KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
COIMBATORE – 641 029
Course Name: M.Sc Chemistry
Curriculum and Scheme of Examination under CBCS
(Applicable to students Admitted from the Academic year 2015 – 2016 onwards)

Semester	Course code / Q.P.Code	Title of the Course	Instruction hours/cycle	Exam. Marks			Duration of Exam (Hrs)	Credits
				CIA	ESE	Total		
I	15PCH101	C.P.-1- Organic Chemistry - I	5	25	75	100	3	5
	15PCH102	C.P. 2 - Inorganic Chemistry - I	5	25	75	100	3	5
	15PCH1E1	ME-1 Major Elective - I	5	25	75	100	3	5
		C.Pr.1 - Organic Chemistry Practical - I	5	-	-	-	-	-
		C.Pr.2 - Inorganic Chemistry Practical-I	5	-	-	-	-	-
		C.Pr.3 - Physical Chemistry Practical-I	5	-	-	-	-	-
II	15PCH203	C.P. 4 - Physical Chemistry - I	5	25	75	100	3	5
	15PCH204	C.P. 3 - Organic Chemistry - II	5	25	75	100	3	4
	15PCH205	C.P. 5 - Inorganic Chemistry - II	5	25	75	100	3	4
	15PCH2N1	NME-1 Non-Major Elective - I	5	25	75	100	3	5
	15PCH2CL	C.Pr.1 - Organic Chemistry Practical - I	3	40	60	100	6	3
	15PCH2CM	C.Pr.2 - Inorganic Chemistry Practical-I	3	40	60	100	6	3
	15PCH2CN	C.Pr.3 - Physical Chemistry Practical-I	4	40	60	100	6	3
III	15PCH306	C.P. 6 - Physical Chemistry - II	5	25	75	100	3	5
	15PCH307	C.P. 7 - Spectroscopy	5	25	75	100	3	5
	15PCH308	C.P.8 - Organic Chemistry - III	5	25	75	100	3	5
	15PCH309	C.P.9- Inorganic Chemistry-III	5	25	75	100	3	5
	15PCH3CO	C. Pr.4-Physical Chemistry Practical -II	4	40	60	100	6	2
		C.Pr.5 - Organic Chemistry Practical - II	3	-	-	-	-	-
		C.Pr.6 - Inorganic Chemistry Practical-II	3	-	-	-	-	-
IV	15PCH410	C.P.10 - Physical Chemistry - III	4	25	75	100	3	4
	15PCH4E2	ME-2 - Major Elective - II	5	25	75	100	3	5
	15PCH4N2	NME- 2 - Non-Major Elective - II	5	25	75	100	3	5
	15PCH4CP	C.Pr.5 - Organic Chemistry Practical - II	5	40	60	100	6	3
	15PCH4CQ	C.Pr.6 - Inorganic Chemistry Practical-II	5	40	60	100	6	3
	15PCH4Z1	Project Work & Viva -Voce	6	40	160	200	-	6
Total						**2200**		**90**

Major Electives papers

(2 papers are to be chosen from the following 4 papers)

1. Physical Methods in Chemistry
2. Polymer science & Technology
3. Green and Nano Chemistry
4. Bio inorganic chemistry

Non-Major Electives papers

(2 papers are to be chosen from the following 4 papers)

1. Environmental chemistry
2. Scientific thesis writing & paper presentation
3. Agricultural Chemistry
4. Industrial Products

Abstract

S.No	Particulars of the Courses	No of courses	Marks	Credits	Total	
					Marks	Credits
01	**Core**				1800	70
	i. Theory	10	1000	46		
	ii. Practicals	06	600	18		
	iii. Project work	01	200	06		
02	Major Electives	02	200	10	200	10
03	Non-Major Electives	02	200	10	200	10
		Total			**2200**	**90**

Extra credit courses

JOB ORIENTED COURSE								
Semester	**Course code / Q.P.Code**	**Title of the Course**	**Instruction**	**Exam. Marks**			**Duration of Exam(Hrs)**	**Credits**
				CIA	**ESE**	**Total**		
	15PCH0J1	JOC - Pharmaceutical Chemistry	6	-	100	100	3	2
ADVANCED LEARNER COURSES *(UNDER SELF STUDY SCHEME)*								
	15PCH0D1	ALC- 1 Chemistry of Corrosion and its Prevention	-	-	100	100	3	2
	15PCH0D2	ALC- 2 Medicinal Chemistry	-	-	100	100	3	2
	15PCH0D3	ALC- 3 Food Chemistry	-	-	100	100	3	2

CBCS – **C**hoice **B**ased **C**redit **S**ystem: CIA – **C**ontinuous **I**nternal **A**ssessment:

ESE – **E**nd-of-**S**emester **E**xamination:

25 % CIA is applicable to all subjects except JOC and ALC, which are considered as extra credit courses.

JOC is conducted for 6 hours per cycle outside the college hours.

Semester	Course code	Course Title
I	15PCH101	C.P-1 Organic Chemistry - I

Credits: 5 **Total teaching hours: 75**

Objectives:

- To motivate the students to comprehend a knowledge on aromaticity and reaction mechanism.
- To enable the students to elucidate the structure of some terpenoids compounds.
- On successful completion of the syllabus, the students should have learnt about addition reactions, electrophilic nucleophilic substitution reactions and name reactions.

UNIT I: AROMATICITY (15 hrs)

Huckel's rule – aromaticity in 5, 6, 7 and 8 membered rings (recall). Aromatic systems with electron numbers other than six – systems of two electrons, four electrons (anti aromaticity), eight electrons, ten electrons and more than ten electrons- homo and heteroaromatic compounds – annulenes and hetero annulenes.

Structure and stability of carbocations, carbanions, free radicals, carbenes, nitrenes. Reaction mechanism: – study of intermediates, isotopic labeling, stereo chemical studies and cross over experiments, linear free energy relationship – Hammett equation – Hammonds postulate-Taft equation.

UNIT-II: ALIPHATIC AND AROMATIC ELECTROPHILIC SUBSTITUTION REACTIONS (15 hrs)

Aliphatic and aromatic electrophilic substitution reactions: SE_1 and SE_2 reactions - mechanisms and reactivity - typical reactions involving migration of double bond - keto-enol tautomerism - halogenation of carbonyl compounds - Stork enamine reactions - decarboxylation of aliphatic acids - Friedel Crafts acylation of olefinic carbon. Aromatic electrophilic substitution - reactivity - orientation and mechanisms - nitration - halogenation and sulphonation - Friedel Crafts alkylation - Friedel Crafts arylation (Scholl reaction) and acylation - Jacobsen reaction - formylation with (i) disubstituted formamides(Vilsmeyer- Haack reaction) (ii) zinc cyanide and HCl (Gattermann reaction) (iii) chloroform (Reimer - Tiemann reaction) - carboxylation with (i) carbonyl halides (ii) carbon dioxide (Kolbe Schmidt reaction) - amidation with isocyanates - hydroxyalkylation (hydroxyalkyl - dehydrogenation)- cyanodehydration of aldehydes and ketones

(Bradsher reaction and Bischer - Napieralski rection) - haloalkylation - aminoalkylation and amido alkylation - thioalkylation -acylation with nitriles (Hoesch reaction) - cyanation – hydroxylation.

UNIT-III ALIPHATIC AND AROMATIC NUCLEOPHILIC SUBSTITUTION REACTIONS (15 hrs)

Aliphatic and aromatic nucleophilic substitution reactions: Bonding - structure and reactivity - acids and bases (hard and soft acid base theory) - methods of determination and the study of reaction mechanisms. SN_1, SN_2, SN_i and neighbouring group mechanisms - kinetics - effects of structure - solvent and leaving and entering group - stereochemistry - hydrolysis of esters - Wurtz reaction - Claisen and Dieckmann condensation - Williamson reactions. Different mechanisms of aromatic nucleophilic substitution - Ziegler alkylation - Chichibabin reaction - Cine substitution - diazonium group as leaving group.

UNIT-IV ADDITION AND ELIMINATION REACTIONS (15 hrs)

Addition and elimination reactions: Addition to C-C and C-O multiple bonds - electrophilic, nucleophilic and free-radical additions - additions to conjucated systems - orientation - Birch reduction - hydroboration - Michael condensation - 1,3 dipolar additions - Diels-Alder reactions - carbene addition to double bonds - hydration of olefines. Mannich reaction - Meerwein-Pondorf reduction - Grignard reactions - Aldol - Claisen - Stobbe - Darsen - Wittig - Thorpe and benzoin condensations - Cannizarro reaction. Elimination reactions - E1 and E2 mechanisms - orientations - Hofmann and Saytzeff rules - elimination versus substitution - Chaugav reaction - Hofmann degradation and Cope elimination - dehydration of alcohols - dehydrohalogenation - mechanisms and orientation in pyrolytic elimination.

UNIT – V: TERPENOIDS (15 hrs)

Isolation and classification of terpenes, structural elucidation and synthesis of Camphor, Zingiberene, Eudesmol, Abeitic acid.

REFERENCE BOOKS

1. Jerry March, Advanced Organic Chemistry, Wiley eastern limited, Fourth Edition, New Delhi, 1999.
2. I.L. Finar – Organic Chemistry, Vol.I, 6th Edition, Addison Wesley Longman Ltd.
3. I.L. Finar – Organic Chemistry, Vol.II, 5th Edition, Addison Wesley Longman Ltd.

4. W.Caruthers., Modern Methods of Organic synthesis, Publisher, Cambridge University Press, 2004
5. J.N.Gurtu and R.Kapoor, Organic reactions and reagents, S. chand & Co. (P)
6. Clayden, Greeves, Warren, Organic Chemistry, Oxford University Press, 2001.
7. P.S. Kalsi- Organic Reaction Mechanism, New Age international publishers, India, 2000.
8. V.K.Ahluwalia and Rakesh kumar Parashar-Organic reaction mechanisms, 3rd edition, Narosa publishing house.
9. O. P. Agarwal – Natural product Chemistry, 20th Edition, Goel Publishing house
10. F. A. Carey, Organic Chemistry-Part-B-Reactions and synthesis, Plenum press, 5th edition 1997.
11. Raj. K. Bansal, Organic Reaction Mechanism, Tata McGraw Hill, New Delhi, 1990.
12. P.Sykes, A Guidebook to Mechanism in Organic Chemistry, 6th edition, Orient Longman Private limited, New Delhi, 1988
13. O.P.Agarwal, Organic Chemistry, Edition, 4. Publisher, Goel Pub. House, 1975.
14. Jagdamba Singh, L. D. S. Yadav - Advanced Organic Chemistry, Second Revised edition, Pragati Prakashan Educational publications, Meerut, India, 2006.
15. Gurdeep Chatawal – Organic Chemistry of Natural Products Vol I & II, Himalaya Publishing House, 2001
16. O.P.Agarwal, Organic Chemistry Reaction and reagents, 51st Edition. Publisher, Goel Pub. House, 2014.
17. Jagdamba Singh, L. D. S. Yadav - Advanced Organic Chemistry, Second Revised edition, Pragati Prakashan Educational publications, Meerut, India, 2006.
18. Gurdeep Chatawal – Organic Chemistry of Natural Products Vol I & II, Himalaya Publishing House, 2001

Semester	Course code	Course Title
I	15PCH102	C.P-2 Inorganic Chemistry - I

Credits: 5 **Total teaching hours: 75**

Objectives:

- To introduce the principles and applications of solid state and nuclear chemistry.
- On successful completion of the syllabus, the students should have learnt about periodic properties and f block elements, nuclear model, modes of decay and detection, measurement of radio activity, nuclear reactors and applications

UNIT I: PERIODIC PROPERTIES AND THEORY OF ACIDS AND BASES (15 hrs)

Periodic properties of atoms – ionization energy – electron affinity – Pauling's and modern scales of electronegativity – Acid-base concept – measure of acid and base strength – non-aqueous solvents NH_3,H_2SO_4,HF,N_2O_4,SO_2 – superacids – hard and soft acids bases – theory and applications.

UNIT II: STRUCTURE AND BONDING (15 hrs)

Introduction– close packing of atoms and ions – bcc, fcc and hcc voids –radius ratio rule – derivation – its influence on structures – structures of NaCl, CsCl, rutile, fluorite, antifluorite, zinc blende, wurtzite,– spinels – normal and inverse spinels and perovskite – lattice energy of ionic crystals – Madelung constant – Born Haber cycle and its applications. VSEPR theory with applications to inorganic compounds.

Solid state defects - Stoichiometric and non-stoichiometric defects- electrical properties of solids – insulators –intrinsic and extrinsic semiconductors (n and p type), band theory - superconductors.

UNIT – III SOLID STATE AND CRYSTALLOGRAPY (15 hrs)

Lattices and unit cells- the crystal systems and Bravais lattices – Miller indices and labeling of planes – symmetry properties – crystallographic point groups and space groups.

Fundamentals of X-ray diffraction – powder and rotating crystal methods – systematic absences and determination of lattice type – analysis of X-ray data for cubic system – electron and neutron diffraction.

UNIT IV: NUCLEAR CHEMISTRY (15 hrs)

Radioactivity – decay constant – half-life period – artificial transmutation – G.M. Counter – Scintillation counter – nuclear forces – nuclear fission and fusion reactions – nuclear models-single particle –liquid drop – nuclear accelerators – linear accelerators – cyclotron, synchrocyclotron, betatron – nuclear reactors – fast breeder reactors – power reactors - radioisotopes and their applications-radioactive isotopes as tracers, analytical, medicinal, agriculture.

UNIT V: CHEMISTRY OF LANTHANIDES AND ACTINIDES (15 hrs)

Lanthanide series – electronic configuration – oxidation states – magnetic properties – colour – ionic radii – lanthanide contraction – chemical reactivity and complex formation – extraction of a mixture of lanthanides from monazite sand – separation of lanthanides – ion exchange method. Actinide series – sources of actinide – preparation of transuranic elements – electronic configurations – oxidation state – colour and complex formation – extraction of thorium from monazite sand and isolation of uranium from pitchblende- comparison of lanthanides and actinides, uses of lanthanides and actinides.

REFERENCE BOOKS:

1. H. J. Arnikar, Essential of Nuclear chemistry 4th Edition, 1997, New Age International Publishers.

2. U. N. Dash, Nuclear Chemistry 1st Edition, 1971.

3. Gurdeep Raj, Advanced Inorganic Chemistry, Vol-I & II Goel Publishing House.

4. Lesly Smart Elain, Moore, Solid State Chemistry, Edition, 2, reprint. Publisher, Chapman & Hall, 1995.

5. Malik, Tuli, Madan , Selected topics in inorganic chemistry, 5th edition, S. Chand.

6. Azaroff. L. Introduction to Solids, Tata McGraw Hill Publishing Company, 1995.

7. Cotton F. A.and G. Wilkinson, Advanced Inorganic Chemistry**,** Fifth edition, John Wiley & Sons, Inc., 1988.

8. James E.Huheey, Inorganic Chemistry**,** Fourth edition, HarperCollins College Publishers, 1993.

9. Lee J. D, Concise Inorganic Chemistry, Fifth edition, ELBS, 1994.

10. Basolo and Pearson, Ralph. G, Mechanism of Inorganic Reactions- A study of metal complexes in solution. Wiley Eastern, New Delhi,1984.

11. Keith F. Purcell and John C. Kotz, Inorganic Chemistry, W.B.Saunders Company, 1997.

12. Jolly, William L, Modern inorganic chemistry, McGraw-Hill, New York, 1985.

Semester	Course code	Course Title
II	**15PCH203**	**C.P-3 Physical Chemistry - I**

Credits: 5 **Total teaching hours: 75**

Objectives:

- To motivate the students to comprehend a knowledge on symmetry elements and symmetry operations.
- To introduce the principles of chemical kinetics to allow exploration of gas-phase and liquid-phase reactions.
- On successful completion of the syllabus, the students should have learnt the concepts of Group theory, chemical kinetics, catalysis and adsorption**.**

UNIT – I GROUP THEORY-I: **(15 hrs)**

Symmetry elements and symmetry operations, identity element, centre of symmetry, plane of symmetry, proper and improper axes of symmetry, groups – definition, properties, types of groups- Abelian group, non-abelian group, sub group, isomorphic group – similarity transformation and classes – group multiplication table for C_{2v} and C_{3v} point group – symmetry classification of molecules into point groups (Schoenflies symbol only). Group theory and dipole moment.

Matrices: definition of matrix, types -square, diagonal, null, unit, row, column, symmetric and skew symmetric- addition and subtraction of matrices – matrix representations of symmetry operations.

UNIT – II-GROUP THEORY-II **(15 hrs)**

Representation of point groups - definition, types (reducible and irreducible representations), the Great orthogonality theorem, significance and its consequences (proof not needed), character tables-construction of the character table for C_{2v} and C_{3v} point group, reduction of reducible representations.

Application of group theory to bonding: hybridization scheme for orbital in AB_3 (planar), $AB_4(T_d)$, $AB_5(D_{3h})$ and $AB_6(O_h)$ type of molecules.

Group theory and vibrational spectroscopy – direct product representation, vibrational modes as basis for group representation, symmetry selection rule for IR and Raman spectra (mutual exclusion principle), classification of vibrational modes.

UNIT – III CHEMICAL KINETICS-I (15 hrs)

Theories of reaction rates – Arrhenius theory, collision theory- classical collision theory, modified collision theory, weaknesses of collision theory, Absolute reaction rate or Transition state theory, statistical mechanical derivation of the rate equation, thermo dynamical formulation of reaction rate, comparison of collision theory and absolute reaction rate theory.

Reactions in solutions: collision in solution, Cage effect, salt effect- primary salt effect and secondary salt effects, significance of salt effect. Effect of pressure on rates of reactions in solutions, Linear Free Energy Relationship (LFER) - Hammett equations, Kinetic Isotope effects.

UNIT – IV CHEMICAL KINETICS-II (15 hrs)

Homogenous catalysis – specific and general acid-base catalysis, Bronsted catalysis law, acidity functions, enzyme catalysis – Michaelis-Menton law – influence of pH and temperature on enzyme catalysis.

Surface phenomenon and heterogenous catalysis – adsorption and free energy relation at interfaces - physisorption and chemisorptions, adsorption isotherms – Langmuir, Freundlich, BET and Gibb's adsorption isotherm, measurement of surface area, kinetics of heterogeneous catalysis - Langmuir-Hinshelwood, Langmuir-Rideal (Rideal-Eley) mechanisms.

UNIT -V POLYMER KINETICS (15 hrs)

Classification of polymers-kinetics and mechanism of polymerization-free radical, ionic and co-ordination, Ziegler-Natta polymerization-degree of polymerization-molecular weights and their determination-average molecular weight –number average and weight average molecular weight-sedimentation and viscosity average molecular weights – kinetics of free radical chain polymerization (derivation of rate equation, kinetic chain length and degree of polymerization), process of polymerization – bulk, solution, suspension and emulsion.

REFERENCE BOOKS

1. Gurdeep Raj, Chemical kinetics, 6th Edition, Goel Publishing House
2. K. V. Raman, Group Theory and its applications to chemistry, Tata McGraw Hill publishing company Ltd,1996.
3. P. K. Bhattacharya, Group theory and its chemical applications, Publisher, Himalaya Publishing House, 1986. Length, 205 pages.
4. V. R. Gowariker & N. V. Viswanathan, Polymer Science 1st Edition, New Age

International Private Ltd.

5 W. J. Moore, Physical Chemistry, 5th Edition, Orient Longman Ltd

6 P. W. Atkins, Physical Chemistry, 6th Edition, Oxford University Press.

7 A. A. Frost and R. G. Pearson, Kinetics and mechanism, Wiley Eastern Pvt. Ltd.

8 F. A. Cotton, Chemical applications of group theory, 3rd Edition, A Wiley Interscience Publication

9 Veera Reddy, Symmetry and Spectroscopy of molecules, New Age International (1998).

10 K. J. Laidler, Chemical kinetics, 2nd Edition, Tata McGraw Hill Ltd.

Semester	Course code	Course Title
II	**15PCH204**	**C.P-4 Organic Chemistry - II**

Credits: 5 **Total teaching hours: 90**

Objectives:

- To give a thorough introduction to the study of organic photochemistry.
- To enable a comprehensive knowledge on conformational analysis and stereochemistry, concerted reactions and pericyclic reactions of organic compounds to the students,
- To give an idea about functional group interconversions.
- On successful completion of the syllabus, the students should have understood the mechanism of elimination reactions, free radical reactions, isolation, general structural elucidation and general bio synthesis of alkaloids.

UNIT – I: CONFORMATIONAL ANALYSIS AND STEREOCHEMISTRY (18 hrs)

Fischer- Newman and Sawhorse projection-R and S notation: stereochemistry of sulphur and nitrogen compounds, geometrical isomerism – E & Z configuration - stereoselective and stereospecific synthesis- asymmetric synthesis -conformation of cyclic systems – cyclohexane derivatives (mono,di-substituted), decalins, perhydrophenanthrene, cyclohexanols, Effect of conformation and reactivity in cyclic systems.

UNIT- II: ORGANIC PHOTOCHEMISTRY

Light absorption, electronic excitation, quantum yield, physical and chemical actinometry, Jablonski diagram, photophysical processes – Fluorescence, phosphorescence, internal conversion and intersystem crossing, photosensitization and energy transfer, Typical photochemical reactions – Norrish type I and type II reactions, Patterno-Buchi reaction, photoreduction, photo oxidation, Optical pumping – Dienone phenol rearrangement, Cis-trans isomerization, photochemistry of arenes, di-π methane rearrangement, valence isomerisation – rearrangement of 1,4 and 1,5 dienes.

UNIT – III: CONCERTED REACTIONS: (18 hrs)

Conservation of orbital symmetry – Woodward-Hoffman selection rule for electrocyclic reaction, cycloaddition reaction, sigmatropic rearrangement.

Electrocyclic reactions – 1,3-diene and 1,3,5-triene, analysis of stereochemistry using correlation diagram and FMO method.

Cycloadditions: (π2s + π2s) Correlation and FMO approach, (π2s + π4s)- Diels-Alder reactions – analysis of stereochemistry by correlation diagram and FMO methods.

Sigmatropic rearrangements – analysis of sigmatropic rearrangements by FMO method-1,3&1,5-sigmatropic rearrangements – other sigmatropic shifts- Cope and Claisen rearrangements, the perturbation theory of pericyclic reactions. (Basic ideas only), 1,3 dipolar addition.

UNIT-IV: SYNTHETIC METHODOLOGY (18 hrs)

Retro synthetic approach - synthons – guidelines for disconnections - functional group interconversion- one group c-x disconnection –1,1- 1,2 and-1,3-two group c-x disconnections-one group disconnection C-C, alcohols, carbonyl,– regio selectivity – use of acetylenes, aliphatic nitro compounds in organic synthesis- reversal of polarity- order of events.

UNIT – V: ALKALOIDS (18 hrs)

Isolation and general structural methods of elucidation of alkaloids, structural elucidation and synthesis of Morphine, Reserpine, Atropine and Quinine.

REFERENCE BOOKS:

1. P. S. Kalsi. Stereochemistry, Conformation and Mechanism (3rd edn.), John Wiley (1995).
2. Ernest.L.Eliel, Stereochemistry of carbon compounds, McGraw-Hill, New York, 1962. Xv-486 pp.
3. D. Nasipuri, Stereochemistry of organic compounds, Publisher, New Age International, 1994.
4. Jerry March, Advanced organic chemistry, 4th Edition, A Wiley Interscience Publication
5. Jagdamba Singh, L. D. S. Yadav, Organic Synthesis, Pragati Prakashan Educational Publications, Meerut, India, 2006.

6. J.M. Coxon and B. Halton, Organic Photochemistry, Cambridge University Press; 2nd edition, 1974.
7. Jagdamba singh, Photo Chemistry, Publisher, New Age International, 2005.
8. Stuart Warren, Organic Synthesis- The disconnection approach, Wiley; Student edition, 1984.
9. C.H. DePuy and D. Chapmann, Molecular reactions and photochemistry, Prentice Hall, 1972
10. Jagdamba Singh, L. D. S. Yadav, Advanced Organic Chemistry, Pragati Prakashan Educational publications, Meerut, India, 2004
10. O. P. Agarwal, Natural product Chemistry, 20th Edition, Goel Publishing house
11. Gurdeep Chatawal, Organic Chemistry of Natural Products Vol I & II, Himalaya Publishing House, 2001.

Semester	Course code	Course Title
II	15PCH205	C.P-5 Inorganic Chemistry - II

Credits: 5 **Total teaching hours: 90**

Objectives:

- To promote an awareness about bonding in coordination complexes to the students.
- To allow the students to get introduced to acid base concepts and chemistry of some important solvents.
- On successful completion of the syllabus, the students should have known about theories of bonding in inorganic complexes and application, substitution reaction mechanism of coordination complexes, electron transfer mechanism of coordination complexes and magnetic behavior.

UNIT-I: INTRODUCTION TO CO-ORDINATIONCOMPOUNDS (18 hrs)

Recall the nomenclature of coordination compounds- types of ligands - coordination number – geometries– stereochemistry and isomerism–constitutional, geometrical and optical-coordination numbers 4 and 6 –theories of bonding - CFT – crystal field splitting in octahedral, square planar, tetrahedral complexes – CFSE- factors influencing the magnitude of Δ_0 – applications of CFT – Jahn-Teller distortions - limitations - LFT and MOT- applications to octahedral complexes – (σ - bonding) – tetrahedral, square planar complexes – comparison of different theories - stabilization of unusual oxidation states by coordination, applications of ORD.

UNIT II: MAGNETIC PROPERTIES & ELECTRONIC SPECTRA OF METAL COMPLEXES (18 hrs)

Magnetic properties of tetrahedral and octahedral complexes- spin cross over rule - microstates of electron configuration in free atoms and ions –term symbols for equivalent and non-equivalent electrons- possible term symbols for given configuration – p^2 - d^2 – splitting of terms in square planar, tetrahedral , octahedral fields- Electronic spectra of various complexes – selection rules - spin orbit coupling -assignment and intensities of transitions – Orgel (d^1 to d^9 octahedral and tetrahedral complexes) and Tanabe Sugano diagrams(d^1 ,d^6 complexes and its

applications)- calculation of Δ_0 and β and Racah parameters – examples from d^2 , d^3 d^7, d^8 octahedral complexes- CT spectra of metal complexes.

UNIT III: REACTION MECHANISM OF METAL COMPLEXES – I (18 hrs)

Ligand substitution reactions in octahedral, square planar complexes- labile and inert complexes– dissociation, association mechanism – Mechanism of hydrolysis reactions – acid hydrolysis – base hydrolysis – anation reactions – trans effect –trans influence–trans effect and its application-theories of trans effect- Thermodynamic and kinetic stability of complexes – factors affecting stability of metal complexes – experimental determination of stability constant of complexes.

UNIT IV: REACTION MECHANISM OF METAL COMPLEXES – II (18 hrs)

Electron transfer reactions – one electron transfer reactions – inner sphere mechanism – outer sphere mechanism - two electron transfer reactions – complementary and non – complementary electron transfer reactions – synthesis of complexes using electron transfer reactions-metal assisted reactions – Aldol condensation – ester hydrolysis –amide hydrolysis – template effect – synthesis of macrocyclic ligands – reaction of coordinated ligand .

UNIT – V BIOINORGANIC CHEMISTRY (18 hrs)

Bioinorganic chemistry – metal ions in biology – metalloporphyrins(heme and non-heme proteins) – cytochromes, heomoglobin, myoglobin, chlorophyll, ferridoxins, rubredoxins, blue copper proteins, enzymes- Vitamin B_{12} and B_{12} coenzymes (structure and functions) – nitrogen fixation(invitro and invivo) – chelate therapy, antitumour agents - cis-platin.

REFERENCE BOOKS:

1. Cotton F.A.and G.Wilkinson, Advanced Inorganic Chemistry, Fifth edition, John Wiley & Sons, Inc., 1988.
2. James E.Huheey, Inorganic Chemistry, Fourth edition, HarperCollins College Publishers, 1993.
3. Lee J. D, Concise Inorganic Chemistry, Fifth edition, ELBS, 1994.
4. Basolo, and Pearson, Ralph. G, Mechanism of Inorganic Reactions- A study of metal complexes in solution. Wiley Eastern, New Delhi,1984.

5. Keith F. Purcell and John C.Kotz, Inorganic Chemistry, W.B.Saunders Company, 1997.
6. Malik, Tuli, Madan , Selected topics in inorganic chemistry, 5th edition, S. Chand&Co., New Delhi.
7. Russel S. Drago, Physical Methods in Inorganic Chemistry, Affiliated East-West Press Pvt. Ltd., New Delhi, 1968.
8. S. FA. Kettle, Co-ordination Compounds
9. H.J. Emeleus and A.J. Sharpe, Modern aspects of Inorganic Chemistry, 1973, ELBS.
10. B. N. Figgis, Introduction to ligand fields.
11. I. Bertini, H.B.Gray, S.J. Lippard and J.S. Nalentine, Bioinorganic Chemistry; University Science Books.
12. Dr. Asim K. Dass, Bioinorganic Chemistry 2007. Books and Allied (P) Limited.

Semester	Course code	Course Title
I & II	15PCH2CL	C.Pr-1 Organic Chemistry Practical- I

Credits: 3 **Total Hours: 120**

Objectives

- To make the students aware about separation of mixture of organic compounds and analyzing the unknown compounds.
- To allow the students to know and practice the techniques of preparation of some organic compounds.

A. Analysis of two component organic mixtures

(Separation and characterization of individual compounds)

Note: Each student has to complete the analysis of minimum of **FIVE** Mixtures during the course

B. Single stage Preparations

1. **Hydrolysis:**
   Preparation of Salicylic acid from Methyl Salicylate.
2. **Acetylation:**
   Preparation of Acetanilide from Aniline.
3. **Bromination:**
   Preparation of p-Bromoacetanilide from Acetanilide.
4. **Nitration:**
   Preparation of m-dinitrobenzene from nitrobenzene.
5. **Benzoylation:**
   Preparation of Benzanilide from Aniline.
6. **Oxidation:**
   Preparation of Benzoic acid from Benzaldehyde.
7. Preparation of Glucose penta acetate.
8. Preparation of Diphenyl hydantoin from Benzil and urea.
9. Microwave synthesis (NOT for ESE)

REFERENCES

1. Gnanprakasam and Ramamurthy, Organic Chemistry Laboratory Manual, Ananda Book Depot, Chennai.
2. NK Vishnoi,Advanced Practical Organic Chemistry, Vikas Publishing House,1992.
3. R. Jagmohan Advanced Practical Organic Chemistry, Vol. I & II.

Distribution of Marks

Internal (Maximum 40)	ESE (Maximum 60)
1. CIA Practical exam – 25 2. Observation note book – 10 3. Attendance – 5	1. Qualitative analysis – 30 2. Preparation of an organic compound – 10 3. Record – 10 4. Viva-Voce - 10

Semester	Course code	Course Title
I & II	15PCH2CM	C.Pr-1 Inorganic Chemistry Practical- I

Credits: 3 **Total Hours: 120**

Objectives

- To give an idea to the students about the separation and analysis of cations from the mixture of common and rare cations.
- To allow the students to know and practice the techniques in preparation of some inorganic complexes.
- To make the students apply colorimetric principle in estimation of metal ions.

A. Semimicro QualitativeAnalysis:

Analysis of mixtures of common metal cations and the following less familiar metal cations - Tungsten, Selenium, Tellurium, Molybdenum, Cerium, Thorium, Vanadium and Lithium.

Note: A minimum of FIVE inorganic mixtures, each containing of two common and two less familiar metal cations has to be analyzed by each student during the course.

B. Preparation of complexes

Any Five preparations selected from the following list:

Tris(thiourea)Copper(I)chloride

Potassiumtrioxalatoaluminate(III)

Potassiumtrioxalatochromate(III)

Tetramminecopper(II)sulphate

Tris(thiourea)copper(II)sulphate

Nickelammoniumsulphatehexahydrate

Hexaminecobalt(III)chloride

Potassiumtrioxalatoferrate(III).

C. Colorimetric Estimations (using photoelectric colorimeter)

Estimation of Copper, Iron, Nickel, Manganese and Chromium

TEXT BOOKS

1. V.V.Ramanajum, Semimicro Qualitative Inorganic Analysis.
2. V.Venkateswaran, R.Veeraswamy and A.R. Kulandaivelu, Principles of Practical Chemistry Sultan Sultan Chand & Sons. (1997) Edition II
3. S.Giri. D.N. Bajpai.and O.P. Panday, Practical Chemistry Vol.I & II, S.Chand & Co

Distribution of Marks

Internal (Maximum 40 marks)	**ESE (Maximum 60 marks)**
1. CIA Practical exam – 25 2. Observation note book – 10 3. Attendance – 5	1. Qualitative analysis – 20 2. Preparation of an Inorganic compound – 10 3. Colorimetric Estimation - 10 4. Record – 10 5. Viva-Voce - 10

Semester	Course code	Course Title
I & II	15PCH2CN	C.Pr-1 Physical Chemistry Practical I

Credits: 3 **Total Hours: 135**

Objectives

- To promote an awareness about potentiometric titrations to the students.
- To arm the future chemist with the knowledge of electrical conductance measurement and conductometric titrations.
- On successful completion of the syllabus, the students should have known to interpret, evaluate and report upon observations and experimental results of determination of molecular weight, partition coefficient, unknown composition in Simple Eutectic System and acid-base, precipitation and redox titrations.

Non Electrical Experiments

1. **Properties of Matter**

Simple Eutectic System- determination of unknown compositions

2. **Molecular weight determination**

Determination of Molecular weight by Rast's macro method

3**. Partition coefficient**

Determination of Equilibrium Constant for the reaction $KI + I_2 \leftrightarrow KI_3$

Electrical Experiments – Potentiometric Titrations

A. Acid-Base titrations *(using quinhydrone electrode)*

4. Titration of Strong acid against Strong base
5. Titration of Weak acid against Strong base
6. Titration of mixture of (strong & weak) acids against Strong base
7. Determination of pH (acidic solutions)
8. Determination of pKa of weak acid

B. Precipitation titrations *(using silver electrode)*

9. Titration of Potassium chloride against Silver nitrate
10. Titration of mixture of halides (chloride and iodide) against Silver nitrate

C. Redox titrations

11. Titration of Potassium Iodide against Potassium Permanganate

12. Titration of Ferrous Ammonium sulphate against Potassium dichromate

REFERENCES

1. S.R. Palit and S.K. De, Practical Physical Chemistry, Science Book Agency, Calcutta
2. P.C. Sharma and Agarwal, Practical Chemistry, Goel Publishing House, Meerut.
3. V. Venkateswaran and A.R. Kulaindaivelu, Practical Physical Chemistry S.Chand & Co.
4. Yadav, Practical Physical Chemistry S.Chand & Co

Distribution of Marks

Internal (Maximum 40 marks)	**ESE (Maximum 60 marks)**
1. CIA Practical exam – 25 2. Observation note book – 10 3. Attendance – 5	1. Experiment – 40 2. Record – 10 3. Viva-Voce - 10

Semester	Course code	Course Title
III	15PCH306	C.P-6 Physical Chemistry - II

Credits: 5 **Total teaching hours: 75**

Objectives:

- To enable a comprehensive knowledge on quantum mechanics to the students.
- To give a thorough introduction to the study of electrochemistry.
- On successful completion of the syllabus, the students should have understood quantum theory, Schrödinger equation, approximation methods, theories of double layer and electrophoresis**.**

UNIT – I: FUNDAMENTALS OF QUANTUM CHEMISTRY: (15 hrs)

Success of quantum theory and the failure of classical mechanics in explaining black-body radiation, photo-electric effect and the H-atom spectrum - DeBroglie's matter waves, Heisenberg's uncertainty principle. Postulates of quantum mechanics, the time-dependent and time-independent Schrodinger equations, Born's interpretation of the wave function and requirements of the acceptable wave function. Operators- sum and product, commutator, linear, Hamiltonian and angular momentum- eigen functions and eigen values, correspondence between physical quantities in classical mechanics and operators in quantum mechanics, quantization of angular momentum and its spatial orientation, average (expectation) values.

UNIT – II: QUANTUM MECHANICS OF SIMPLE SYSTEMS (15 hrs)

Particle in a 1-D and 3-D box- quantization of energy, normalization of wave function, orthogonality. Harmonic oscillator model of a diatomic molecule, solving of Schrodinger equation for the one-dimensional harmonic oscillator, illustration of the uncertainty principle and correspondence principle with reference to harmonic oscillator.

Rigid rotor model of a diatomic molecule, solving of Schrodinger equation for a rigid rotor,

Schrodinger equation for the H – atom (or H - like species) separation of variables (solving of radial equation is not needed but nature of solution is given).

UNIT – III: APPLICATIONS OF QUANTUM CHEMISTRY (15 hrs)

Electron spin, He atom and the Pauli principle, antisymmetric nature of the wave functions, slater determinants, approximate wave function of many electron atoms.

Need for approximation methods - The perturbation theory (first order only), application of the perturbation method to He atom, the variation method, application of variation method to He atom, Born – Oppenheimer approximation, treatment of the H_2^+ ground state by LCAO–MO method.

UNIT – IV: ELECTROCHEMISTRY-I (15 hrs)

Interionic attraction theory, Debye-Huckel-Onsager equation, derivation, verification and validity of DHO equation, Falkenhagen effect, Wien effect, activity and activity co-efficient, ionic strength, Debye-Huckel limiting law and its applications.

Electrokinetic phenomena: theories of double layer - Helmoltz-Perrin, Gouy-Chapmann & Stern theories - Butler-Volmer equation.

UNIT – V: ELECTROCHEMISTRY-II (15 hrs)

Electrolytic oxidation and reduction, voltametry, cyclic voltametry and polarography, current-voltage relationship, dropping mercury electrode, diffusion current, factors affecting diffusion current, Ilkovic equation (derivation not necessary), half-wave potentials, applications of polarography, amperometric titrations.

Fundamental principles of coulometric methods, constant current and controlled – potential methods, primary and secondary titrations – simple applications.

REFERENCE BOOKS:

1. R. K. Prasad, Quantum Chemistry, New Age International Publishers, 2001.
2. S. Glasstone, Introduction to electrochemistry, 10th Edition, East West Press Private Ltd.
3. B.R. Puri & L R. Sharma, Advanced Physical Chemistry, 2009 Edn., Milestone Publishers & Distributors
4. Ira. N. Levine, Quantum Chemistry, Prentice Hall; 5th edition 1999
5. Ira. N. Levine, Physical Chemistry, 3rd Edition, McGraw-Hill Book Company, 1971
6. P. W. Atkins, Physical Chemistry, 6th Edition, Oxford University Press
7. A.K. Chandra, Quantum chemistry, Tata McGraw-Hill, 1974.

8. W. J. Moore and R. G. Pearson, Kinetics and mechanism, Wiley 3rd edition, 2004.
9. Mc. Quarrie and Simon, Physical Chemistry: A molecular Approach, Viva Publishing House New Delhi, 2001.
10. W. J. Moore – Physical Chemistry, Wiley; 3rd edition, 2004.
11. L. I. Andropov, Theoretical Electrochemistry, Mir Publishers, Moscow.

Semester	Course code	Course Title
III	15PCH307	C.P- 7 Spectroscopy

Credits: 5 **Total teaching hours: 75**

Objective

- To interpret and solve problems using various spectra.
- Spectroscopic methods are very useful in structural determination of unknown compounds. On successful completion of the syllabus, the students should have acquired knowledge in various spectroscopic methods.

UNIT - I: MICROWAVE AND IR SPECTROSCOPY (15 hrs)

Rotational microwave spectroscopy**-** Rigid diatomic molecule-selection rule-effect of isotopic substitution-non rigid rotator-force constant-centrifugal distortion constant D – application of rotational spectra.

IR Spectroscopy- The vibrating diatomic molecule-the simple harmonic oscillator- selection rules-the diatomic rotator-vibration of polyatomic molecule (fundamental vibrations and their symmetry)-overtone and combination frequencies - Molecular vibrations -factors influencing vibrational frequencies- - force constant-identification of functional groups, hydrogen bonding and IR spectra, finger print region - Fermi Resonance -applications of infrared to organic compounds.

UNIT – II: UV AND VISIBLE SPECTROSCOPY (15 hrs)

Theory- laws of photochemistry - electronic spectra of diatomic molecules-Born-Oppenheimer approximation- intensity of vibrational electronic spectra– Franck-Condon principle-selection rules–dissociation energy- Fortrat diagram-predissociation-types of transition-auxochromes and chromophores, Woodward-Fieser rules for calculating absorption maxima of dienes, polyenes and α, β-unsaturated ketones.

UNIT – III: MASS SPECTROMETRY (15 hrs)

Presentation of mass spectrum-instrumentation-double focusing mass spectrometer-ion source-mass analyzers-ion detectors, types of ions-molecular ion, fragment ion, rearrangement ion, metastable ion, odd and even electron ions, molecular ion peak, base peak and metastable ion peak, determination of molecular formula-Nitrogen Rule, isotopic abundance, Retro-Diels

Alder Reaction, McLafferty rearrangement, Ortho elimination- double hydrogen rearrangement, double bond and ring equivalence.

Fragmentation associated with functional groups (aliphatic and aromatic) – hydrocarbons, unsaturated hydrocarbons, aldehydes, ketones, carboxylic acids, esters, amides, alcohols, thiols, amines, ethers.

UNIT – IV: NUCLEAR MAGNETIC RESONANCE -^{1}H NMR (15 hrs)

Magnetic properties of nuclei – theory of nuclear resonance, Instrumentation, Relaxation mechanisms(spin-spin & spin-lattice)- Chemical shifts- Electronegative effect, shielding effect, Hydrogen bonding effect, Anisotropy, spin-spin coupling, geminal, vicinal, Long range, deuterium exchange – solvents used in NMR, First order and non-first order NMR spectra- AB, ABC, A_2B_2, and ABX spectra, simplification of complex spectra- chemical shift reagents, double resonance (NMDR), magnetic field strength, Nuclear Overhauser Effect (NOE), dynamic NMR Applications of NMR to organic compounds.

UNIT – V: ^{13}C NMR (15 hrs)

Sensitivity, differences between ^{13}C NMR and ^{1}H NMR, measurement of ^{13}C NMR spectra, solvents, Types of ^{13}C NMR spectra - fully coupled, proton noise decoupled (fully decoupled), off resonance decoupled spectrum, DEPT, intensity of signals, carbon chemical shift- inductive effect, resonance effect, hydrogen bonding, heavy atom effect, substituent effects γ-gauche effect, γ-Anti effect.

2D NMR spectroscopy: Theory, basic components of two-dimensional experiment, Homonuclear Correlation Spectroscopy (H, H-COSY), Heteronuclear correlation (C,H-COSY) spectrum.

Solving problems using IR, UV, NMR and mass spectra for simple organic molecules not exceeding C_{12} units.

REFERENCE BOOKS

1. C.N. Banwell, Fundamentals of molecular spectroscopy,3rd Edition, Tata McGraw Hill Publishing Company Ltd
2. Jagmohan, Organic Spectroscopy Principles and Applications, second edition, Narosa publishing house(2005)

3. Y.R.Sharma, Elementary Organic Spectroscopy, 3rd Edition, S. Chand & Company Ltd.
4. Silverstien, Bassler and Morril, Spectrometric identification of organic compounds, 5th Edition, John Wiley and Sons, INC
5. W. Kemp, Organic Spectroscopy, 3rd Edition, Mc Millan Press Ltd
6. P.S. Kalsi, Spectroscopy of organic compounds, Wiley Eastern Ltd.
7. K. Veera Reddy, Symmetry and Spectroscopy of molecules, New Age International (1998).
8. Dudley H. Williams,Ian Fleming, Spectroscopic methods in organic chemistry,5th Edition, Tata McGraw Hill Education Private Ltd.
9. D.L. Pavia, G.M. Lampman, George S. Kriz, Introduction to spectroscopy, Brooks Cole; 3rd Edition, 2000

Semester	Course code	Course Title
III	15PCH308	C.P- 8 Organic Chemistry -III

Credits: 5 **Total teaching hours: 75**

Objectives

- To foster an awareness in the student the ideas of molecular rearrangement and oxidation and reduction reactions of organic compounds.
- To introduce steroids and to enable the students to elucidate their structures.
- On successful completion of the syllabus, the students should have acquired knowledge about the classification, characterization of proteins, vitamins, non-steroidal, antifungal, antibacterial drugs and some heterocyclic compounds.

UNIT-I MOLECULAR REARRANGEMENTS (15 hrs)

Introduction, nucleophilic, free radical and electrophilic rearrangements, 1, 2 – rearrangement - Wagner – Meerwein, Acid –catalysed rearrangement - Arndt-Eistert synthesis-Base –catalysed rearrangement –Favorskii, Carbon to Carbon migration of other groups - Neber rearrangement, Wolf rearrangement-Carbon to Nitrogen migration - Hofmann rearrangement, Curtius rearrangement, Lossen rearrangement, Schmidt rearrangement, Beckmann rearrangement Nitrogen to carbon, oxygen to carbon, sulphur to carbon migration of groups- Stevens, Wittig.

Unit – II OXIDATION AND REDUCTION (15 hrs)

Oxidation: Selenium dioxide, periodic acid, aluminium t-butoxide, peroxides and peroxyacids, PCC (Corey's reagent), MnO_2, OsO_4, Jones reagent, copper chromite, Ozonolysis, Oppenauer oxidation, Lead tetraacetate, Mercuric acetate, Thallium acetate, DCC, DMSO, Woodward and Prevost hydroxylation.

Reduction: Complex metal hydrides such as $LiAlH_4$, $NaBH_4$, and trialkyl tin hydride-BH_3 / THF, 9-BBN- Dissolving metal reduction – Clemenson and Wolff-Kishner reduction.

UNIT – III: STEROIDS (15 hrs)

Introduction, structural elucidation of Cholesterol (synthesis not necessary), structural elucidation and synthesis of Estrone (Arndt-Eistert synthesis), Testosterone and Progesterone

(synthesis from Cholesterol), introduction and structures of Bile acids, biosynthesis of steroids (General principles only).

UNIT – IV: PROTEINS AND VITAMINS (15 hrs)

Classification and characteristics of proteins – General methods of synthesis of polypeptides, solid phase peptide synthesis, structure and their biological importance of nucleic acids-RNA and DNA.

Vitamins-Introduction-structure, sources, functions and deficiency diseases. Structural elucidation of Vitamin- A, B1, B2, C.

UNIT– V: HETEROCYCLIC COMPOUNDS AND REAGENTS FOR ORGANIC SYNTHESIS (15 hrs)

Structure and synthesis of flavone, , flavanols, isoflavone, coumarins, chromones and anthocyanins (cyanin and pelargonin).

Reagents: Gilman`s reagent, lithium diisoprpylamide (LDA), dicyclohexylcarbodiimide (DCC), 1, 3-Dithiane, Woodward and Prevost hydroxylation, DDQ, DBU, PPA, NBS, mCPBA, Baker's yeast.

REFERENCE BOOKS:

1. Jagdamba Singh, L. D. S. Yadav, Organic Synthesis,10th Edition Pragati Prakashan Educational Publications, Meerut, India, 2014.
2. O.P.Agarwal, Organic Chemistry Reaction and Reagents, 51st Edition. Publisher, Goel Pub. House, 2014.
3. R.K. Mackie, D.M. Smith and R. A. Aitkin – Guide book to organic synthesis, Longman Group United Kingdom; 2 Sub editions, 1990.
4. Jerry March, Advanced Organic Chemistry, Wiley eastern limited, Fourth Edition, New Delhi, 1999.
5. F.A.Carey, Organic Chemistry-Part-B-Reactions and synthesis, Plenum press, 5th edition 1997.
6. R K Bansal, Heterocyclic Chemistry, Wiley Eastern, 1990.
7. T.L Gilchrist., Heterocyclic Chemistry, 1st edition, John Wiley & Sons, 1985.
8. I. L Finar – Organic Chemistry Vol. I & II, Longman Publishing Group; 1998.

9. O. P. Agarwal – Natural product Chemistry, 20th Edition, Goel Publishing house
10. Gurdeep Chatawal – Organic Chemistry of Natural Products Vol I & II, Himalaya Publishing House, 2001.

Semester	Course code	Course Title
III	15PCH309	C.P- 9 Inorganic Chemistry -III

Credits: 5 **Total teaching hours: 75**

Objectives

- To create an awareness in the student the fundamental concepts of inorganic photochemistry and bioinorganic chemistry.
- To allow the students to get introduced to the study of organometallic complexes.
- On successful completion of the syllabus, the students should have acquired knowledge in the nature, preparation and properties metal carbonyl complexes, photochemistry of metal complexes and various applications and the role metals in biological systems.

UNIT – I INTRODUCTION OF METAL CARBONYLS (15 hrs)

Definition of organometallic compound – 18 electron rule – EAN rule – classification of organometallic compound – the metal carbon bond types – ionic bond – sigma covalent bond – electron deficient bond – dative bond. Metal carbonyls - methods of preparation, structure, reactions-metal carbonyl bonding- IR spectroscopy of metal carbonyls. Carbonylate ions, carbonyl hydrides, carbonyl halides, Vaska's complex.

UNIT – II π COMPLEXES-STRUCTURE AND BONDING (15 hrs)

Synthesis, reactions, bonding and structure in metal alkyl, alkene, alkyne, allyl and dienyls complexes. Carbene, carbyne and carbide complexes. carbocyclic pi compounds-synthesis, reactions, bonding and structure of cyclopentadienyl complexes-Ferrocene-structure and bonding, arene complexes, complexes formed by 7 and 8 member aromatic rings.

UNIT – III ORGANOMETALLIC COMPOUNDS-CATALYSIS (15 hrs)

Organometallic compounds in catalysis – coordinative unsaturation – acid base behaviour reaction – migration of atoms or groups from metal to ligand – insertion reaction – reactions of coordinated ligands-CO, NO and Arenes- Olefin metathesis– isomerisation of alkenes – hydrogenation (Wilkinson's catalyst) – hydroformylation(Oxo process) and hydrosilation of

alkenes – Wacker process-carbonylation of methanol and methyl acetate(Monsonto acetic acid process)- Synthesis gas.

UNIT V: CHARACTERIZATION OF INORGANIC COMPOUNDS (15 hrs)

Photoelectron spectroscopy- Theory of XPS and UPS-determination of ionization potential- chemical identification of elements- ESCA- chemical shift. F^{19} and P^{31} NMR, IR applications in the structural problem solving of inorganic compounds.

UNIT – V INORGANIC POLYMERS (15 hrs)

Chains – catenation, silicones, silicates, isopoly anions, sulphur nitrogen chains. Rings - Borazines, Cyclophosphazenes (synthesis ,structure, bonding and properties). and – sulphur, nitrogen ring compounds .Homocyclic rings – sulphur rings and cyclophosphines. Cages – phosphorus cage compounds, Boron Cage Compounds – wade's theory – closo, nido and arachno structures of boranes and carboranes. Clusters - dinuclear, trinuclear, tetranuclear, hexanuclear and organometallic clusters (structure only).

REFERENCE BOOKS

1. Cotton F.A.and G.Wilkinson, Advanced Inorganic Chemistry, Third edition, Wiley Eastern
2. Lee J. D, Concise Inorganic Chemistry, Fifth edition, Chapman & Hall Ltd.
3. W.L. Jolly – Modern Inorganic chemistry, McGraw-Hill Education – Europe, 1991.
4. J.E. Huheey – Inorganic chemistry, 2nd Edition, Harper & Row Publishers
5. D.F. Shriver, P.W. Atkins and C.H. Longford, – Inorganic chemistry, Oxford Univ Press, 2nd edition, 1995.
6. S.F.A. Kettle – Coordination compounds, Thomas Nelson & Sons Ltd, 1969.
7. E. A. V. Ebsworth, David W. H. Rankin, Stephan Cradock, Structural methods in inorganic chemistry, Blackwell Scientific Publications, 1987.
8. R.S. Drago, Physical methods in Inorganic chemistry, 1st Edition, W. B. Saunders Company.

Semester	Course code	Course Title
IV	15PCH410	C.P-10 Physical Chemistry - III

Credits: 5 **Total teaching hours: 75**

Objectives

- To stimulate students, create and sustain their interest in physical chemistry by providing a thorough introduction to the study of chemical and statistical thermodynamics.
- To foster an awareness in the student the fundamental concepts of photochemistry.
- On successful completion of the syllabus, the students should have acquired knowledge in the third law of thermodynamics, probability theorems, distribution laws, partition functions and principles of photochemistry**.**

UNIT - I CHEMICAL THERMODYNAMICS (15 hrs)

Second law of thermodynamics- Concept of entropy , entropy change in reversible and irreversible processes, work and free energy functions, Maxwell's relations, Criteria for reversible and irreversible process, Gibs-Helmholtz equation, Thermodynamics of open system- Partial molar properties, chemical potential, Gibbs-Duhem equation, Fugacity and Activity- Determination of fugacity of gas in a gaseous mixture, Concept of activity, activity co-efficient, Standard states.

Chemical equilibrium- Law of mass action- Thermodynamic derivation, Phase equilibrium- Derivation Gibbs phase rule-and its application to two component (Formation of compounds with congruent and incongruent melting point) and three component systems (Solid-Liquid system), Ehrenfest classification of phase transitions.

UNIT – II STATISTICAL THERMODYNAMICS-I (15 hrs)

Third law of thermodynamics, probability and third law, need for third law, Nernst heat theorem and other forms stating third law, thermodynamic quantities at absolute zero, statistical meaning of third law and apparent exceptions.

Theories of probability, theories of permutations and combinations, thermodynamic probability, thermodynamic probabilities of systems in equilibrium, Boltzmann expression for

entropy, Stirling's approximation, states of maximum thermodynamic probability, thermodynamic probabilities of systems involving energy levels.

UNIT – III STATISTICAL THERMODYNAMICS-III (15 hrs)

Partition function – definition, justification of nomenclature, micro canonical and canonical ensembles, equipartition principle, molecular partition function and canonical partition functions, relation between the total partition function of a molecule and the separate partition function, partition function - translational, rotational, vibrational and electronic, effect of molecular symmetry on rotational partition function, Ortho and para hydrogen, evaluation of thermodynamic properties E, H, S, A, G, C_p and C_v from monoatomic and diatomic ideal gas molecule partition functions.

UNIT – IV STATISTICAL THERMODYNAMICS-II (15 hrs)

Quantum statistics: Distribution laws- Maxwell-Boltzmann distribution law - Evaluation of alpha and beta in M.B. distribution law, Bose-Einstein distribution law, Entropy of Bose-Einstein gas, Bose-Einstein Condensation, Fermi-Dirac distribution law, Entropy of a Fermi-Dirac gas, Plank distribution law for black-body radiation, negative absolute temperature, heat capacities of solids - Einstein's and Debye's theories of heat capacities of solids

UNIT V PHOTOCHEMISTRY (15 hrs)

Physical properties of the electronically excited molecules-Excited state Dipole moment-Excited state acidity constants-pK* values-Geometry of some electronically excited molecules-Types of photophysical pathways-Fluorescence emission-Phosphorescence-Photophysical kinetics of unimolecular processes-Stern-Volmer equation-quenching-Delayed fluorescence-study of excited states –Flash photolysis-chemiluminescence.

REFERENCE BOOKS

1. M.C. Gupta, Statistical thermodynamics , Wiley Eastern Limited (1990).
2. Rajaram, Kuriacose, Thermodynamics,Shoban lal&Co,4th edition,2006.
3. Andrew Maczek, Statistical Thermodynamics, Oxford University Press, 1998.
4. K.K.Rohatgi, Mukherjee, Fundamentals of Photochemistry, Wiley eastern limited,Revised edition,1992.

5. Glasstone, Thermodynamics for chemists, Van Nostrands (1964).
6. F.T. Wall, Chemical Thermodynamics, Freeman and Company (1965).
7. Gurdeep Raj, Advance Physical Chemistry, Goel Publishing House.
8. W. J. Moore, Physical Chemistry, 5th Edition, Orient Longman Ltd
9. P. W. Atkins, Physical Chemistry, 6th Edition, Oxford University Press.
10. Puri, Sharma, Pathania, Principles of physical chemistry, 46th Edition, Vishal Publishing Co., (2013).

Semester	Course code	Course Title
III & IV	15PCH4CO	C. Pr- 4 Organic Chemistry Practical-II

Credits: 3 **Total teaching hours: 120**

Objectives:

- To attain knowledge in estimating organic compounds quantitatively.
- To learn and practice the methods of preparation of some organic compounds.

A. Quantitative estimations:

Estimation of phenol, aniline, ethyl methyl ketone, Glucose (Fehling's method and Bertrand's method).

B. Two stage Preparations:

1. Benzanilide from benzophenone
2. Acetyl salicylic acid from methyl salicylate
3. Preparation of m- nirtrobenzoic acid from methyl benzoate
4. Preparation of p- nitroaniline from acetanilide
5. Preparation of p-bromo acetanilide from aniline

C. Extraction and estimations: (Not for ESE examination**)**

1. Lactose from milk
2. Caffeine from tea
3. Nicotine from tobacco extract
4. Citric acid or ascorbic acid from a tablet of from a natural source.

D. Analysis of oil: (Not for ESE examination)

Reichart – Meisel value, soponification value and iodine value.

REFERENCES:

1. Gnanprakasam and Ramamurthy, Organic Chemistry Laboratory Manual Ananda Book Depot, Chennai.
2. Jagmohan, Advanced Practical Organic Chemistry Vol. I & II.

Distribution of marks

Internal (Maximum 40 marks)	**ESE (Maximum 60 marks)**
1. CIA Practical exam – 25 2. Observation note book – 10 3. Attendance – 5	1. Quantitative analysis - 25 2. Preparation of an Organic Compound – 15 3. Record – 10 4. Viva-Voce – 10

Semester	Course code	Course Title
III & IV	15PCH4CP	C. Pr- 5 Inorganic Chemistry Practical-II

Credits: 3 **Total teaching hours: 120**

Objectives:

- To get an idea about the industrial analysis of alloys.
- To know and apply the principle of complexometric titration using EDTA method.
- To understand some chromatographic techniques.
- To learn about the preparation and properties of Inorganic complexes
- To get an idea about the quantitative analysis of mixture of cations using volumetric and gravimetric principles.

A. Titrimetry: Complexometric titration involving EDTA.

Estimation of Calcium, Magnesium, Nickel, Zinc and Hardness of water

B. Chromatography: Column, Paper, thin layer (Demonstration only)

C. Preparation:

Analysis and study of the properties of at least five coordination complexes.

(single stage / two stage preparations)

D. Quantitative estimation:

Mixture of cations involving volumetric and gravimetric estimation:

Copper & Nickel, Iron & Nickel, Iron & Magnesium and Calcium & Barium

REFERENCES

1. V.Venkateswaran, R.Veeraswamy and A.R. Kulandaivelu, Principles of Practical Chemistry Edn II Sultan Chand & Sons (1997)
2. Giri. S, Bajpai. D.N. and O.P Panday, Practical Chemistry Vol. I & II, S.Chand & Co.
3. J. Bassart, R.C. Dennay, G.H. Jeffery and Mendham, Vogel's text book of qualitative Inorganic Analysis, 4th Edn. The ELBS & Longman.

Distribution of marks

Internal (Maximum 40 marks)	**ESE (Maximum 60 marks)**
1. CIA Practical exam – 25 2. Observation note book – 10 3. Attendance – 5	1. Quantitative analysis (volumetric and gravimetric estimations –15+15)- 30 2. Preparation - 10 3. Record – 10 4. Viva-Voce – 10

Semester	Course code	Course Title
III	15PCH4CQ	C. Pr- 6 Physical Chemistry Practical - II

Credits: 3 **Total teaching hours: 60**

Objectives:

- To arm the future chemist with the knowledge of electrical conductance measurement and conductometric titrations.
- On successful completion of the syllabus, the students should have gained knowledge to make and record observations on conductometric titrations and chemical kinetics.

Electrical Conductance measurements

1. Determination of cell constant & Verification of Ostwald's dilution law
2. Verification of Kohlrausch's law

Conductometric Titrations

3. $BaCl_2$ Vs $MgSO_4$
4. Buffer Vs Strong acid

Chemical Kinetics

5. Acid hydrolysis of an ester – Relative strength of acids
6. Reaction kinetics of KI and $K_2S_2O_8$
7. Iodination of acetone

Adsorption

8. Adsorption of oxalic acid on charcoal

REFERENCES

1. S.R. Palit and S.K. De, Practical Physical Chemistry, Science Book Agency, Calcutta
2. P.C. Sharma and Agarwal, Practical Chemistry, Goel Publishing House, Meerut.
3. Venkateswaran and Kulaindaivelu, Practical Physical Chemistry S.Chand & Co
4. J.B. Yadav, Advanced Practical Physical Chemistry, Goel Publishing house, Meerut.

Distribution of marks

Internal (Maximum 40 marks)	ESE (Maximum 60 marks)
1. CIA Practical exam – 25 2. Observation note book – 10 3. Attendance – 5	1. Experiment- 40 2. Record – 10 3. Viva-Voce – 10

Semester	Course code	Course title
III &IV	**15PCH4Z1**	**Project work &viva-voce**

Credits: 6

COMPONENT FOR PROJECT

CIA / ESE	Particulars	Project Out of 200 Marks
CIA	Project Review	30
	Regularity	10
	Total Internal Marks	**40**
***ESE**	Project Report Present	120
	Viva Voce	40
	Total External Marks	**160**
Total Marks(CIA+ESE)		**200**

Note: - The Project work dissertation evaluation and viva-voce examination will be conducted jointly by the Internal and External Examiners

JOB ORIENTED COURSE

Semester	Course code	Course Title
	15PCH0J1	**JOC – Pharmaceutical chemistry**

Credits: 2 **Teaching hrs (out of class hours): 30**

Objectives

- To give the students a thorough introduction to the study of drugs.
- To educate the students and to create an awareness about first aid.
- On successful completion of the syllabus, the students should have been aware of the causes, treatment and prevention of some common diseases, biological role of some elements, the structure, uses and adverse effects of analgesics, antiseptics and disinfectants.

UNIT –I THE NATURE AND SOURCES OF DRUGS (6 hrs)

Terminologies used in pharmaceutical chemistry-pharmacy, pharmacology, bacteria, virus, fungi, chemotherapy, pharmacopeia and toxicology, biological and chemical classification of drugs, metabolism of drugs-biotransformation-oxidative reaction-hydroxylation, oxidative dealkylation, oxidative deamination and hydrolytic (hydrolysis) reactions, conjugation reactions-glucuronide conjugation, aminoacid conjugation, sulphate conjugation, methylation and N-acetylation, routes of administration and the process of adsorption of drugs.

UNIT –II FIRST AID FOR ACCIDENTS (6 hrs)

Aims and rules of first aid, first aid treatment for cuts/abrasions/ bruises, bleeding, fracture, burns, fainting and poisonous bites, clinical symptoms of poisoning and basic therapeutic treatment, common poisons and their antidotes-acid, alkali, disinfectants, hallucinogens, alcohol, mercury and salicylate poisoning, articles to be kept in a standard first aid box.

UNIT –III COMMON DISEASES (6 hrs)

Some common diseases: Causes, treatment and prevention of malaria, filarasis, plague, diphtheria, whooping cough, influenza, measles, mumps, common cold, tuberculosis(T.B), cholera, typhoid, dysentery, jaundice, asthma, epilepsy, piles and leprosy.

Biological role of following elements and their compounds: potassium, calcium, iodine, copper and zinc.

UNIT – IV BLOOD AND DIABETES (6 hrs)

Composition of Blood: Plasma, RBC, WBC, platelets(thrombocytes)-their functions.

Blood pressure: Primary and secondary hypertension-hypotension-measurement of blood pressure. Anaemia: Causes and control-sign, symptoms & types-antinaemic drugs.

Diabetes: Types-diabetes insipdus and diabetes mellitus-juvenile & adult, control of diabetes-insulin structure and sources, oral hypoglycemic drugs - tolbutamide, chlorpropamide, glibenclamide, bigunides (penformin and metformin)

Unit – V THERAPEUTIC AGENTS (6 hrs)

Structure, uses and adverse effects of Analgesics agents: morphine, pethidine and methadone. Antipyretic-anti-inflammatory agents: aspirin, methyl salicylate, para acetamolphenacetin, analgin, indomethacin & ibuprofen. Antiseptic and disinfectants: distinction between disinfectants and antiseptics, standardization of disinfectants and antiseptics, source, structure and uses of the following compounds-cresols, thymol, chloroxylenol, chloramines-T, crystal violet, methylene blue, nitromersol, dequalinium chloride and formalin.

REFERENCE BOOKS

1. Jayashree Ghosh, A Text Book of Pharmaceutical Chemistry 3rd Edn 2008, S.Chand & Co Ltd.,
2. L.M.Atherden, Text Book of Pharmaceutical Chemistry, 8th Edn, 1995, Oxford University Press
3. C.R.Chatwal, Pharmaceutical Chemistry Vol. I & II, III Edn, 2007, Himalaya Publishing House

(SELF STUDY COURSES)

ADVANCED LEARNER COURSES

Semester	Course code	Course Title
	15PCH0D1	**ALC- 1 Chemistry of Corrosion and its Prevention**

UNIT – I INTRODUCTION TO CORROSION

Definition of corrosion cost of corrosion, importance of corrosion studies – classification of corrosion – expressions for corrosion rate – corrosion principles – electrochemical principles of corrosion – Faradays Laws, types of electrochemical cells, concentration cells. Thermodynamic principles of corrosion – Standard electrode potentials and thermodynamic corrosion theory – Galvanic series of metals and alloys.

UNIT – II KINETICS

Kinetics of electrochemical corrosion – importance of kinetics, graphical presentation of kinetic data, exchange current density, polarization of electrodes, concentration polarization, activation polarization and resistance polarization. Mixed potential theory. Applications of electrodes kinetics to experimental observation

UNIT-III PASSIVITY

Kinetics of passivity – introduction – electrochemical behavior of active / passive metals, flade reactivation potential, criteria for selecting a metal exhibiting passivity, factors influencing electrochemical behavior and corrosion rate of metals exhibiting passivity, theories of passivity.

UNIT – IV FORMS OF CORROSION

Different form of corrosion and the factors influencing atmospheric, intergranular, pitting, galvanic, crevice, stress, soil). Protection against corrosion - design improvement, changes of metal, change of environment, change of metal potential, use of coatings.

UNIT – V MONITORING TECHNIQUES

Interpretation and measurement of corrosion – potential measurements, corrosion current measurements using rotating disc electrode, polarization measurements (polarization break, Tafel and linear)- two electrode system, three electrode system, advantages, disadvantages and precautions in usage, Corrosion behavior diagram.

TEXT BOOK

1. Raj Narayan, An introduction to metallic corrosion and its prevention, Oxford and IBH Publishing Co.

Semester	Course code	Course Title
	15PCH0D2	**ALC- 2 Medicinal chemistry**

Credits: 2

UNIT- I INTRODUCTION TO MEDICINAL CHEMISTRY

Introduction-medicinal chemistry-modern medicinal chemistry-chronology of drug introductions-development of various classes of drugs-cell structure-types of molecules in the cell affected by drugs-protein binding.

UNIT- II GENERAL PRINCIPLE OF DRUG ACTION

Definition of drugs-classification of drugs-characteristics of different routes to drug administration-absorption of drug-distribution of drug-mode of drug action-mechanism of drug action-drug receptors-drug-receptor bonds-excretion.

UNIT- III PHYSIO CHEMICAL PARAMETERS IN RELATION TO BIOLOGICAL ACTIVITY

Introduction-physical properties-solubility,partition coefficient,ionization and pka values-hydrogen bonding-surface activity-applications-complexation-redox potential-steric features of drug-conformational isomers-optical isomers-bioisosterism-classical bioisosterers-nonclassical bioisosterers.

UNIT –IV DRUG DESIGN AND DRUG-TARGET INTERACTION

Drug design-Fundamentals and objectives of QSAR-variation of substituents-alkyl and aromatic substituents-extension of the structure-chain extensions/contractios-ring expansions/contractions-ring variations-ring fusions-isosterers-simplification and rigidification of the structure-conformation blockers-X-ray crystallographic studies-molecular modeling studies-drug design by nuclear magnetic resonance- a case study-oxaminquine.

UNIT -V THERAPEUTIC AGENTS

Structure Activity Relation (SAR) of antibiotics cephalosporins, streptomycin, tetracycline, erithromysin and chloremphenicol-SAR of antimalarial drug cinchonine-SAR of anticancer drug cisplatin-cardiovascular drugs-definition and categories-synthesis and use of

diuretic drug chloemerodrin Hg^{197}-antiparkinsonism drug biperiden hydrochloride-antipsychotics and the structure of reserpine-antithyroid drugs-drugs to combat aids.

REFERENCE BOOKS

1. Rama Rao Nadendla, Medicinal chemistry, Pharmamid press.
2. K.Illango, P.Vanitha, Text book of medicinal chemistry-Volume I &II- First edition, Keerthi publishers.
3. Ashutosh kar- Medicinal chemistry-4th edition-New age international publishers
4. Graham L. Patrick, An Introduction to Medicinal Chemistry, 2nd edition-Oxford University Press.

Semester	Course code	Course Title
	15PCH0D2	**ALC- 3 Food chemistry**

Credits: 2

UNIT – I FUNCTIONS OF FOOD

Food – definition, functions, basic food groups, chemical composition and nutritive value of some common food stuffs (cereals, pulses, vegetables and fruits, eggs, milk and meat).

UNIT – II IMPORTANT NUTRIENTS IN FOOD

Nutrients – definition, properties and nutritive value of some important nutrients (carbohydrates, proteins, fats, vitamins, minerals and water).

UNIT – III FOOD ADDITIVES

Some important food additives – antioxidants, chelating agents, colouring agents, flavouring agents, curating agents, emulsifiers, leavening agents, anticaking agents, humectants, non-nutritive sweeteners, thickeners, stabilizers, preservatives.

UNIT – IV FOOD PRESERVATION

Food spoilage, methods of food preservation, preservation of food by – low temperature, high temperature, preservatives, osmotic pressure, dehydration, food irradiation.

UNIT – V FOOD ADULTERATION AND FUTURE FOODS

Adulteration – definition, types of adulterants – intentional and incidental adulterants, metallic contaminants, food laws, organic foods, low cost nutrient supplement, packaging of foods, nutrition labeling.

REFERENCE BOOKS

1. B. Srilakshmi, Food science, New Age International, V edition, 2010.
2. Lillian H. Meyer, Food chemistry, CBS publishers and distributors.

MAJOR ELECTIVE COURSE – 1

Semester	Course code	Course Title
I or III		ME Physical Methods in Chemistry

Credits: 5 **Total teaching hours: 75**

Objectives

- To introduce the principles of error analysis to the students.
- To enable the students to attain knowledge on various chromatographic techniques and thermoanalytical methods.
- On successful completion of the syllabus, the students should have gained knowledge in ESR and Mossbauer spectroscopy, AAS and polarimetry.

UNIT – I ERROR ANALYSIS (15 hrs)

Errors – determinate and indeterminate errors, accuracy and precision, mean, median, average deviation, standard deviation , relative standard deviation , standard deviation for 'Sample' and 'Population of data'-rejection of measurements- Quotient test -confidence limits, confidence interval, tests of significance - t-test and f-test -minimization of errors- significant figures, rounding off the numerical expressions, reporting of analytical data.

UNIT- II CHROMATOGRAPHIC METHODS (15 hrs)

Basic principles, theories, instrumentation, experimental procedures and application of following chromatographic techniques – Paper (PC), Thin Layer (TLC), Column (CC), Gel Permeation (GPC), Gas (GC) and High Performance Liquid Chromatography (HPLC), Ion-exchange chromatography.

UNIT – III THERMAL ANALYSIS (15 hrs)

Introduction - different types of thermo analytical methods. Thermo gravimetric analysis (TGA) - principle – factors influencing thermograms. Derivative thermogravimetry (DTG) - principle – factors influencing thermograms. TGA instruments – precautions in the use of thermo balance. Differential thermal analysis (DTA) – principle – instrumentation – applications – thermometric titrations-principle-instrumentation and applications. Differential scanning calorimetry (DSC) - principle - instrumentation and applications.

UNIT –IV ESR & MOSSBAUER (15 hrs)

Electron spin resonance- Theory – derivative curves-'g' values, Kramer's degeneracy-zero field splitting – hyperfine splitting – isotropic and anisotropic systems – identification of free radicals – applications.

Mossbauer spectroscopy-Principle and theory-Isomer shift – quadruple interactions – magnetic interactions – applications to Iron complexes

UNIT- V ATOMIC ABSORPTION SPECTROMETRY& POLARIMETRY (15 hrs)

AAS-Principle- instrumentation – detection of metals & non-metals, interference, detection limit & sensitivity and applications. Flame Emission spectrometry- Principle, instrumentation, methodology and applications. Comparison between AAS and FES.

