PG DEPARTMENT OF CHEMISTRY

SYLLABUS
2015-2017 BATCH

FACULTY MEMBERS

Dr. K. POONKODI, M.Sc.,M.Phil.,Ph.D.
Dr. S. VADIVEL., M.Sc., Ph.D.

NGM COLLEGE (Autonomous)
Affiliated to Bharathiar University
Re-Accredited with 'A' grade by NAAC & ISO 9001:2008 certified
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NGM College

Vision

Our dream is to make the college an institution of excellence at the national level by imparting quality education of global standards to make students academically superior, socially committed, ethically strong, spiritually evolved and culturally rich citizens to contribute to the holistic development of the self and society.

Mission

Training students to become role models in academic arena by strengthening infrastructure, upgrading curriculum, developing faculty, augmenting extension services and imparting quality education through an enlightened management, committed faculty who ensure knowledge transfer, instill research aptitude and infuse ethical, cultural values to transform students into disciplined citizens in order to improve quality of life.

PG DEPARTMENT OF CHEMISTRY

Vision

An effective Teaching – Learning adjunct to cater the need of industry in the context of the developing needs of the country.

Mission

The Chemistry Department pledges itself to encourage in the broadest and most liberal manner, the advancement of science and particularly chemistry in all of its branches through its education, research, and service missions.

N.G.M. COLLEGE (AUTONOMOUS)
POLLACHI
M.Sc., Chemistry (Effective from the year: 2015-16 onwards)

Semester	Course Code	Title of the Paper	Hrs / