBJECTIVES

- To know the basic principles of coordination chemistry
- To know the basic principles of organometallic compounds
- To understand the important theories of coordination chemistry
- To utilize the applications of coordination compounds

UNIT-I: **Stability of Complexes** **(15 Periods)**

Stability of complexes- Factors affecting stability of complexes, Thermodynamic aspects of complex formation,Stepwise and overall formation constants, Stability correlations, statistical factors and chelate effect, Determination of stability constant and composition of the complexes: Formation curves and Bjerrum's half method, Potentiometric method, Spectrophotometric method, Ion exchange method.

Stereochemical aspects- Stereoisomerism in inorganic complexes- Isomerism arising out of ligand distribution and ligand conformation, Chirality and nomenclature of chiral complexes.

UNIT-I: **Metal Ligand Bonding** **(15 Periods)**

Crystal field theory – Splitting of d orbitals under various geometries - factors affecting splitting, CFSE, evidences for CFSE(Structural and thermodynamic effects), spectrochemical series, Jorgensen relation, site preferences, Jahn Teller distortion – Dynamic and Static J.T. effect, Jahn Teller effect and chelation, Application of CFT – Magnetic properties, spectral properties and Kinetic properties, Limitations of CFT.

MO theory and energy level diagrams concept of Weak and strong fields. Sigma and pi bonding in octahedral, square planar and tetrahedral complexes. Nephelauxetic effect, Magnetic properties of complexes. Comparison of CFT and MOT of bonding in octahedral complexes.

UNIT-III :**Term symbols** **(15 Periods)**

Term symbols for the 3d-block elements and their ions – Orgel diagram ($d^3$and d^5only) – Tanabe-Sugano diagram for Co^{3+}system – John-Tellar distortions– spin-orbit coupling – Nephelauxetic effect – charge transfer Spectra. Racah parameters. Substitution reactions in square planar and octahedral complexes – trans effect – redox reactions (Inner and Outer sphere mechanism).

UNIT-IV: **Organometallic Compounds** **(15 Periods)**

Classifications of ligands (σ and π donors). Hapticity (η^1 - η^6).18e rules . Metal carbonyls – Preparation and Structure of Fe2(CO)9 and Co4(CO)12 – Carbonyl hydrides [HMn(CO)5], [HCo(CO)4], [H2Fe(CO)4] (Preparation and chemical reaction only)- Metal Nitrosyls – bridging and terminal nitrosyls, bent and linear nitrosyls . Metal olefins (Zeise salt).Complexes of molecular nitrogen and oxygen (synthesis and reactions). Isolable analogies.

Reactions of organometallic compounds – substitution – electrophilic and nucleophilic attack on ligands; carbonylation and decarbonylation; oxidative addition and reductive elimination, insertion and de insertion(elimination).

UNIT-V: **Organo metallic Catalysis** **(15 Periods)**

General principles of catalysis – basic reactions involved in the catalysis by organometallic compounds. Hydrogenation of olefins (Wilkinson's catalyst) ; Hydroformylation of olefins using Cobalt or Rhodium catalysts (OXO process); oxidation of olefins to aldehydes and ketones (Wacker process) Monsanto acetic acid synthesis from methanol. Cyclooligomerisation of acetylene using Ni catalyst (Reppe's catalyst) Synthetic gasoline by using ZSM-5 catalyst (Fisher-Tropsch and mobile process) polymerization of olefins (Zeigler – Natta Catalyst), polymer bound catalyst.

UNIT – VI :METAL DRUG, DISCOVERY AND DESIGN (For Continuous Internal Assessment Only)

Drug discovery and design - Therapeutic index and chemotherapeutic index - Structure activity relationship - Factors governing drug design - Computer aided drug design - Gold-based drugs - treatment of cancer and rheumatoid - mechanism of interaction. Lithium containing drugs- uses - mode of interaction - side effects. Silver based drugs anti-bacterial - antifungal agent - anticancer agent. Bismuth containing drugs - the treatment of acidity and related diseases.

Text Books

1.Shriver and Atkins, Inorganic Chemistry, Fifth Edition.

2.K.F. Purcell and J.C. Cotz, Inorganic chemistry, , Fifth Edition

Reference Books

1.James E. Huheey, Ellen A. Keiter and Richerd L. Keiter : Inorganic Chemistry, IV Edn., 1993

2.Cotton and Wilkinson : Advanced inorganic Chemistry, Wiley Eastern (P), Ltd.,1968

3.H.J. Emeleus and A.G.Sharp : Modern aspects of Inorganic Chemistry, IV Edn.,1989

4.R.C. Mehrotra and A. Singh : Organometallic Chemistry

COURSE OUTCOMES

CO number	CO statement	Knowledge level
	On the Successful completion of the course the student would be able	
CO1	To understand some principles and theories in coordination chemistry	**K2**
CO 2	To learn about organometallic and bio inorganic chemistry	**K3**
CO 3	To analyze the concepts, types, and nomenclature of coordination chemistry	**K4**
CO 4	To evaluate the application of coordination compound in various fields	**K5**
CO 5	To analyze the concepts, types, and nomenclature of coordination chemistry	**K5**

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course					Hours	Credits
II	24PCH2C5	INORGANIC CHEMISTRY-II					5	5
Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	3	3	2	3	2	3	3	2	2.6
CO2	2	2	3	2	3	3	2	3	2	3	2.5
CO3	3	3	2	2	3	3	3	3	2	2	2.6
CO4	3	3	3	3	2	3	3	2	3	3	2.8
CO5	2	3	2	3	3	2	2	3	3	2	2.5
Mean overall score											2.6(High)

CORE COURSE-VI
PHYSICAL CHEMISTRY -II

Semester	**: II**	**Max. Marks**	**: 75**
Course Code	**: 24PCH2C6**	**Credit**	**: 04**
Total Periods	**: 60**	**Exam Hrs**	**: 03**

OBJECTIVES

- To have an exposure to the Thermodynamics.
- To acquire awareness about the basic concepts of Quantum Statistics.
- To understand basics of Heat capacities of solids.

UNIT – I : Thermodynamics and Non-ideal systems (12 Periods)

Chemical potential and the definition of fugacity. Determination of fugacity of gases by graphical method and from equations of state. Variation of fugacity with temperature. fugacity and the standard state for non-ideal gases. Definition of activity. Activity coefficient. Temperature coefficient of activity. Standard states. Applications of activity concept to solutions. The rational and practical approaches. Measurement of activity of solvent from colligative properties. Determination of activity of solute.

UNIT – II : Third Law of Thermodynamics (12 Periods)

Need for third law of thermodynamics. Nernst heat theorem and other forms stating third law. Thermodynamic quantities at absolute zero. Statistical meaning of third law and apparent exception. Mathematical Introduction: Theories of permutation & combination, Laws of probability. Distribution laws. Gaussian distribution.

UNIT – III :Quantum statistics (12 Periods)

Maxwell - Boltzmann statistics. Thermodynamic probability. Thermodynamic probabilities of systems in equilibrium. Boltzmann expression for entropy. Stirling ‘s approximation. States of maximum thermodynamics probability. Lagrangian multipliers, thermodynamic probabilities of systems involving energy levels. Maxwell - Boltzmann distribution law. Evaluation of alpha and beta in M.B. distribution law.

UNIT – IV :Partition function (12 Periods)

Partition function - definition, justification of nomenclature, microcanonical and canonical ensembles. Molecular partition function and canonical function. The relation between the total partition

function of a molecule and the separate partition functions. Translational partition function, rotational partition function. Effect of molecular symmetry on rotational partition function. Ortho and para hydrogen. Vibrational partition function. Electronic partition function. Evaluation of thermodynamic properties E, H, S, A, G, Cv and Cp from monoatomic and diatomic ideal gas molecule partition functions.

UNIT – V : Heat capacities of solids **(12 Periods)**

Einstein‘s and Debye‘s theories of heat capacities of solids. Bose- Einstein and Fermi-Dirac Statistics: Bose-Einstein distribution law. Entropy of Bose- Einstein gas. Plank distribution law for black-body radiation. Fermi – Dirac distribution law. Entropy of a Fermi- Dirac gas.

UNIT – VI: Colloids and Micelles **(For Continuous Internal Assessment Only)**

Colloids: Distinction between suspension, colloidal solutions and true solutions – lyophilc and lyophobic colloids – Tyndall effect – stability of colloids – coagulation – emulsions – various types. Micelles: Surfactant (amphipathic molecules) – micellization - critical micelle concentration – size of micelle – aggregation number – Thermodynamics of micellization– reverse micelles.

Text Books

1.Klotz : Chemical thermodynamics .

2.P.W.Atkins : Physical Chemistry

Reference Books

1.S. Glasstone:Thermodynamics

2.M . C. Gupta: Statistical thermodynamics

3.Lee. Sears and Salinger : Statistical thermodynamics

4.K. J. Laidler, Chemical Kinetics, Harper and Row, New York, 1987.

5.Samuel Glasstone and David Lewis 2nd edition ,Elements of Physical Chemistry.

6.G. M. Harris, Chemical Kinetics, D. C. Health and Co, 1966.

7.A. W. Anderson, Physical Chemistry of Surfaces, Wiley – Inter Science, Network, 1990.

8.Paula, Peter Atkins and Julio de, Elements of Physical chemistry, 5th Ed, Oxford U. P, 2012.

COURSE OUTCOMES

CO number	CO statement On the Successful completion of the course the student would be able	Knowledge level
CO1	To understand the ideas of Thermodynamics	K2
CO2	To acquire basic knowledge about Quantum Statistics	K2
CO3	To analyze the quantum mechanics problem	K4
CO4	To analyze Thermodynamic properties E, H, S, A, G, Cv and Cp .	K5
CO5	To analyze statistical thermodynamics equations	K5

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course	Hours	Credits
II	24PCH2C6	PHYSICAL CHEMISTRY-II	4	4

Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	3	3	2	3	3	2	2.8
CO2	3	3	3	2	3	3	2	3	2	3	2.7
CO3	3	3	2	3	3	3	3	3	2	3	2.8
CO4	3	3	3	3	2	3	3	2	3	3	2.8
CO5	2	3	3	3	3	2	3	3	3	2	2.7
Mean overall score											2.76(High)

CORE COURSE-VII
PHYSICAL METHODS IN CHEMISTRY

Semester	**: II**	**Max. Marks**	**: 75**
Course Code	**: 24PCH2C7**	**Credit**	**: 04**
Total Periods	**: 60**	**Exam Hrs**	**: 03**

OBJECTIVES

- To understand the basis of visible, IR, UV, ^{1}H NMR, ^{13}C NMR and Mass Spectroscopy
- To understand instrumentation techniques
- To acquire deep knowledge about characterization of organic molecules using IR, UV ,NMR and Mass spectroscopy
- To understand Correlation NMR Spectroscopy

UNIT – I :Infrared Spectroscopy (12 Periods)

Infrared Spectroscopy Principle of infrared spectroscopy - description of double beam IR spectrophotometer-IR spectra of polyatomic molecules-factors affecting the vibrational frequencies-application of IR spectroscopy for organic and inorganic compounds-problems..

UNIT – II :Ultraviolet and Visible Spectroscopy (12 Periods)

Ultraviolet and Visible Spectroscopy-Electronic spectra of diatomic molecules – Laws of photometry – Electronic absorption transitions – Correlation of electronic structure with molecular structure – Simple chromophoric groups – Effects of conjugation – Woodward – Fieser rules – Aromatic system and systems with extended conjugation – applications to organic and inorganic compounds – Instrumentation.

UNIT – III : ^{1}H NMR Spectroscopy (12 Periods)

^{1}H NMR Spectroscopy-magnetic properties of nuclei – theory of nuclear resonance – Chemical shift and its measurement – Factors influencing chemical shift – Chemical equivalence and magnetic equivalence – solvents and NMR spectra – Spin –Spin coupling – Spin-Spin splitting systems – Proton exchange reactions – Heteronuclear coupling – Deuterium exchange – Double resonances.

UNIT – IV :^{13}C NMR Spectroscopy (12 Periods)

^{13}C NMR Spectroscopy- magnetic moment and natural abundance- broad band decoupling- deuterium coupling- NOE effect- Off-resonance decoupling- peak assignments using DEPT spectrum – structural applications of ^{13}C NMR spectroscopy. Correlation NMR Spectroscopy- theory- ^{1}H-^{1}H COSY, ^{1}H-^{13}C COSY.

UNIT – V :Mass Spectrometry (12 Periods)

Mass Spectrometry-Theory – Instrumentation – Isotopic abundance – Determination of molecular weights and formulae, Ionisation techniques (CI, FD, FAB &ESI) – Nitrogen rule – Metastable ions and peaks – Ion fragmentation mechanisms – Retro Diels-Alder rearrangement – Mclafferty rearrangement – Fragmentation associated with functional groups – aliphatic and aromatic compounds – Elimination due to ortho groups.

UNIT – VI: Fluorescence Spectroscopy (For Continuous Internal Assessment Only)

Basic aspects of synchronous fluorescence spectroscopy – spectral hole burning – flow cytometry – fluorometers (quantization) – instrumentation – applications.

Reference Books

1. W. Kemp, Organic Spectroscopy
2. P. S. Kalsi, Spectroscopy of Organic Compounds
3. C. N. Banwell, Fundamentals of Spectroscopy
4. Das and James, Mass Spectrometry
5. F. W. McLafferty, Mass Spectrometry
6. Sheinmann, Introduction to Spectroscopic Methods
7. Silverstein and Webster, Spectrometric Identification of Organic Compounds
8. Y. R. Sharma, Elementary Organic Absorption Spectroscopy
9. Abraham and Lofters: 13C NMR spectroscopy
10. B. Stuart, Infrared Spectroscopy: Fundamentals and Applications, John Wiley & Sons Ltd (2004).

COURSE OUTCOMES

CO number	CO statement On the Successful completion of the course the student would be able	Knowledge level
CO1	To understand the principle, theory, and applications of different spectral techniques.	K3
CO2	To interpret the principle and applications of ^{1}H NMR , ^{13}CNMR and Mass Spectroscopy	K4
CO3	To acquire deep knowledge about characterization of organic molecules using IR, UV,	K5
CO4	To analyze ^{1}HNMR , ^{13}C NMR and Mass Spectroscopy	K5
CO5	To analyze structure of organic molecules	K5

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course					Hours	Credits
II	24PCH2C7	PHYSICAL METHODS IN CHEMISTRY					4	4

Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	3	3	3	3	3	2	3	2	2	2.6
CO2	3	3	2	2	3	3	2	3	2	3	2.6
CO3	3	2	2	3	3	3	2	3	2	3	2.6
CO4	3	3	3	3	2	3	3	2	3	3	2.8
CO5	2	3	2	3	1	2	3	3	2	2	2.3
Mean overall score											**2.56(High)**

CORE PRACTICAL -II
ORGANIC CHEMISTRY PRACTICAL

Semester	**: II**	**Max. Marks**	**: 60**
Course Code	**: 24PCH2C2P**	**Credit**	**: 3**
Total Periods	**: 90**	**Exam Hrs**	**: 06**

OBJECTIVES

- To perform the qualitative analysis of a given organic mixture
- To carry out the preparation of organic compounds.

1. Qualitative Analysis of an Organic Mixture Containing Two Components

Mixtures containing two components are to be separated (pilot separation) and purified (bulk separation) – The physical constants are to be reported (analysis).

2.Quantitative Analysis of Organic Compounds

Estimation of following

(a) Phenol (b) Aniline (c)Ketone (d) Glucose

Text and Reference Books

1. J. Mohan, Organic Analytical Chemistry: Theory and Practice; Narosa, 2003.
2. V. K. Ahluwalia, P. Bhagat, and R. Agarwal, Laboratory Techniques in Organic Chemistry; I. K. International, 2005.
3. N. S. Gnanaprakasam and G. Ramamurthy, Organic Chemistry Lab Manual; S.V.Printers, 1987.
4. A. I. Vogel, A. R. Tatchell, B. S. Furniss, A. J. Hannaford and P. W. G. Smith,
5.Vogel's Textbook of Practical Organic Chemistry; 5th Ed., Prentice Hall, 1989

COURSE OUTCOMES

CO.NO	**CO statement**	**Knowledge level**
	On the Successful completion of the course the student would be able	
CO1	To get the ability to analyse the organic mixture containing two components.	K3
CO2	To analyse the pharmaceutical applications of organic compound.	K3
CO3	To prepare the organic compounds.	K4

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course					Hours	Credits			
II	24PCH2C2P	ORGANIC CHEMISTRY PRACTICAL					6	3			
Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	2	3	2	3	2	2	2.6
CO2	2	3	2	2	3	3	2	3	2	3	2.5
CO3	3	2	2	3	3	2	2	3	2	2	2.4
Mean overall score											2.5(High)

INDUSTRIAL BASED COURSE
INDUSTRIAL CHEMISTRY

Semester	**: II**	**Max. Marks**	**: 60**
Course Code	**: 24PCH2I1**	**Credit**	**: 3**
Total Periods	**: 45**	**Exam Hrs**	**: 06**

OBJECTIVES

- To know the basic ideas of an industry and industrial wastes.
- To understand the petroleum and petrochemicals.
- To study the principles of pulp and paper.
- To know the preparation of soaps, detergents and perfumes.

UNIT – I :Basic Ideas and Industrial Wastes (9 Periods)

Basics idea about unit operation – flow chart – chemical conversion – batch versus continuous processing – chemical process selection – design – chemical process control.

Types of industrial wastes – treatment of wastes or effluent with organic impurities – treatment of wastes or effluent with inorganic impurities – treatment of some important chemical wastes.

UNIT – II: Petroleum and Petrochemicals (9 Periods)

Introduction – saturated hydrocarbons from natural gas – uses of saturated hydrocarbons – unsaturated hydrocarbons – acetylene, ethylene, propylene, butylene – aromatic hydrocarbons – toluene and xylene.

Preparation of rectified spirit from beat – methylated spirit – preparation of absolute alcohol from rectified spirit – petrochemicals in India.

UNIT – III: Manufacture of Cement (9 Periods)

Introduction – types of cement – high alumina cement, water proof cement, slag cement, acid resisting cement, white cement, coloured cement, Pozzolana cement.

Setting of cement – properties of cement – testing of cement – uses of cement – concrete – cement industries in India.

UNIT – IV: Manufacture of Paper from Pulp (9 Periods)

Introduction – manufacture of pulp – types of pulp – sulphate or craft pulp, soda pulp, Rag pulp – beating, refining, filling, sizing and colouring. Calendaring – uses – paper industries in India.

UNIT – V: Soaps And Detergents **(9 Periods)**

Introduction – types of soaps – hard and soft soaps – manufacture of soap (hot and continuous process only) – cleansing action of soap – detergents – surface active agents – biodegradability of surfactants, amphoteric detergents.

UNIT – VI: Dyes (**For Continuous Internal Assessment Only**)

Introduction-sensation of colour-colour and constitution-nomenclature-basic operations in dyeing-classification of dyes according to the mode of applicationsynthesis, reaction and applications of diphenyl methane dyes-triphenylmethane dyes-phthalein dyes- xanthene dyes-acridine dyes-Sulphur dyes-cyanine dyes.

References

1. B. K. Sharma, Industrial Chemistry; 8th Ed., Goel Publishing House, New Delhi, 1997. (Unit–I, II, III, IV and V)
2. R. N. Shreve, and J. A. Brink Jr. Chemical Process Industries; 4th Ed., McGraw Hill, Toronto, 1977. (Unit–I, II, III, IV and V)
3. A. C. S. Brain, Production and Properties of Industrial Chemicals; Reinhold, New York, 1989. (Unit–I)

COURSE OUTCOMES

CO number	**CO statement** On the Successful completion of the course the student would be able	**Knowledge level**
CO1	To get the basic ideas about the industrial wastes	K2
CO2	To get the knowledge about petrochemicals	K3
CO3	To analyze the manufacturing techniques of cement and paper	K4
CO4	To classify the types and methods of preparation of pulps	K4
CO5	Students acquire production natural perfumes, soaps and detergents	K5

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	**Course code**		**Title of the Course**							**Hours**	**Credits**
II	**24PCH2I1**		**INDUSTRIAL CHEMISTRY**							**3**	**3**
Couse outcomes	**Programme outcomes(POs)**					**Programme Specific Outcomes(PSOs)**					**Mean scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	3	2	2	2	3	2	2	2.4
CO2	3	3	2	2	3	3	2	3	2	3	2.6
CO3	3	2	2	3	3	3	2	3	2	3	2.6
CO4	2	3	3	3	2	3	2	2	2	3	2.5
CO5	3	3	2	2	2	2	3	3	2	2	2.4
Mean overall score											**2.5(High)**

NON MAJOR ELECTIVE-I
CHEMISTRY OF POLLUTION, FOOD AND COSMETICS

Semester	**: II**	**Max. Marks**	**: 60**
Course Code	**: 24PCH2N1A**	**Credit**	**: 2**
Total Periods	**: 45**	**Exam Hrs**	**: 06**

OBJECTIVES

- To understand the principles of Green chemistry.
- To learn the various pollutions affecting the environment.
- To acquire basic knowledge about chemistry of food and cosmetics.

UNIT – I: Air Pollution **(9 Periods)**

Air- Introduction- Definition- Composition of air- Air Pollution-Definition-Air Pollutants-Types of Air pollution - effect of Air pollution on human health Prevention of Air pollution.

UNIT – II: Water Pollution **(9 Periods)**

Water-Introduction-Definition-Sources of water-Types of water-Water quality parameters-Water pollution- Definition-Types of Water pollution- Causes of Water pollution on human health-Prevention of Water pollution.

UNIT – III :Soil Pollution **(9 Periods)**

Soil quality standards, monitoring and analysis of selected soil contaminants: pesticides, heavy metals, POP's, fluoride, cyanide, nitrate, phosphate, oil & grease, Geo biochemical impact of municipal solid waste, steel plants effluent, domestic sewage.

UNIT – IV: Food Chemistry **(9 Periods)**

Introduction to general Constituents of food, Proximate Constituents and their analysis, Additives- Introduction -Types - Study of preservatives colors and Antioxidants and method of estimation, adulteration - Introduction, Types, Test for adulterants.

Introduction of standards composition and analysis of following foods: Wheat, Bread, Biscuits, Jam, Jelly, Honey, Milk, Ice Cream, Butter, Cheese, Milk Powder, Oils and Fats, Tea, Coffee, Soft drinks, Alcoholic beverages, Cereal and pulses, Confectionery, Fruits, Vegetables, Egg, Fish, Meat.

UNIT – V :Cosmetics **(9 Periods)**

Introduction of Cosmetics, evaluation of cosmetics materials, raw material and additives, Cosmetics colors, Perfumes in cosmetics, Cosmetics formulating, introduction, standards and methods of analysis, Creams, Face powders, Makeup, Shaving preparations, Bath preparations.

UNIT – VI: Noise Pollution **(For Continuous Internal Assessment Only)**

Noise pollution: Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation; psychoacoustics and noise criteria, effects of noise on health, annoyance rating schemes.

References

1. Environmental Chemistry, S.E. Manahan, Lewis Publishers.
2. Environmental chemistry, Sharma and Kaur, Krishna Publishers.
3. Environmental Chemistry, A.K. De, Wiley Eastern.
4. Environmental Chemistry, Analysis, S.M. Khopkar, Wiley Eastern.
5. Standard Method of Chemical Analysis, F.J. Welcher Vol. III, Van Nostr and ReinholdCo.
6. Environmental Toxicology, Ed.J. Rose, Gordon and Breach Science Publication.
7. Environmental Chemistry, C. Baird, W.H. Freeman.
8. Analytical chemistry, G.D. Christian, J. Wiley.
9. Fundamentals of Analytical Chemistry, D.A.Skoog, D.m. Westand F.J. Holler, W.B. Saunders.
10. Analytical Chemistry - Principles, J.H. Kennedy, W. Saunders.
11. Analytical Chemistry-Principles, and Techniques, L.G. Hargis, Prentice Hall.
12. Principles of Instrumental Analysis, D.A. Skoog and J.L. Loary, W.B. Saunders.
13. Principles of Instrumental Analysis, D.A. Skoog, W.B. Saunders.
14. Quantitative Analysis, R.A. Day, Jr. and A.L. Underwood, Prentice Hall.
15. Environmental Solution Analysis, S.M. Khopkar, Wiley Eastern. Basic Concepts of Analytical Chemistry, S.M. Khopkar, Wiley Eastern.
16. Handbook of Instrumental Techniques for Analytical Chemistry, F. Settle, Prentice Hall.
17. Environmental Biotechnology, Indushekhar Thakur, I.K. International Pvt. Ltd.
18. Fundamental of Analytical Chemistry D.A. Skoog, D.m. West, F.J. Holler and S.R. Crouch, Thompson Learning Inc.
19. APHA, 1977, “Methods of air c Health Sampling Association Washingtonand – Analysis US.

COURSE OUTCOMES

CO. Number	CO statement On the Successful completion of the course the student would be able	Knowledge level
CO1	To identify the principles of Green chemistry	K3
CO2	To learn the various pollutions affecting the environment.	K3
CO3	To analyze standards composition of food materials	K4

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course	Hours	Credits
II	**24PCH2N1A**	**CHEMISTRY OF POLLUTION, FOOD AND COSMETICS**	**3**	**2**

Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	2	2	2	2	3	2	2	22
CO2	2	3	2	2	3	3	2	2	2	3	24
CO3	2	2	2	3	2	3	2	2	2	2	22
Mean overall score											**2.26(High)**

NON MAJOR ELECTIVE-I
AGRICULTURAL CHEMISTRY

Semester	**: II**	**Max. Marks**	**: 75**
Course Code	**: 24PCH2N1B**	**Credit**	**: 2**
Total Periods	**: 45**	**Exam Hrs**	**: 06**

OBJECTIVES

- To enable students understand the chemical composition of soil
- To provide knowledge on the chemistry behind fertilizers
- To enable students know and understand the chemistry behind pesticides
- To enable students analyze and find a suitable method to promote agriculture.
- To acquire knowledge on Insecticides

UNIT- I: Soil Chemistry **(9 Periods)**

Soil analysis. composition of soil: organic and inorganic constituents. Soil acidity : buffering capacity of soils. Absorption of cations and anions: availability of soil nutrients to plants.

UNIT-II: Fertilizers **(9 Periods)**

Difference between fertilizer and manure – Superiority of manure over fertilizers, Peat and organic manures (composts). Effluent from Gobar gas plants. Use of fertilizers: urea, DAP, Super phosphate, Gypsum, NPK-mixed fertilizers, Optimal addition of fertilizers to obtain estimated yields.

UNIT-III: Pesticides, Fungicides, Herbicides And Weedicides **(9 Periods)**

Pesticides: Classification on the basis of mode of action, types of pests and Chemical nature with examples – safety measures while using pesticides. 2.4 Fungicides, Herbicides, Acaricides, Rodenticides, Repellants, Fumigants, Defoliants (Definitions and Examples).

UNIT-IV:. Plant Growth Regulators **(9 Periods)**

3-Indole acetic acid, naphthalene acetic acid, Ethepon (2-chloroethyl phosphoric acid).

succinic acid-2, 2-dimethylhydrazine. Plant hormones: Gibberlin, Cyclocel, Phosphon, dwarfing compound (CCC: 2-Chlorethyltrimethyl ammonium chloride).

Unit-V: Insecticides (9 Periods)

Basic and newer formulations of insecticides, contact insecticides, fumigants, manufacture and uses of insecticides. DDT, BHC, pyrethrin mention of aldrin, dieldrin, endrin and pentachlorophenol.

UNIT – VI: Handling hazards of insecticides (For Continuous Internal Assessment Only)

Handling hazards of insecticides – Symptoms of poisoning, first aid and antidotes.

Text books

1.Joseph Scudder Chamberlain Organic Agricultural Chemistry (the Chemistry of Plants and Animals); A Textbook of General Agricultural Chemistry or Elementary Bio-Chemistry for Use in Colleges, Andesite Press, 2015

2.H. Parameshwar Hegde, Textbook of Agro-Chemistry, Discovery Publishing Pvt. Ltd, 2009.

Reference books

1.G.T. Austin: Shreve's Chemical Process Industries, 5th edition, Mc-Graw-Hill, 1984

2.B.A. Yagodin (Ed). Agricultural Chemistry, 2 Volumes, Mir Publishers (Moscow), 1976

COURSE OUTCOMES

CO. Number	CO statement	Knowledge level
	On the Successful completion of the course the student would be able	
CO1	To understand the chemical composition of soil	K1
CO2	To illustrate the chemistry behind fertilizers and pesticides	K4
CO3	To analyse the chemistry behind agricultural methods	K5
CO4	To find and suggest suitable methods to promote agriculture	K5
CO5	To create knowledge on Insecticides	K5

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course					Hours	Credits
II	24PCH2N1B	AGRICULTURAL CHEMISTRY					3	2
Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	2	3	2	2	2	3	2	3	24
CO2	3	3	2	2	3	3	2	2	2	3	25
CO3	2	2	3	3	2	3	2	2	3	2	24
CO4	2	3	3	3	2	3	2	2	2	3	25
CO5	3	3	2	2	2	2	3	3	2	2	24
Mean overall score											2.44(High)

CORE COURSE-VIII
ORGANIC CHEMISTRY-III

Semester	**: III**	**Max. Marks**	**: 60**
Course Code	**: 24PCH3C8**	**Credit**	**: 6**
Total Periods	**: 90**	**Exam Hrs**	**: 03**

OBJECTIVES

- To learn the Photochemistry and Pericyclic reactions.
- To apply the various spectroscopic techniques of organic compounds
- To understand the Retro synthetic analysis and strategy.

UNIT – I : Organic Photochemistry (18 Periods)

Fundamental concepts- Jablonski diagram- energy transfer- characteristics of photo reactions- photo oxidation-photo reduction- photo reactions of ketones and enones- Norrish type I and II- reactions- photo-chemistry of alkenes, dienes and aromatic compounds- photosensitization- photo additions- Barton reaction- Paterno Buchi reaction. Photo-Fries rearrangement –Zimmerman's di-π-methane rearrangement.

UNIT - II : Pericyclic Reactions (18 Periods)

Concerted reactions- stereochemistry- orbital symmetry and correlation diagram- Frontier molecular orbital approach- Woodward- Hoffmann rules- electrocyclic reactions- cycloaddition reactions- selection rules- sigmatropic rearrangements- selection rules with examples- 1,3 and 1,5 hydrogen shifts- Cope and Claisen rearrangements.

UNIT – III :UV-Visible Spectroscopy& Infrared Spectroscopy (18 Periods)

Ultraviolet and visible Spectroscopy: Basic principles of electronic transitions- correlation of energy change with electronic transitions- Applications of UV- visible spectroscopy- Woodward Fischer Scott rules- applications to conjugated dienes, trienes and polyenes- unsaturated carbonyl compounds, conjugated cyclic ketones, acto phenones. Differentiation of position isomers- stereo-chemical factors affecting electronic spectra of biphenyl and binaphthyls- cis trans isomers- angular distortion- cross conjugation.

Infrared Spectroscopy: Factors influencing group frequencies- finger print region - identification of functional groups- hydrogen bonding, intermolecular and intra molecular- solvent effect on vibrational frequencies.

UNIT – IV: Nuclear Magnetic Resonance Spectroscopy (18 Periods)

^{1}H NMR Spectroscopy – multiplicity – coupling constants – spin-spin splitting – vicinal and geminal coupling constants – Karplus equation – long range coupling constants, influence of stereochemical factors on chemical shift of protons.