Polarimetry – Plane polarized light – optical activity of molecules – polarimeter and its uses. ORD and CD spectrometry, circular birefringence, circular dichroism, optical rotatory dispersion, Plain curves, anomalous curves - cotton effect – axial haloketone rule and octant rule – application.

REFERENCE BOOKS

1. Gurdeep R. Chatwal & S.K. Anand, Instrumental Methods of Chemical Analysis, 2003, Himalaya Publishing House.
2. B. K. Sharma, Instrumental methods of Chemical analysis, Goel Publishing house, 18th edition,1999.
3. Gary D. Christian, Analytical Chemistry**,** 6th edition, John Wiley & Sons, Inc., 2004.
4. D.A. Skoog, D.M. West, F.J. Holder and S.R. Grouch, Analytical chemistry an Introduction 6th Edition, Saunders College publishing
5. H.H. Willard, L.L. Merrit and J.A. Dean, Instrumental method of analysis, 7th Edition, CBS Publishers & Distributors
6. V K Srivastava and K K Srivastava, Introduction to chromatography-Theory and Practice, S.Chand& Company LTD,2nd edition ,1981.
7. R.S. Drago, Physical methods in Inorganic chemistry, 1st Edition, W. B. Saunders Company.

MAJOR ELECTIVE COURSE - 2

Semester	Course code	Course Title
I or III		ME- Polymer Science and Technology

Credits: 5 **Total teaching hours: 75**

Objectives

- To stimulate students to have in-depth knowledge in polymer chemistry.
- To introduce the structure, properties and uses of various polymers, fibres and elastomers.
- On successful completion of the syllabus, the students should have acquired a clear idea about various properties of polymers, fibres, elastomers and their applications in industries.

UNIT – I POLYMER (15 hrs)

Introduction-Definitions-Industrial Polymers-Plastics-Fibers-Rubber-Coatings and adhesives-Chemical structure and properties of polymers-Glass Transition Temperature(Tg) Stereochemistry- crystallinity- Mechanical properties-thermal Stability-Flammability and Flame resistance-Chemical resistance-Degradability-Electrical Conductivity- Nonlinear Optic Properties. Degrading agencies and mechanism of degradation: Thermal, mechanical, ultrasonic degradation, degradation by high-energy radiation, photo degradation, oxidative and hydrolytic degradation.

UNIT – II INDIVIDUAL POLYMERS (15 hrs)

Production, properties and uses of ethenic polymers – polythene (HDPE & LDPE), polypropylene, polystyrene, PVC, polyvinylacetate, polyvinylalcohol, polymethylmethacrylate and polyacrylonitrile. Production-properties and uses of polycondensation polymers – phenol-formaldehyde, urea-formaldehyde and epoxy resins. Polymer additives: Fillers, Antioxidants, thermal and UV-stabilizers, lubricants, colorants, flame retardants, blowing agents, and Plasticizers – effect of plasticizers on Tg.

UNIT – III, FABRICATION PROCESS: (15 hrs)

One-dimensional processes – application of coatings and adhesives, Two-dimensional processes – Casting (Die casting, rotational and film casting), Clandering, Lamination and Extrusion (flat film and Blown film extrusion) processes. Three-dimensional processes – Moulding (Compression, Injection, Reaction injection, Blow, Transfer, and Rotational moulding) processes, Forming (atmosphere pressure and Fluid pressure forming) processes and Foaming process.

UNIT – IV FIBRE TECHNOLOGY (15 hrs)

Production, properties and uses of natural and synthetic fibres, cellulosic fibre, polyamide fibre, polyester fibres and acrylic fibres. Classification and properties of textile fibres – criteria for fibre formation, orientation of molecules on drawing. Spinning processes–melt spinning, dry spinning and wets pinning. Treatment of fibres – sizing, dyeing, finishing, scouring and lubrication.

UNIT – V ELASTOMER TECHNOLOGY (15 hrs)

Structure and properties of elastomers – vulcanization – Chemistry of vulcanization – sulphur and nonsulphur types of vulcanization –Elastomer properties and compounding. Synthetic rubbers – GRS(Buna-S), N-butyl rubber, nitrile rubber, sulphide rubber, urethane rubber and silicone rubber. Applications of Polymers in Industry: Membrane applications of polymeric materials-Biomedical applications-Drug delivery-artificial organs-Electronic applications-Conducting polymers.

REFERENCE BOOKS:

1. F. W. Billmeyer – Text book of polymer science, 3rd Edition, John Wiley & Sons
2. V.R.Gowariker & N. V.Viswanathan, 1st Edition, New Age International Private Ltd.
3. J.R.Fried,Polymer Science & Technology, 2ndEdition, Prentice Hall of India Private Ltd.
4. B. P. Corbman, Textiles Fiber to Fabric, 6th Edition, McGraw Hill Book Company
5. George Odian, Principles of Polymerization, 3rd Edition, John Wiley & Sons, INC
6. Malcolm P.Stevens, Polymer Chemistry, an introduction, Oxford University Press,3rd edition,1999.
7. M. S. Bhatnagar, A Textbook of polymers, S. Chand & company Ltd,2004

MAJOR ELECTIVE COURSE – 3

Semester	Course code	Course Title
I or III		ME- Green and nano chemistry

Credits: 5 **Total teaching hours: 75**

Objectives

- To introduce the concepts of green chemistry to the students.
- To stimulate the students to know about green synthesis.
- On successful completion of the syllabus, the students should have gained knowledge on principles of green chemistry, microwave assisted reactions and ultrasound assisted reactions.

UNIT – I GREEN CHEMISTRY PRINCIPLES (15 hrs)

Definition, need for green chemistry, twelve basic principles of green chemistry-planning a green synthesis in a chemical laboratory-– concept of atom economy – rearrangement reaction– addition reaction – substitution reaction – elimination reaction - concept of selectivity – chemo selectivity - regio selectivity – enantioselectivity – diastereoselectivity

UNIT – II GREENER SOLVENTS & REACTIONS (15 hrs)

Green solvents – super critical carbondioxide, solvent-less reactions, selection of appropriate solvent-fundamentals of closed vessel heating- Water as greener solvent- reactions in ionic-liquid, solvent free reaction- solid supported organic synthesis, phase transfer catalyst (PTC), use of microwaves and sonication in organic reactions.

UNIT – III SUPRAMOLECULAR CHEMISTRY (15 hrs)

Definition: Host guest compounds, coordination, lock and key analogy, chelate and macrocyclic effects, Preorganisation and complementarity, Nature of supramolecular interactions: Ion-Ion interactions, Ion-dipole interactions, Dipole-dipole interactions, Hydrogen bonding, cation-π interactions, π-π stacking, Van der waals force, Close packing in the solid state, Hydrophobic effects. Supramolecular host design. Template and self-assembly: Biochemical, Coordination compounds Catananes and rotaxanes.

UNIT – IV NANO SCIENCE (15 hrs)

Introduction- definition-types-quantum dots, wires and wells, nano rods, fullerenes and carbon nanotubes - nanowires and crystals, nano composites and clusters – properties of nano materials- Physical methods of preparation of Nano Structured Materials – Bottom up and Top down approaches– plasma arching, chemical vapour deposition, electrodeposition, sol-gel synthesis, ball-milling and use of natural nano particles.

UNIT –V SYNTHESIS CHARACTERISATION AND APPLICATIONS OF NANOMATERIALS (15 hrs)

Chemical reduction (borohydride, citrate and polyol), high temperature thermal decomposition, liquid-liquid interface reaction, solution state polymerization-Experimental Techniques - Instrumentation, principle and applications of Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), -Powder XRD-Applications of Nanomaterials- catalysis, environmental and biomedical (drug delivery) applications. Nanomaterials-environmental hazards.

REFERENCE BOOKS

1. V. Kumar, An Introduction to Green Chemistry, Vishal Publishing Co.
2. V.K. Ahluwalia, Green Chemistry, Ane Books In
3. T. Pradeep, Nano-The Essentials, Tata McGraw-Hill Publishing Company Limited, 2nd Edition, 1998.
4. Richard Booker& Earl Boysen Nanotechnology, Wiley Publishing, 2006.
5. Mark Ratner, Daniel Ratner, Nanotechnology, Pearson Education, 2006.
6. S. Shnmugam, Nanaotachnology, MJP Publishers, 2010
7. V S. Muralidharan, A. Subramania, Nanoscience and technology, Ane books pvt, 2010.
8. Charles P. Poole, Frank J Owens, Introduction of nanotechnology, 2009.
9. Challa S S R Kumar, Josef Hormes, Carola Leuschner, Nanofabrication towards biomedical application, Wiley publications, 2007.
10. B.S.Murty, P. Shankar, Baldev Raj, B.B. Rath, James Murday, Text book of nanoscience and nanotechnology, Universities Press, 2013.
11. P.S. Kalsi and J.P. Kalsi, Bioorganic, Bioinorganic and Supramolecular chemistry, New Age International Publishers, 2011.

MAJOR ELECTIVE COURSE – 4

Semester	Course code	Course Title
I or III		ME- Bioinorganic Chemistry

Credits: 5 **Total teaching hours: 75**

Objectives

- To motivate the students to study about the role of metal ions in biological systems.
- To enable the students to know the structure, function and physiology of Haemoglobin and myoglobin.
- On successful completion of the syllabus, the students should have learnt about electron transfer, respiration, photosynthesis, function of metalloenzymes and the applications of metals in medicine.

UNIT –I METAL STORAGE, TRANSPORT AND BIOMINERALISATION (15 hrs)

Metals in biological systems-trace and ultra trace metals-the roles of metal ions in biological systems-structurally defined sites-the entatic state-iron storage-ferritin- haemosiderin-synthetic iron-oxo aggregates-iron transport-transferrin-siderophores.

UNIT- II DIOXYGEN MANAGEMENT (15 hrs)

Hemoglobin and myoglobin – dioxygen binding, transport and utilization – the binding of dioxygen to myoglobin – the physiology of myoglobin and hemoglobin – structure and functions of hemoglobin – other biological dismutases – oxidases and oxygenases – tyrosinase – methane monooxygenase – dioxygenases.

UNIT -III ELECTRON TRANSFER, RESPIRATION AND PHOTOSYNTHESIS (15 hrs)

Ferredoxins – rubredoxins – synthetic models e-s proteins – blue copper proteins – cytochromes – photosynthesis – chlorophyll and photosynthetic reaction center – photosynthetic pathway – manganese and photosystem II.

UNIT -IV METALLOENZYMES (15 hrs)

Enzymes – structure and function – zinc enzyme – carboxypeptiase and carbonic anhydrase – iron enzymes – catalase, peroxidase and cytochrome P-450 – copper enzymes –

superoxide dismutase – molybdenum oxatransferase enzymes – xanthine oxidase – vitamin B_{12} and the coenzyme – nitrogenase.

UNIT- V METALS IN MEDICINE (15 hrs)

Metal deficiency and disease – metals used for diagnosis and chemotherapy with reference to anticancer drugs – toxic effects of metals – function and toxicity of the elements in biological systems – antibiotics and related compounds – chelate therapy – metal complexes as probes of nucleic acids.

REFERENCE BOOKS

1. I. Bertini, H.B.Gray, S.J. Lippard and J.S. Nalentine, Bioinorganic Chemistry; University Science Books.
2. Stephen J. Lippard and Jeremy M. Berg, Principles of Bioinorganic Chemistry, 2nd edition, Panima publishing corporation.
3. Dr. Asim K. Dass, Bioinorganic Chemistry 2007. Books and Allied (P) Limited.
4. J.E.Huheey, E.A.Kieter, R.L.Keiter, Inorganic Chemistry 4th Edition, Addision Wesely Publishing Company.
5. P.S. Kalsi and J.P. Kalsi, Bioorganic, Bioinorganic and Supramolecular chemistry, New Age International Publishers, 2011.
6. Gurdeep Raj, Advanced Inorganic chemistry, 13th Edition, Krishna Prakashan Media (P) Ltd., 2012.

NON-MAJOR ELECTIVE COURSE -1

Semester	Course code	Course Title
II or IV		NME- Environmental Chemistry

Credits: 5 **Total teaching hours: 75**

Objectives

- To create awareness among the students about various environmental issues like pollution of air, water and soil which threaten the mankind.
- To motivate the students to know the measures to prevent and control pollution.
- On successful completion of the syllabus, the students should have learnt about various pollution, their sources, effects and control measures.