^{13}C NMR Spectroscopy – broad band decoupling – off resonance decoupling – chemical shifts of common functional groups – FT NMR and its importance– DEPT spectra – identification of small compounds based on NMR data – 2D techniques: ^{1}H–^{1}H COSY, ^{1}H– ^{13}C HETCOR – NOESY-Heteronuclear Multiple Bond correlation (HMBC).

UNIT – V: ORD, CD & Mass Spectrometry (18 Periods)

ORD& CD: Optical rotatory dispersion and circular dichroism – introduction to theory and terminology – cotton effect – ORD curves – axial haloketone rule and its applications – the octant rule –applications of ORD to determine absolute configuration of monocyclic ketones.

Mass Spectrometry: Resolution – ESI, EI, CI and FAB methods – base peak, isotopic peaks, metastable peaks – importance of metastable peaks, parent peak, recognition of molecular ion peak – fragmentation – general rules – pattern of fragmentation for various classes of compounds, McLafferty rearrangement – nitrogen rule.

UNIT – VI : Photochemistry of Alkenes, Ketones and Aromatic Compounds
(For Continuous Internal Assessment Only)

Olefin photochemistry - conjugated olefins - Isomerisation and rearrangements – cis trans isomerization - valence isomerization - rearrangement of 1,4 and 1,5 dienes - di- pi methane rearrangement - Cope and Claisen rearrangement - cycloaddition reactions - Photochemistry of Aromatic compounds - Arene photo isomerization – Photo dimerization - Cycloaddition reactions – 1,2 cycloadditions – Photo oxygenation - ene reaction. Photo reduction - oxetane formation – Reactivity of π-π^* excited ketones – Photochemistry of α, β- unsaturated ketones - dienone phenol photo rearrangement.

References

1. J. D. Coyle, Organic Photochemistry; Wiley, New York, 1998.
2. J. M. Coxon, and B. Halton, Organic Photochemistry; 2nd Ed., Cambridge, University Press, UK, 1987.
3. G. R. Chatwal, Organic Phtochemistry; 1st Ed., Himalaya Publications house, Bangalore, 1998.

4. S. Sankararaman, Pericyclic Reactions – A Textbook: Reactions, Applications and Theory; Wiley-VCH, New York, 2005.
5. P. M. Silverstein and F. X. Western, Spectroscopic Identification of Organic Compounds; 8th Ed., John Wiley, New York, 2014.
6. W. Kemp, Organic Spectroscopy; 3rd Ed., Palgrave, New York, 1991.
7. J. R. Dyer, Applications of Absorption Spectroscopy of Organic Compounds, PHI Learning, New Delhi, 2009.
8. Y. R. Sharma, Elementary Organic Spectroscopy – Principles and Chemical applications; S. Chand, New Delhi, 1992.
9. P. S. Kalsi, Spectroscopy of Organic Compounds; 6th Ed., New Age International Publishers, New Delhi, 2004.

COURSE OUTCOMES

CO number	CO statement On the Successful completion of the course the student would be able	Knowledge level
CO1	To understand fundamental concepts of photochemistry	K2
CO2	To get the knowledge about pericyclic reaction	K3
CO3	To apply concept of uv visible,ir,nmr spectroscopy	K4
CO4	To understand and apply ORD,CD& mass spectrometry techniques	K4
CO5	To do Structural elucidation of organic compounds	K6

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course					Hours	Credits			
III	24PCH3C8	ORGANIC CHEMISTRY-III					6	6			
Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	2	2	2	3	2	1	2.4
CO2	3	3	3	2	3	3	2	3	2	3	2.7
CO3	2	2	2	3	3	3	2	3	2	2	2.4
CO4	2	3	3	3	2	3	2	2	2	3	2.5
CO5	3	3	3	3	2	2	3	3	3	3	2.8
Mean overall score											2.56(High)

CORE COURSE-IX
PHYSICAL CHEMISTRY-III

Semester	**: III**	**Max. Marks**	**: 75**
Course Code	**: 24PCH3C9**	**Credit**	**: 05**
Total Periods	**: 75**	**Exam Hrs**	**: 03**

OBJECTIVES

- To study the applications of quantum chemistry and group theory.
- To acquire knowledge about various spectroscopic techniques.
- To Learn about Symmetry and group theory

UNIT – I: Quantum Chemistry Introduction (18 Periods)

Success of quantum theory and the Failure of classical mechanics in explaining blackbody radiation, heat capacity of solids, Photo-electric effect and the H-atom Spectrum. Heisenberg‘s Uncertainty principle.

The time-dependent and time-independent Schrodinger equations — Born‘s interpretation of the wave function. Requirements of the acceptable wave function. Postulates of quantum mechanics.

Algebra of operators. Sums and products of operators. Commutator. Linear operators. Eigen functions and eigen values. Hamiltonian operator. Angular momentum operator. Quantization of angular momentum and its spatial orientation.

UNIT – II: Quantum Chemistry –Applications -I (18 Periods)

Particle in a one - dimensional box. Quantization of energy. Normalization of wave function. Orthogonality of the particle in a one—dimensional box wave functions. Illustration of the uncertainty principle and correspondence principle with reference to the particle in a one dimensional box. Particle in a three-dimensional box. Separation of variables.

Particle in a two - dimensional box. Quantization of energy. Particle in a three - dimensional box. Quantization of energy. Harmonic oscillator.

UNIT – II: Quantum Chemistry –Applications -II (18 Periods)

Applications of wave mechanics – the harmonic oscillator, rigid rotator – hydrogen and hydrogen like atoms – shapes and nodal properties of orbitals – space quantization – approximation methods – methods of variation, application to hydrogen and helium atoms – perturbation method – non- degenerate systems – helium atom – effective nuclear charge.

Electron spin – many electron atoms – Pauli's principle – Slater determinants – atomic structure calculation – self-consistent field method – Hartree-Fock method for atoms – angular momentum in many electron systems –vector atom model- spin-orbit interaction, L-S and j-j coupling schemes.

UNIT – III : Molecular Quantum Mechanics (18 Periods)

Born-Oppenheimer approximation-MO and VB treatments of hydrogen molecule comparison– hybridization, solving wave equation for sp, sp^2 and sp^3 hybrid orbitals – Huckel's molecular orbital theory and its application to ethylene and butadiene - charge density, pi-bond order and free valence.

UNIT– IV: Group theory and its Applications (18 Periods)

Symmetry and group theory: Symmetry elements and operations – point groups – assignment of point groups to molecules – group postulates and types of groups – group multiplication tables, sub groups, similarity transformations – conjugate elements and classes. Matrix representation of symmetry operations and point groups – reducible and irreducible representations – properties of irreducible representation.

The great orthogonality theorem – construction of character table (C_2V & C_3V)– direct product – projection operators – symmetry of hybrid orbitals. IR and Raman activity of fundamentals in CO_2, H_2O,N_2F_2–the rule of mutual exclusion.

UNIT – V: Colloids and Micelles (18 Periods)

Colloids: Distinction between suspension, colloidal solutions and true solutions – lyophilic and lyophobic colloids – Tyndall effect – stability of colloids – coagulation – emulsions – various types.

Micelles: Surfactant (amphipathic molecules) – micellization - critical micelle concentration – size of micelle – aggregation number – Thermodynamics of micellization– reverse micelles.

UNIT – VI : Fundamental Concepts of Quantum Chemistry
(For Continuous Internal Assessment Only)

Preliminary mathematics; Fundamental concepts and problems in trigonometric - Exponential functions - Matrices Vector Algebra - Differential equations – Integrations - Legendre differential

equations - Legendre and associated Legendre Polynomials - Hermite and Associated Laguerre polynomials - Orthogonal functions and Sturm-Liouville problems.

References

1. A.K. Chandra, Introductory Quantum Chemistry; 4th Ed., Tata McGraw Hill, Noida, 1994.
2. D. A. Mcquarrie, Quantum Chemistry; University Science Books, Herndon, 2008.
3. J. P. Lowe, and K. A. Peterson, Quantum Chemistry; 3rd Ed., Academic Press, Cambridge, 2005.
4. N. Levine, Quantum Chemistry; 7th Ed., Prentice Hall, New Jersey, 2013.
5. R. K. Prasad, Quantum Chemistry; 4th Ed., New Age International Publishers, New Delhi, 2014.
6. G. W. Castellan, Physical Chemistry; Narosa, New Delhi, 1986.
7. C. N. Banwell, Fundamentals of Molecular Spectroscopy; 4th Ed., McGraw Hill Education, Noida, 1994.
8. B.P. Straughan and S. Walker, Spectroscopy; Vol.1-3, Halstead Press, Sydney, 1978.
9. G.M. Barrow, Introduction to Molecular Spectroscopy; McGraw Hill, New York, 1964.
10. P.K. Ghosh, Introduction to Photoelectron Spectroscopy; John Wiley, New York, 1989
11. P. Atkins and J. de Paula, Physical Chemistry; 9th Ed., W. H. Freeman Publications, New York, 2009.
12. J. R. Dyer, Applications of Absorption Spectroscopy of Organic Compounds, PHI Learning, New Delhi, 2009.
13. Puri, Sharma & Pathania, Principles of Physical chemistry, Vishal Publishing Co, 46th edition.

COURSE OUTCOMES

CO number	**CO statement** On the Successful completion of the course the student would be able	**Knowledge level**
CO1	To analyze the time-dependent and time-independent Schrodinger equations	K4
CO2	To get the knowledge about Fundamental concepts of quantum mechanics	K4
CO3	To understand Symmetry and group theory	K4
CO4	To apply group theory to simple molecule	K6
CO5	To identify point group for organic and inorganic molecules	K6

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course					Hours	Credits		
III	24PCH3C9	PHYSICAL CHEMISTRY-III					5	5		
Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	3	3	3	2	2	2	3	2	2	2.4
CO2	3	3	3	2	3	3	2	3	2	3	2.7
CO3	2	2	2	3	3	3	2	2	2	2	2.3
CO4	2	3	3	3	2	3	2	2	2	3	2.5
CO5	3	3	3	2	2	2	3	3	3	3	2.7
Mean overall score											2.5(High)

CORE COURSE-X
BIOINORGANIC & BIOPHYSICAL CHEMISTRY

Semester	**: III**	**Max. Marks**	**: 75**
Course Code	**: 24PCH3C10**	**Credit**	**: 05**
Total Periods	**: 75**	**Exam Hrs**	**: 03**

OBJECTIVES

- To have a knowledge about protein metallo biomolecules and the role of metal ions in biological process.
- To learn about chemical toxicology and uses of inorganic compounds as therapeutic agents.
- To learn about storage and transport of metal ions in biological system
- To acquire the knowledge about polymers, types of polymers, Mechanism and Kinetics of polymerization.
- To understand the Principles of Polymer reactivity and stereochemistry of Polymerization.
- To get deep knowledge about various methods of polymerization and specialty Polymers.

UNIT-I: Metallo Proteins **(15 Periods)**

Iron containing proteins: Metallo Porphyrins-Hemoglobin and myoglobin – Structures and work functions – synthetic oxygen carriers – Cytochrome – structure and work function. Non heme oxygen carriers – Electron carrier proteins – Iron Sulphur proteins.

Magnesium containing proteins: Chlorophyll – structure – photosynthetic sequence.

Copper containing proteins: Classification – blue copper proteins – structure of blue copper electron transferases – copper protein as oxidases – cytochrome c oxidase – mechanistic studies of cytochrome c oxidase.

UNIT II: Metallo Enzymes **(15 Periods)**

Metallo enzymes: Carboxy peptidase A – structure and function;Carbonic anhydrase – inhibition and poisoning – Corrin ring system – Vitamin B_{12} (cyanocobalamin) and B_{12} coenzymes – In vivo and In vitro nitrogen fixation.

Metals in medicine: Anti-arthritis drugs – Au and Cu in rheumatoid arthritis – Li in psychiatry – Pt, Au and metallocene's in anti-cancer drugs.

Transport and storage of Fe . Molecular mechanism of iron transport across the membrane – sodium and potassium ion pumps.

UNIT- III :Biological Cell And Its Constituent (15 Periods)

Biological cell, structure and functions of proteins, enzymes, DNA and RNA in living systems. Helix coil transition. Bioenergetics - Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP.

UNIT - IV: Statistical Mechanics in Biopolymers (15 Periods)

Chain configuration of macromolecules, statistical distribution end to end dimensions, calculation of average dimensions for various chain structures. Polypeptide and protein structures, introduction to protein folding problem.

UNIT -V : Biopolymer Interactions & Thermodynamics of Biopolymer Solutions (15 Periods)

Forces involved in biopolymer interactions. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibria Various types of binding processes in biological systems. Hydrogen ion titration curves.

Thermodynamics of biopolymer solutions, osmotic pressure, membrane equilibrium, muscular contraction and energy generation in mechanochemical system.

UNIT -VI: Basic Molecular Dynamics (For Continuous Internal Assessment Only)

Equations of motion – potential functions – integration computations – Initial state – boundary conditions – equilibration – dynamics protocols – trajectories – analyses of results – AMBER, CHARM, -simple applications to proteins and nucleic acids Miscellaneous topics

References

1. S. J. Lippard and J. M. Berg, Principles of Bioinorganic Chemistry, Panima Publishing Corporation, 1997.
2. W. Kaim and B. Schwederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life, (An Introduction and Guide), John Wiley and Sons, 1994.

3. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education, 2004.
4. F. A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, Wiley Eastern, 5th Ed, 1998.
5. Geoffrey L. Zubay, William W. Parson and Dennis E. Vance, Principles of Biochemistry-McGraw-Hill Education, 1995.
6. R. Alcock and F. W. Lamber, Contemporary Polymer Chemistry, Prentice Hall, 1981.
7. K. L. Choy, Process principles and applications of novel and cost-effective ESAVD based methods, World Scientific Publishing, Singapore, 2002.
8. R. J. Young and P. A. Lovell, Introduction to Polymers, 2nd Ed, Chapman and Hall, 2002.
9. G. Odian, Principles of Polymerization, Fourth edition, Wiley-Inter science, 2004.
10. L. H. Sperling, Introduction to Physical Polymer Science, Wiley- Interscience, 1986.
11. M. Rubinstein and R. A. Colby, Polymer Physics, Oxford University Press, 2003.
12. T. Pradeep, Nano: The Essentials, Tata McGraw Hill, 2007.
13. F. W. Billmeyer, Text Book of Polymer Science, 3rd Ed, John Wiley & Sons, New York, 2003

COURSE OUTCOMES

CO number	CO statement On the Successful completion of the course the student would be able	Knowledge level
CO1	To understand the structure and functions of various types of metallo enzymes.	**K4**
CO2	To get the knowledge about the importance of trace elements in biological system.	**K4**
CO3	To enable the students to understand the role of metals in medicine.	**K4**
CO4	Understand the PrinciplesStatistical Mechanics in Biopolymers	**K6**
CO5	Capacity to analyze Biopolymer Interactions	**K6**

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course					Hours	Credits			
III	24PCH3C10	BIOINORGANIC & BIOPHYSICAL CHEMISTRY					5	5			
Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	3	3	3	2	2	2	3	2	2	2.4
CO2	3	3	3	2	3	3	2	3	2	3	2.7
CO3	2	2	2	3	3	3	2	2	2	2	2.3
CO4	2	3	3	3	2	3	2	2	2	3	2.5
CO5	3	3	3	2	2	2	3	3	3	3	2.7
Mean overall score											2.5(High)

CORE PRACTICAL-III
PHYSICAL CHEMISTRY PRACTICALS

Semester	**: III**	**Max. Marks**	**: 75**
Course Code	**: 24PCH3C3P**	**Credit**	**: 03**
Total Periods	**: 90**	**Exam Hrs**	**: 03**

OUTCOMES

- Students will be able to perform the physical experiments using different techniques

Experiments

1. Kinetics-acid hydrolysis of ester.
2. Kinetics-acid hydrolysis of ester– comparison of strengths of acids / determination of energy of activation (Ea).
3. Determination of molecular weight of substance by transition temperature method.
4. Determination of molecular weight/ depression in freezing point of substances by Rast method.
5. Determination of Critical Solution Temperature (CST) of phenol-water system and effect of impurity on CST.
6. Study of phase diagram of two components forming a simple eutectic/ forming a compound.
7. Distribution law – study of association of benzoic acid in benzene.
8. Adsorption – oxalic acid/acetic acid on charcoal using Freundlich isotherm.
9. Conductometry – precipitation titrations.
10. Conductometry – solubility product of sparingly soluble silver salts.
11. Verification of Onsager equation - conductivity method.
12. Potentiometric titrations – precipitation titrations.
13. Potentiometric titrations – redox titrations.
14. Potentiometry – determination of dissociation constant of weak acids.
15. To determine the relative strength of two acids by conductance measurements.
16. To determine the pH of a buffer solution using a quinhydrone electrode.

Text And Reference Books

1. B. P. Levitt, Findlay's Practical Physical Chemistry; 9th Ed., Longman, 1985.

2. J. N. Gurtu and R. Kapoor, Advanced Experimental Chemistry; Vol. 1-Physical, S. Chand and Co., New Delhi, 1987.

3. J. B. Yadav, Advanced Practical Physical Chemistry; 20th Ed., GOEL Publishing House, Krishna Prakashan Media Ltd., Chennai, 2001.

4. B. P. Levitt, Findlay's Practical Physical Chemistry; 9th Ed., Longman, London, 1985.

5. J. N. Gurtur and R. Kapoor, Advanced Experimental Chemistry; Vol. 1-Physical, S. Chand and Co. Ltd, New Delhi, 1997.

COURSE OUTCOMES

CO number	CO statement	Knowledge level
	On the Successful completion of the course the student would be able	
CO1	To perform the physical experiments using different techniques	**K5**
CO2	To determine the conductivity by using conductometric titration	**K5**
CO3	To determine the emf by using potentiometric titration	**K5**

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course	Hours	Credits
III	24PCH3C3P	PHYSICAL CHEMISTRY PRACTICALS	6	3

Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	3	2	3	3	2	3	2.8
CO2	3	3	3	2	3	3	2	3	2	3	2.7
CO3	3	2	2	3	3	3	3	2	3	3	2.7
Mean overall score											2.7(High)

CORE ELECTIVE COURSE-II
SOLID STATE CHEMISTRY

Semester	**: III**	**Max. Marks**	**: 75**
Course Code	**: 24PCH3E2A**	**Credit**	**: 03**
Total Periods	**: 75**	**Exam Hrs**	**: 03**

OBJECTIVES

- To learn the band theory and defects of solids.
- To study the preparative methods and solid state reactions.
- To learn the applications of thermal and magnetic materials.
- To study the chemistry of organic solids and metal-organic frame work.

UNIT-I : Theory Of Solids And Crystal Defects (15 Periods)

Metallic state - free electron and band theories- Metals, insulators and semiconductors, electronic structure of solid-band theory, band structure of metals, insulators and semiconductor, intrinsic and extrinsic semiconductors, n- and p-type- doping semiconductor, p-n-junction, super conductors-general applications.

Defects in solids: Stoichiometry-Schottky defects and Frenkel defects - nonstoichiometric defects- dislocations in solids-line-point defects.

UNIT-II : Preparative Methods And Solid State Reactions (15 Periods)

Preparative methods: Chemical Precursor methods, co-precipitation, sol-gel metathesis, self-propagating high temperature synthesis, ion exchange reactions, intercalation/deintercalation reactions; hydrothermal and template synthesis, high pressure synthesis. Types of solid state reactions (Solid-solid, solid-liquid, solid-gas)

UNIT-III : Thermal And Magnetic Properties of Solids (15 Periods)

Electronic specific heat, lattice heat capacity, Hall effect, Einstein theory, Debye theory, Born's modification of the Debye theory - thermoelectric effects , Thomson, Peltier, Seeback.

Origin and classifications of magnetic substance, magnetic moment, ferromagnetic, anti ferromagnetic and ferromagnetic ordering, magnetic susceptibility, Curie and Cuire-Weiss law, super exchange, magnetic domains, and hysteresis.

UNIT-IV: Organic Solid State Chemistry (15 Periods)

Topochemical control of solid state organic reactions – intramolecular reactions – conformational effects – intermolecular reactions – molecular packing effects – photodimerization of 2-ethoxycinnamic acid (α form, β form, γ form) – photopolymerization of 2,5-distyrylpyrazine – photopolymerizations of diacetylenes.

Organic reactions within inorganic host structures – electrically conductive organic solids – organic metals, conjugated systems, doped polyacetylene, poly Para phenylene, polypyrene – organic charge transfer complexes.

UNIT-V : Metallo Organic Frameworks (15 Periods)

M.O.Fs (Metallo Organic Frameworks) – organometallic systems – combinations of different interactions to design molecular rods, triangles, ladders, networks, etc. Design of nano porous solids.

Inter ligand hydrogen bonds in metal complexes – implications for drug design – crystal engineering of NLO and OLED materials.