UNIT-I ENVIRONMENT (15 hrs)

Definition-components of -segments: atmosphere and its structure: troposphere, stratosphere, mesosphere, ionosphere and exosphere, hydrosphere, lithosphere and biosphere, ecosystem-types, components and biogeochemical cycles (brief aspects only)-sulphur, phosphorus, carbon-hydrogen, oxygen nitrogen and hydrological cycles.

UNIT-II AIR POLLUTION (15 hrs)

Composition of air, Classification of pollutants-gaseous pollutants-oxides of N,S and C, hydrocarbons and particulates(sources, reactions in the atmosphere, effects on plants/human beings and control measures), monitoring and control of air pollution-CO sensor-Green house effect-definition-major sources of green house gases-consequences of green house effect, Global warming- Ozone layer depletion – mechanism-Chlorofluro carbons (CFC), Smog-photochemical smag, Acid rain-theory of acid rain-effects of acid rain-prevention and control.

UNIT – III WATER POLLUTION (15 hrs)

Sources of water pollution sewage & domestic wastes, industrial effluents, agricultural discharges, fertilizers, detergents, toxic metals, siltation, thermal and radioactive materials. Types of water pollution -ground water, surface water, lake water, river water and sea water pollution and their harmful effects. Effects of oil pollution in marine water. Eutrophication – types, effects and its control measures. Control measures of water pollution.

UNIT – IV SOIL POLLUTION (15 hrs)

Types of soil and their characteristics. Sources of soil pollutants and their deterimental effects-industrial, urban wastes, radioactive materials, agricultural products, chemical & metallic wastes and biological agents. Diseases caused by soil pollution. Remedial measures for soil pollution.

Thermal Pollution:- definition-sources-nuclear power plants, thermal power plants, industrial effluents, domestic & municipal sewage. Harmful effects of thermal pollution.

UNIT –V RADIOACTIVE POLLUTION (15 hrs)

Radio activity and kinds of radiation. Natural and anthropogenic sources of radiation. Harmful biological effects of ionizing, non-ionizing (unit of measurement REM), micro wave, radio frequency, x-ray etc. radiation. Disposal methods of radioactive wastes from nuclear power plants, low level and high level nuclear waste - biomedical waste.

Noise Pollution: definition. Sources, effects and control. Units of sound-dB

REFERENCE BOOKS

1. B.K.Sharma, Environmental Chemistry 2010 Edn, GOEL Publishing Company
2. A.K De, Environmental Chemistry, Wiley Eastern Ltd
3. G.S.Sodhi, Fundamentals of Environmental Chemistry, Narosa Publishing House

NON-MAJOR ELECTIVE COURSE -2

Semester	Course code	Course Title
II or IV		NME- Scientific Thesis Writing & Paper Presentation

Credits: 5 **Total teaching hours: 75**

Objectives

- To introduce students to the research prospectus and thesis/dissertation writing process with the focus on both the rhetorical framework and grammatical patterns germane to these tasks and the purpose of the research project.
- To focus on the communication problems encountered in researching and writing a thesis.
- On successful completion of the syllabus, the students should have trained themselves how to write a thesis.

UNIT – I INTRODUCTION (15 hrs)

Writing introduction of thesis- General introduction and chapter introduction - example of organization of the thesis in general introduction – example of statement if aims and objectives in a general introduction – introduction of a chapter in a thesis

Writing review of literature – need for review of literature – review process and bibliography – locating literature – publications – reading the literature – placement of review of literature in a thesis – organizing and writing literature review – time period covered in the review – contents of a review — use of tabular format in review – focus of the organization – revision of the draft.

UNIT – II TABLES AND FIGURES (15 hrs)

Writing materials and methods – General guidelines – details required about the chemical material.Writing results – voice, tense and style – topical sentence – sequence – structure – content…Preparation of table – tabular form – introduction and placement of a table – table format – numbering of table – title of the table – the stub – box heading – unit of measurements – footnotes.

Preparation of figures – introduction – introduction and placement of figures – numbering of figures – caption of figures – preparation of statistical diagrams – preparation of photographs and microphotographs.

UNIT - III DISCUSSION (15 hrs)

Writing discussion – style of writing discussion – sequence of discussion – structure and content of discussion – key findings and interpretation – discussion of methodology – comparison of results – discussion of the significance of the result – discussion of unexpected result – discussion of unexpected result – discussion in the absence of pertinent literature – conclusion of discussion – structured format of discussion – an example of discussion

Writing abstract, keywords, summary and synopsis of thesis.

UNIT – IV FORMATTING (15 hrs)

References citing and listing – introduction – different systems of reference citation – name year system – citation in the text – listing references- citation sequence system – alphabet number system.

Formatting and typing thesis – introduction – paper – margins – paragraph indentations – widow and orphan lines – spacing – alignment – hyphenation – fonts – pagination – format of a thesis .

UNIT - V MANUSCRIPT PREPARATION (15 hrs)

Preparing manuscript for presentation – poster presentation – poster size – poster Vs. oral presentation – preparation of poster – poster printing – displaying the poster – presenting the poster. Preparing for oral presentation – preparation of the script – timings – using visual aids – presentation style.

Journal article – nature and purpose – journal as a medium of communication – decision prior to publication – preparing manuscript – from manuscript to publication.

REFERENCE BOOKS:

1. N. Gurumani, Scientific thesis writing and paper presentation, MJP publishers, 2010.
2. Hans Fridrich Ebel, Claus Bliefert, Willaim E. Russey, The art of scientific writing, Wiley, VCH, 2004.

NON-MAJOR ELECTIVE COURSE – 3

Semester	Course code	Course Title
II or IV		NME- Agricultural Chemistry

Credits: 5 **Total teaching hours: 75**

Objectives

- To introduce students to the concepts of agricultural chemistry.
- To focus on the preparation, applications and toxic effects of fertilizers and pesticides.
- On successful completion of the syllabus, the students should have known about the principles of soil science, applications and hazards of fertilizers, pesticides, fungicides and herbicides.
-

UNIT – I SOIL SCIENCE-1 **(15 hrs)**

Introduction, definitions of soils, properties of soils – physical properties, chemical properties, mechanical components, soil as a three-phase system, soil profile, soil structure. soil density, soil color, texture, mechanical analysis, functions of sand, slit and clay, textural grouping of soils, soil water, moisture content of soil, wilting coefficient, soil air, soil temperature, soil mineral matter, soil colloids.

UNIT – II SOIL SCIENCE-2 **(15 hrs)**

Ion exchange reactions in soil: Cation exchange – anion exchange, soil fertility, theories of nutrient supply- solution theory – contact exchange theory- soil organic matter- soil humus – soil organisms, carbon cycle, nitrogen cycle, carbon- nitrogen ratio, soil pH, types of soil acidity, determination of soil pH – electrometric method – dye methods, buffer action, nutrient elements, availability of nutrients and soil pH, acid soils, alkaline and alkaline soils, reclamation.

UNIT – III FERTILIZERS-1 **(15 hrs)**

Introduction, requisites of a good fertilizer, classification of fertilizers, nitrogenous fertilizers – effect of nitrogen on plant growth and development – importance of nitrogenous fertilizers – classification of nitrogenous fertilizers. Preparation and uses of some nitrogenous fertilizers - ammonium sulphate, ammonium nitrate, ammonium sulphate – ammonium nitrate,

sodium nitrate, calcium nitrate, aqueous ammonia, calcium ammonium nitrate, urea, calcium cynamide.

UNIT – IV FERTILIZERS-2 (15 hrs)

Phosphate fertilizers**:** Introduction, deficiency symptoms, kinds of phosphate fertilizers, super phosphate, bone metal, basic slag, rock phosphate, and dicalcium phosphate.

Potassium fertilizers – functions of potassium in the plants, deficiency symptoms, classification into chlorine and non chlorine forms, manufacturing processes and properties of potassium fertilizers – potassium chloride, potassium nitrate.

Complex fertilizers- introduction, manufacture, composition, calculation of fertilizer formulae.

UNIT – V PESTICIDES (15 hrs)

Introduction, classification of pesticides- general methods of preparation and applications (outline only), toxicity. Insecticides – introduction, insect killer and repellents. Preparation and action- Nicotine, pyrethrum, rotenone, chlorohydrocarbons, methoxychlor.

Fungicides – sulphur and its compounds, copper compounds, Bordeaux mixture. Herbicides – introduction, classification, inorganic herbicides- arsenic compounds, boron compounds, cynamide and thiocyanates, chlorates organic herbicides – chlorinated compounds, pyridine compounds.

REFERENCE BOOK

1. R. Lakshmanan, Agricultural chemistry, V.V publications. Thanjavur
2. A. Mariakulandai, T.S. Manickam, Chemistry of fertilizers and manures, Asia publishing house, 1975.

NON-MAJOR ELECTIVE COURSE – 4

Semester	Course code	Course Title
II or IV		Industrial products

Credits: 5 **Total teaching hours: 75**

Objectives

- To introduce students to the concepts of Industrial products.
- To focus on the preparation, applications of glass, cement, fertilizer, paints and pigments.

UNIT –I GLASS (15 hrs)

Physical and chemical properties of glass. Raw materials used in the manufacture. Steps used for the manufacture-formation of batch materials, melting, shaping, annealing and finishing. Chemical reactions in the furnace. Pot furnace and tank furnace. Regenerative and recuperation types. Verity of glasses-silica, optical, borosilicate, lead, safety, pyrex, alkali silicate, photochromic and glass wool.

UNIT –II CEMENT (15 hrs)

Types of cement. Types of Portland cement. Raw materials-manufacturing process – wet and dry process-types of kiln and reactions in kiln- composition of clinker-additives added during grinding-setting, curing and hardening of cement-physiochemical transformations. Properties of cement Mortars and concrete-RCC.

UNIT –III FERTILIZERS (15 hrs)

Plant nutrients-primary, secondary and micro nutrients. Need for fertilizers-classification of fertilizers. Source of fertilizers-natural and artificial. Nitrogenous fertilizers-ammonium nitrate, ammonium sulphate and urea. Phosphate fertilizers-phosphate rocks-normal super phosphate-triple super phosphate. Potassium fertilizers-NPK fertilizers.

UNIT –IV PAINTS AND PIGMENTS (15 hrs)

Paints :- Definition-classification-constituents-manufacture-requirements of a good paint. Paint failure. Types of paints-emulsion paints-latex-luminescent-fire retardant-heat resistant. Methods of applying paint. Paint removers. Varnishes - types and classes. Lacquers, solvents, thinners and oils. Pigments:-white pigments- manufacture-white lead(electrolytic method)-zinc oxide(French process)-titanium dioxide(chlorine method). Blue pigment-ultramarine. Red pigment-red lead. Green pigment-chrome green. Yellow pigment-chrome yellow.

UNIT –V RUBBER AND ALLIED PRODUCTS (15 hrs)

Natural rubber-types and classification-latex-coagulation-refining of crude rubber-vulcanization (sulphur and non-sulphur)-properties of vulcanized rubber. Synthetic rubber-manufacture and uses of-Buna-S(from petroleum), Neoprene, Butyl rubber, silicone rubber and poly urethane.

REFERENCE BOOKS

1. B.K.Sharma, Industrial Chemistry, GOEL Publishing Company.
2. G.T. Austin, Industrial Chemistry, Shteves chemical process Industries 5th Edition.
3. B.N. Chakarabarthy, Industrial Chemistry, Oxford and IBH publishing house.

QUESTION PAPER PATTERN FOR **CIA** AND **ESE**

Theory (including electives except JOC and ALC)

Maximum marks 75

Section – A (10 X 1 = 10 marks)

Q.No.1 to 10: Multiple choice types alone with four distracters each

Section – B (5 X 5 = 25 marks)

Q.No.11 to 15: either or / short notes type questions (one question 'a' or 'b' from each unit)

Section – C (5 X 8 = 40 marks)

Q.No.16 to 20: either or / essay type questions (one question 'a' or 'b' from each unit)

QUESTION PAPER PATTERN FOR **ESE**

JOC and ALC

Maximum marks 100

Section – A (10 X 1 = 10 marks)

Q.No.1 to 10: Multiple choice types alone with four distracters each

Section – B (5 X 6 = 30 marks)

Q.No.11 to 15: either or / short notes type questions (one question 'a' or 'b' from each unit)

Section – C (5 X 12 = 60 marks)

Q.No.16 to 20: either or / essay type questions (one question 'a' or 'b' from each unit)