UNIT-VI : Crystal Engineering of Organic Solids (For Continuous Internal Assessment Only)

Hydrogen bonded supramolecular patterns involving water / carboxyl / halide motifs – concepts of different types of synthons based on non-covalent interactions – principles of crystal engineering and non-covalent synthesis – polymorphism and pseudo polymorphism – supramolecular isomorphism, polymorphism and crystal engineering of pharmaceutical phases.

References

1. A. R. West, Solid State Chemistry and Its Applications; 2nd Ed., John Wiley and sons, New York, 2014 (Unit III – V).
2. J. M. Lehn, Supramolecular Chemistry; VCH, Weinheim, 1995.
3. G. R. Desiraju, Crystal Engineering: The Design of Organic Solids; Elsevier, Amsterdam, 1989.
4. G. R. Desiraju, and T. Steiner, The Weak Hydrogen Bond in Structural Chemistry and Biology; Oxford University Press: Oxford, 2002.
5. G. A. Jeffrey, Introduction to Hydrogen Bonding; Oxford University Press, New York, 1997.
6. J. M. Lehn, Transition Metals in Supramolecular Chemistry; Vol 5, John Wiley and Sons, New York, 1999.
7. C. N. R. Rao, Current Science, 2001, 81, 1030.
8. Journals:

a. Crystal Growth and Design http://www.pubs.acs.org/journals/cgdefu/index.html
b. Crystal Engineering Communication, http://www.rsc.org/Publishing/ Journals /ce/ ind

COURSE OUTCOMES

CO number	CO statement On the Successful completion of the course the student would be able	Knowledge level
CO1	To learn the band theory and defects of solids.	K2
CO2	To study the preparative methods and solid-state reactions.	K2
CO3	To learn the applications of thermal and magnetic materials.	K3
CO4	To know Organic reactions within inorganic structures	K3
CO5	To study the chemistry of organic solids and metal-organic frame work.	K4

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course					Hours	Credits			
III	24PCH3E2A	SOLID STATE CHEMISTRY					5	3			
Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	3	3	3	2	3	3	3	2	3	2.7
CO2	3	3	3	2	3	3	2	3	3	3	2.8
CO3	3	2	2	3	3	3	2	2	2	2	2.4
CO4	2	3	3	3	2	3	2	3	2	3	2.6
CO5	3	3	3	2	3	2	3	3	3	3	2.8
Mean overall score											2.66(High)

CORE ELECTIVE COURSE-II
KINETICS OF POLYMERIZATION

Semester	**: III**	**Max. Marks**	**: 75**
Course Code	**: 24PCH3E2B**	**Credit**	**: 03**
Total Periods	**: 75**	**Exam Hrs**	**: 03**

OBJECTIVES

1. To understand the kinetics of step polymerisation, radical chain polymerisation and ionic chain polymerisation
2. To acquire the knowledge about chain copolymerisation and its kinetics in detail
3. To recognise the Zigler –Natta catalysis, role of Zigler-natta catalyst in polymerization and basic kinetics

UNIT-I : Step polymerization **(15 Periods)**

Theory of reactivity of large molecules, reactivity of functional groups and molecular size. kinetics of step polymerization, self catalysedpolymerization,external catalysis of polymerizations. CycizationVs linear polymerization, thermodynamic and kinetic consideration. Molecular weight control and distribution in Linear polymerization

UNIT-II : Kinetics of‘ radical chain polymerization **(15 Periods)**

Kinetics of‘ radical chain polymerization: Kinetic scheme for polymerization in the presence of an initiator. Thermal decomposition of initiators. redox initiation. Photochemical initiation, propagation and terminations — rate expression. Initiator efficiency, auto acceleration mechanism. Kinetics of chain transfer, chain transfer to monomer, initiation and solvents.

UNIT-III : Ionic chain polymerization **(15 Periods)**

Comparision of radical and ionic polymerizations. Cationic polymerization - initiation, propagation and termination - chain transfer to monomer spontaneous and backbiting. Kinetics expression and validity of steady state assumption. The nature and mechanism of anionic polymerization, effect of monomers, initiators and solvents. Initiation, termination - polymerization without termination, termination by impurities and added transfer agents. Kinetics of polymerization withterminations.

UNIT-IV: Chain copolymerization **(15 Periods)**

Types of copolymers, evaluation of monomer reactivity ratio copolymer composition, the copolymer equation. Types — of copolyrnerizationbehaviour — ideal co- polymerization, alternating copolymerization and block — copolymerizations. The Q-e scheme and rate of copolymerization — chemical controlled termination, diffusion controlled termination.

UNIT-V : Ziegler — Natta catalysis and polymerization **(15 Periods)**

Definition Ziegler-Natta catalysts, chemical description of Ziegler-Nattn catalysts for olefins, co-factors determining behaviour of catalysts. modification of Ziegler—Natta catalysts by third components, mechanisms for initiation and propagation mechanisms for stereochemical control of alpha—olefins. isotactic and syndiotacticpropagation. Basic kinetics schemes and rate of polymerization.

UNIT- VI : Dendrimers and hyperbranched polymers (For Continuous Internal Assessment Only)

Properties of Dendrimers and Hyperbranched Polymers and their Blends: Dendrimers and their structure, synthesis of Dendrimers, Hyperbranched Polymers and their structure. Synthesis of hyperbranched polymers, branching and polydispersity, conformation, general concepts of polymer blends. Blends of Dendritic polymers with thermoplastics.

Text Book(s)

1.P.J. Flory : Principles of‘ Polymer Chemistry, Cornell Unit, Press. New York,1953

HR. Allcock and F.W. Lamp : Contemporary Polymer Chemistry, Prentice Hall, Englewood, NJ,1981

Reference Book(S)

1.N.G. Gaylord and H.F.Mark : Linear and Stereographer Addition Polymers, Wiley (lnter science), New York,1959

2.F.W.Billmeyer : Jr. Textbook of Polymer Science, Wiley,New York,1984

3. R.B. Seymour and CE. Carraher : Polymer Chemistry, An Introduction Dekker, New York,1981

4. T Keii : Kinetics of Ziegler — Natta Polymerization; Chapman and Hall,1972

COURSE OUTCOMES

CO number	**CO statement** On the Successful completion of the course the student would be able	**Knowledge level**
CO1	To understand the kinetics of step polymerization and radical chain polymerization and ionic chain polymerization	K2
CO2	To apply knowledge for polymerization mechanism in industrial need.	K2
CO3	To apply the Zigler –Natta catalyst in polymerization reaction	K3
CO4	To acquire deep knowledge about chain co-polymerization and its kinetics in detail	K3
CO5	To understand the different types of copolymer.	K4

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course					Hours	Credits			
III	24PCH3E2B	KINETICS OF POLYMERIZATION					5	3			
Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	3	3	3	2	2	3	3	2	2	2.5
CO2	3	3	3	2	3	3	2	1	3	3	2.6
CO3	3	2	2	3	3	2	2	2	2	2	2.3
CO4	2	3	3	2	2	3	2	3	2	3	2.5
CO5	3	3	3	2	2	2	3	3	3	2	2.6
Mean overall score											2.5(High)

NON MAJOR ELECTIVE COURSE-II
NANOMATERIALS

Semester	**: III**	**Max. Marks**	**: 75**
Course Code	**: 24PCH3N2A**	**Credit**	**: 02**
Total Periods	**: 45**	**Exam Hrs**	**: 03**

OBJECTIVES

- To Understand the synthesis, characterization, properties and applications of nanomaterials.
- To Apply the knowledge of nanomaterials in science and technology

UNIT-I : Synthesis of Nanomaterials **(9 Periods)**

Synthesis: Top-down processes: physical processes- milling, lithographic processes, machining, vapour phase condensation, plasma assisted deposition; Bottom– up processes;micro emulsion technique .

UNIT-II : Carbon Materials **(9 Periods)**

Graphene, Fullerene, SWNT, MWNT, Functionalized CNT – preparation, properties and applications

UNIT-III : Properties of Nanomaterials **(9 Periods)**

Band diagrams. Electrical transport properties, Thermal transport properties, Magnetic Properties, Optical Properties, Mechanical properties.

UNIT-IV: Nanodevice Fabrication **(9 Periods)**

Nanodevices - introduction- template fabrication, polycarbonate etched track templates, fabrication of anodized alumina membrane - Fabrication of nanostructures in the templates; electrodeposition, sol-gel, CVD methods

UNIT-V : Applications of Nanomaterials **(9 Periods)**

Electronic, magnetic, thermal and biological – application with and an example for each category.

UNIT-VI : Nano Structures **For Continuous Internal Assessment Only**)

Various types of nano-structures and nano-crystals. Classification: of bulk Nanostructured materials 1D and 2D structures – Size Effects – Fraction of Surface Atoms- specific Surface Energy and Surface Stress.

Text Book(S)

1.G. Balasubramanian (Ed.), Advances in Nanomaterials: Fundamentals, Properties and Applications, Springer, 2017. ISBN 978-319647159.

Reference Books

1.M. Raj Shankar (Ed.), Textbook of Nanoscience and Nanotechnology, Orient Black swan Publishers, New Delhi, 2012. ISBN: 978-8173717383.

2.D. Vollath (Ed.), Nanomaterials: An Introduction to Synthesis, Properties and Applications, Wiley, 2013. ISBN: 978-3-527-33379-0.

3.S. Singh and M.S. Ramachandra Rao (Ed.), Nanoscience and Nanotechnology: Fundamentals of Frontiers, Wiley Publishers, 2013. ISBN 978-8126542017.

4.T. Pradeep (Ed.), NANO: The Essentials: Understanding Nanoscience and Nanotechnology, McGraw Hill Education, 2017. ISBN-13: 978-0070617889.

COURSE OUTCOMES

CO number	**CO statement** On the Successful completion of the course the student would be able	**Knowledge level**
CO1	To acquire knowledge about the nano science	K2
CO2	To understand the carbon materials	K2
CO3	To analyses properties of nano elements.	K3
CO4	To determine Quality assurance of nanodevice	K3
CO5	To classify and understand application of nano materials.	K4

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	**Course code**	**Title of the Course**					**Hours**	**Credits**	
III	**24PCH3N2A**	**NANOMATERIALS**					**3**	**2**	
Couse outcomes	**Programme outcomes(POs)**					**Programme Specific Outcomes(PSOs)**					**Mean scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	2	2	3	3	2	3	2.7
CO2	3	3	3	2	3	3	2	3	3	3	2.8
CO3	3	2	2	3	3	2	2	3	2	2	2.4
CO4	2	3	3	2	3	3	2	3	2	3	2.6
CO5	3	3	3	2	3	2	3	3	3	3	2.8
Mean overall score											**2.66(High)**

NON MAJOR ELECTIVE COURSE-II
CHEMISTRY IN DAY-TO-DAY LIFE

Semester	**: III**	**Max. Marks**	**: 75**
Course Code	**: 24PCH3N2B**	**Credit**	**: 02**
Total Periods	**: 45**	**Exam Hrs**	**: 03**

OBJECTIVES

- To acquire the fundamental concepts related to the chemistry in daily life.
- To understand the importance of different types of commercial products for the environment.
- To apply the basic concepts of chemistry in the manufacture of commercial products for the society.
- To introduce the properties, structural elucidation, applications and the demerits of the products of the applied chemistry.

UNIT-I: Essential Micronutrients (9 Periods)

Carbohydrates - Proteins - Lipids - Nucleic acids and Vitamins – Definition, Sources, Classification, Applications and Diseases due to deficiency.

UNIT -II: Soil Nutrients and Food Additives (9 Periods)

Fertilizers – Pesticides - Insecticides – Definition, Classification, Characteristics and Uses. Additives –Definition, Characteristics, Uses and Abuse of additives in foods and beverages.

UNIT-III: Dyes, Paints And Pigments (9 Periods)

Dyes – Definition, Classification based on mode of application and structure, Applications. Paints – Definition, Ingredients, Characteristics, uses and drying process. Pigments -Varnishes - Definition, Characteristics, Types and Uses.

UNIT-IV: Soaps, Detergents and Disinfectants (9 Periods)

Soaps and Detergents - Definition, Ingredients, Classification, Characteristics and Uses. Disinfectants – Definition, Characteristics and Uses. Perfumes - Definition, Characteristics, Raw materials and perfumes used in soaps - Cosmetics.

UNIT -V :Ceramics, Cement and Glass (9 Periods)

Ceramics: General properties, porous and non-porous wares. Manufacturing process, extrusion, turning, drying, decoration). Porcelain and china.

Cement: Types, manufacture, additives, setting, properties & testing of cement.

Glass: Manufacture, properties, shaping of sheets & plate glasses. Annealing, finishing. Special glasses.

UNIT-VI: Plastics and Polymers (For Continuous Internal Assessment Only)

Introduction to polymers, types of polymers. Plastic in daily use: HDPE, LDPE, PVC, PET, PP. Environmental Hazards of plastics. Recycling of plastics International universal recycling codes and symbols for identification. Biodegradable plastics. Alternatives: Paper news print, writing paper, paper boards, cardboards and Natural materials: Wood, cotton, jute, coir.

References

1. B. K. Sharma: introduction to Industiral Chemistry, Goel Publishing, Meerut (1998)
2. Medicinal Chemistry by Ashtoush Kar.
3. Drugs and Pharamaceutical Sciences Series, Marcel Dekker, Vol. II, INC, New York
4. Analysis of Foods – H.E. Cox: 13. Chemical Analysis of Foods – H.E. Coxandpearson.
5. Foods: Facts and Principles. N. Shakuntala Many and S. Swamy, 4th ed. New Age International (1998)
6. Physical Chemistry – P l Atkins and J. de Paula – 7 th Ed. 2002, Oxford University Press.
7. Handbook on Feritilizer Technology by Swaminathan and Goswamy, 6th ed. 2001, FAI.
8. K. Bagavathi Sundari (2006), Applied Chemistry, MJP Publishers.
9. Des W. Connell (2016). Basic Concepts of Environmental Chemistry, Second edition, Taylor & Francis Group.
10. Ley E. Manahan (2009), Fundamentals of Environmental Chemistry, Third Edition, CRC Press, Taylor & Francis Group

COURSE OUTCOMES

CO number	CO statement On the Successful completion of the course the student would be able	Knowledge level
CO1	To understand the importance of different types of commercial products	**K3**
CO2	To apply concepts of chemistry in the manufacture of commercial products for the society	**K3**
CO3	To analyze basic concepts of various micronutrients, fertilizer, dyes, disinfectants and detergents.	**K4**
CO4	To classify types of various micronutrients, fertilizer, dyes, disinfectants and detergents.	**K4**
CO5	To analyze structural elucidation, applications and the demerits of the products of the applied chemistry.	**K5**

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course					Hours	Credits			
III	**24PCH3N2B**	**CHEMISTRY IN DAY-TO-DAY LIFE**					**3**	**2**			
Couse outcomes	**Programme outcomes(POs)**					**Programme Specific Outcomes(PSOs)**					**Mean scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	2	2	3	3	2	3	2.7
CO2	3	3	3	2	3	3	2	3	3	3	2.8
CO3	3	2	2	3	3	2	2	3	2	2	2.4
CO4	2	3	3	2	3	3	2	3	2	3	2.6
CO5	3	3	3	2	3	2	3	3	3	3	2.8
Mean overall score											**2.66(High)**

CORE COURSE-XI
INORGANIC SPECTROSCOPY

Semester	**: IV**	**Max. Marks**	**: 75**
Course Code	**: 24PCH4C11**	**Credit**	**: 06**
Total Periods	**: 90**	**Exam Hrs**	**: 03**

OBJECTIVES

- To educate students on electronic and Raman spectroscopy.
- To acquire knowledge in NMR, EPR and NQR spectroscopy.
- To apply Mossbauer Spectroscopy And NQR Spectroscopy on structure elucidation of inorganic molecules
- To understand about x ray diffraction techniques in structural elucidation of inorganic molecules.
- To elucidate structure of inorganic compounds using spectral data.

UNIT – I: Infrared and Raman spectroscopy (18 Periods)

Vibrations in simple molecules (H_2O, CO_2) and their symmetry notation for molecular vibrations – group vibrations and the limitations – combined uses of IR and Raman 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 and dimethyl sulfoxide.

Effect of isotopic substitution on the vibrational spectra of molecules – vibrational spectra of metal carbonyls with reference to the nature of bonding – applications of Raman spectroscopy – Combined application of Raman and IR spectroscopy in inorganic small molecules.

UNIT – II: NMR Spectroscopy (18 Periods)

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 – Effect of quadrupolarnuclei (^2H, ^{10}B, ^{11}B) on the ^1H NMR spectra-Systems with chemical exchange-kinetic and thermodynamic parameters from NMR- satellite spectra – study of fluxional behaviour of molecules – NMR of paramagnetic molecules – isotropic shifts contact and pseudo-contact interactions – lanthanide shift reagents.

UNIT – III: EPR Spectroscopy (18 Periods)

Theory of EPR spectroscopy – Isotropic and anisotropic system- Hyperfine splitting (methyl, p-benzosemiquinone, naphthalene radical)-spin densities and McConnell relationship –g values ($g^{\perp}$ and $g^{\parallel}$)- factors affecting the magnitude of g and A tensors in metal species – Zero-field splitting and Kramers degeneracy – spectra of V(II), Mn(II), Fe(II), Co(II), Ni(II) and Cu(II) complexes – applications of EPR to a few biological molecules containing Cu(II) and Fe(III) ions.

UNIT – IV: Mossbauer Spectroscopy and NQR Spectroscopy (18 Periods)

Theory of MB spectra- Isomer shifts -quadrupole splitting – magnetic interactions – applications to iron and tin compounds.

NQR spectroscopy – characteristics of quadrupolar nucleus – effects of field gradient and magnetic field upon quadrupolar energy levels – NQR transitions – applications of NQR spectroscopy.

UNIT – V: Photoelectron Spectroscopy & X-Ray Absorption Spectroscopy (18 Periods)

Photoelectron spectroscopy (UV and X-ray) – Physical principle – Experimental details - Koopman's theorem - chemical shift and correlation with electronic charges – Applications of PES.

X-ray absorption spectroscopy (XAS) and Extended X-ray absorption fine structure (EXAFS) – Applications of X-ray absorption spectroscopy. X-ray Absorption Edges - X-ray Fluorescence - Measurement of X-ray Absorption Spectra -Theoretical Description of EXAFS Spectra - Single scattering, Multiple scattering – Data reduction and analysis – Applications.

UNIT – VI: Electronic Spectroscopy (For Continuous Internal Assessment Only

Microstates, terms and energy levels for d1 – d9 ions in cubic and square fields intensity of bands – group theoretical approach to selection rules – effect of distortion and spin-orbit coupling on spectra – evaluation of 10Dq and β for octahedral complexes of cobalt and nickel – applications to simple coordination compounds – charge transfer spectra – electronic spectra of $[Ru(bipy)_3]^{2+}$.

References

1. R.S. Drago, Physical Methods in Inorganic Chemistry; Affiliated East-West Press Pvt. Ltd., New Delhi, 2012.
2. R.S. Drago, Physical Methods in Chemistry; Saunders College Publications, Philadelphia, 1992.
3. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 6th Ed., Wiley- Eastern Company, New Delhi, 1999.
4. P.J. Wheatley, The Determination of Molecular Structure; 2nd Ed., Dover Publications, Mineola, 1981.

5. G. J. Leigh, N. Winterton, Modern Coordination Chemistry; Royal Society of Chemistry, UK, 2002.
6. E.A.V. Ebsworth, Structural Methods in Inorganic Chemistry; 3rd Ed., ELBS, Great Britain, 1987.
7. W. Kemp, Organic Spectroscopy; 3rd Ed., Palgrave, New York, 2011.
8. J. R. Dyer, Applications of Absorption Spectroscopy of Organic Compounds, PHI Learning, New Delhi, 2009.
9. Y.R. Sharma, Elementary Organic Spectroscopy – Principles and Chemical Applications; S. Chand and Co., New Delhi, 1992.
10. P.S. Kalsi, Spectroscopy of Organic Compounds; 6th Ed., New Age International Publishers, New Delhi, 2004.
11. D.N. Sathyanarayana, Electronic Absorption Spectroscopy and Related Techniques; University Press, Hyderabad, 2001.

COURSE OUTCOMES

CO number	**CO statement** On the Successful completion of the course the student would be able	**Knowledge level**
CO1	To understand electronic and Raman spectroscopy of inorganic compounds	K3
CO2	To apply the concepts of NMR,EPR spectroscopy in structure analysis	K4
CO3	To apply Mossbauer Spectroscopy and NQR Spectroscopy on structure elucidation of inorganic molecules	K4
CO4	To apply x ray diffraction techniques in structural elucidation of inorganic molecules.	K5
CO5	To analyze structural elucidation using spectral data	K5

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	**Course code**		**Title of the Course**					**Hours**		**Credits**
IV	**24PCH4C11**		**INORGANIC SPECTROSCOPY**					**6**		**6**
Couse outcomes	**Programme outcomes(POs)**					**Programme Specific Outcomes(PSOs)**				**Mean scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	2	2	3	3	3	3	2	2.6
CO2	3	2	3	3	2	3	2	3	2	2	2.5
CO3	2	2	3	2	3	3	3	3	3	2	2.6
CO4	2	3	3	2	2	3	3	3	2	3	2.6
CO5	3	3	3	2	3	2	3	3	3	3	2.8
Mean overall score											**2.6(High)**

CORE ELECTIVE COURSE-III
GREEN CHEMISTRY

Semester	**: IV**	**Max. Marks**	**: 75**
Course Code	**: 24PCH4E3A**	**Credit**	**: 03**
Total Periods	**: 90**	**Exam Hrs**	**: 03**

OBJECTIVES

- To learn the green chemistry and their principles.
- To learn the importance of greener reactions.
- To learn Sonication reactions
- To understand the phase-transfer catalyst in green chemistry.
- To understand Phase-transfer catalyst reactions

UNIT – I: Introduction to Green Chemistry (18 Periods)

Introduction to green chemistry – twelve principles of green chemistry – planning a green synthesis in a chemical laboratory – evaluating the type of reaction involved – rearrangement, addition, substitution, elimination and pericyclic reactions.

Selection of appropriate solvent – aqueous phase reaction – reactions in ionic liquids – organic synthesis in solid state – solid supported organic synthesis – selection of starting materials – use of protecting group – use of catalyst – use of microwaves and sonication.

UNIT – II :Addition and Condensation Reactions (18 Periods)

Addition reactions – Michael addition in [aqueous medium and solid state] – Diels-Alder reactions in aqueous phase.

Condensation reactions – Aldol condensation of aldehydes with nitroalkanes and nitriles – Aldol condensation in solid phase – benzoin condensation under catalytic conditions – applications.

UNIT – III: Oxidation and Reduction Reactions (18 Periods)

Oxidation reactions – Baeyer-Villiger oxidation in aqueous phase and solid state – enzymatic Baeyer-Villiger oxidation.

Reduction reactions – Clemmensen reduction – mechanism – limitations – applications .

UNIT – IV :Phase-Transfer Catalyst Reactions (18 Periods)

Phase-transfer catalyst reactions – Heck reaction – Michael addition reaction – oxidation of toluene

to benzoic acid – Reimer-Tiemann reaction – BakerVenkataraman synthesis – Williamson ether synthesis – Dozen reaction.

UNIT – V :Sonication Reactions **(18 Periods)**

Sonication reactions – Barbier reaction – Reformatsky reaction – Simmons-Smith reaction – Strecker synthesis – Ullmann coupling reaction – Wurtz reaction – Bouveault reaction.

UNIT – VI : Emerging Green Technology, Alternative Energy Sources and Renewable Resources (For Continuous Internal Assessment Only)

Design for Energy efficiency-Photochemical reactions- Advantages-Challenge faced by photochemical process. Microwave technology on Chemistry- Microwave heating –Microwave assisted reactions-Sono chemistry and Green Chemistry – Electrochemical Synthesis-Examples of Electrochemical synthesis.

References

1. V.K. Ahluwalia, Green Chemistry; 2nd Ed., Ane Books Pvt Ltd., New Delhi, 2016.
2. P.T. Anastas and J. C. Warner, Green chemistry Theory and Practice; Oxford University Press, New York, 2005.
3. V.K. Ahluwalia and K. Agarwal, Organic Synthesis, Special Techniques; 2nd Ed., Narosa Publishing House, New Delhi, 2007.

COURSE OUTCOMES

CO number	**CO statement** On the Successful completion of the course the student would be able	**Knowledge level**
CO1	To analyze the concept of green chemistry and their principles.	K3
CO2	To apply green reactions in laboratory works	K4
CO3	To carry out Sonication reactions	K5
CO4	To apply x ray diffraction data in structural elucidation of inorganic molecules.	K5
CO5	To develop knowledge about phase-transfer catalyst in green chemistry.	K5

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	**Course code**	**Title of the Course**					**Hours**	**Credits**	
IV	**24PCH4E3A**	**GREEN CHEMISTRY**					**6**	**3**	
Couse outcomes	**Programme outcomes(POs)**					**Programme Specific Outcomes(PSOs)**					**Mean scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	2	2	3	3	2	3	2	2.5
CO2	3	2	2	3	2	3	2	3	2	2	2.4
CO3	2	2	3	2	3	1	3	3	1	2	2.2
CO4	2	3	3	2	2	3	3	2	2	3	2.5
CO5	1	3	3	2	2	2	3	3	2	3	2.4
Mean overall score											**2.4(High)**

CORE ELECTIVE COURSE-II
CATALYSIS

Semester : IV **Max. Marks : 75**

Course Code : 24PCH4E3B **Credit : 03**

Total Periods : 90 **Exam Hrs : 03**

OBJECTIVES

- To understand the basic concepts of catalysis
- To know about Acid-base catalytic reactions
- To learn the various techniques and mechanisms involved in catalysis.
- To understand about electro catalysis
- To study Applications of enzymes in organic synthesis

UNIT – I: Introduction to Catalysis (18 Periods)

Activity, selectivity, promoters, stabilisers and poisons, Catalyst's deactivation, Turn over number, inhibitors.

Thermodynamic consideration in catalysis: Energy factor, significance of activation parameters and application to kinetic systems.

Physical adsorption-Unimolecular adsorption- types of adsorption isotherms, Multimolecular adsorption-BET method, Harkins-Jura equation. Chemisorption of gases onmetals and oxides.

UNIT – II: Homogeneous and Heterogeneous Catalysis (18 Periods)

Acid-base catalytic reactions, protolytic and protropic mechanisms, activation energy of theprocesses, catalytic activity and acid-base strength, acidity functions: Hammett-Zuckertreatments, linear free energy relationships.

Homogeneous catalysts for the polymerization of olefins, oxidative dehydrogenation, Ethylbenzene to styrene, Ziegler-Natta polymerization. Heterogeneous catalysis .

Phase transfer catalysis – Rhodium water soluble catalyst systems with carboxylate and sulfonatedphosphines for hydroformylation reactions.

UNIT –III :Photocatalysis (18 Periods)

Thermal and photochemical reactions between H_2-Cl_2 and H_2-Br_2 and H_2- I_2 reactions, fluorescence, phosphorescence and quenching-Stern-Volmer equation.

Photocatalytic studies using non-stoichiometric oxides such as N-type and P-type semiconductors (TiO_2, ZnO, Cr_2O_3, doped and coupled semiconductors for the degradation of dyes)

UNIT – IV: Electrocatalysis **(18 Periods)**

Solar energy conversion, electrochemical cells, photo electrolysis of water and photocatalytic reactions .

Photocatalytic reduction of dinitrogen, photocatalysis for organic reactions oxidation, reduction, polymerization, substitution and isomerization reaction using TiO_2.

UNIT – V: Biocatalysis **(18 Periods)**

Mechanisms: Covalent catalysis, acid-base and metal-ion catalysis, entropy and geometric effects, structural complementary of the active site to the transition state, prevention of the side reactions, the size of the enzymes.

Applications of enzymes in organic synthesis: Oxidoreductase: Oxidation - Alcohols, epoxides, sulfoxides, amino acids, lactones.

UNIT – VI: Techniques in Catalysis **(For Continuous Internal Assessment Only)**

Structural characterization-BET surface area method, pore volume, and pore size distribution-BJH method, t-plot method, XRD, SEM, TEM, AFM, STM, TPR and TPD. Special relevance to metal oxides with different structures

References

1. B. Viswanathan, S. Sivasanker and A.V. Ramaswamy, Catalysis: Principles and Applications, Narosa Publishing House, New Delhi, 2004
2. G.C. Bond, Heterogeneous catalysis: Principles and applications, Oxford University Press,Ely House, London W.I, 1974.
3. V. Murugesan, A. Banumathi and M. Palanichamy, Recent Trends in Catalysis, Narosa Publishing House, New Delhi, 1999.
4. K.J. Laidler, Chemical Kinetics, Tata Mcgraw-Hill Publishing Company Ltd, New Delhi, 1973.
5. D.K. Chakrabarty, Adsorption and Catalysis by solids, Wiley Eastern Limited, New Delhi, 1991.
6. J.M Thomas, W.J. Thomas, Principles and practice of Heterogeneous Catalysis, Wiley- VCH, New York, 1996.

COURSE OUTCOMES

CO number	CO statement	Knowledge level
	On the Successful completion of the course the student would be able	
CO1	To understand the basic concepts of catalysis	K3
CO2	To analyze the role of Acid-base catalytic reactions	K3
CO3	To learn the various techniques and mechanisms involved in catalysis.	K4
CO4	To demonstrate electro catalysis	K5
CO5	To analyze applications of enzymes in organic synthesis	K5

Mapping with Programme Outcomes and Programme Specific outcomes

Semester	Course code	Title of the Course					Hours	Credits			
IV	24PCH4E3B	CATALYSIS					6	3			
Couse outcomes	Programme outcomes(POs)					Programme Specific Outcomes(PSOs)					Mean scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	2	3	3	3	2	3	2	2.7
CO2	3	2	2	3	2	3	2	3	2	3	2.5
CO3	3	2	3	2	3	2	3	3	3	2	2.6
CO4	2	3	3	3	2	3	3	2	2	3	2.6
CO5	3	3	3	2	3	2	3	3	2	3	2.7
Mean overall score											2.6(High)

PROJECT WORK

Semester : IV **Max. Marks : 60**

Course Code : 24PCH4PW **Credit : 06**

Total Periods : 270

Each candidate shall be required to take up a Project Work and submit it at the end of the final year. The Head of the Department shall assign the Guide who, in turn, will suggest the Project Work to the student in the beginning of the final year.

The Project will be evaluated by an internal and an external examiner. The candidate concerned will have to defend her Project through a Viva-voce.

ASSESSMENT /EVALUATION /VIVA-VOCE

1. **PROJECT REPORT EVALUATION (Both Internal & External)**

   I. Plan of the Project - 20 marks

   II. Execution of the Plan/collection of Data / Organisation of Materials / Hypothesis, Testing etc and presentation of the report. - 45 marks

   III. Individual initiative - 15 marks

2. **VIVA-VOCE / INTERNAL& EXTERNAL** - 20 marks

TOTAL - 100 marks

PASSING MINIMUM

Project	Vivo-Voce 20 Marks 40% out of 20 Marks (i.e. 8 Marks)	Dissertation 80 Marks 40% out of 80 marks (i.e. 32 marks)

A candidate shall be declared to have passed in the Project work if she gets not less than 40% in each of the Project Report and Viva-voce but not less than 50% in the aggregate of both the marks for Project Report and Viva-voce.

A candidate who gets less than 40% in the Project must resubmit the Project Report. Such candidates need to defend the resubmitted Project at the Viva-voce within a month. A maximum of 2 chances will be given to the candidate.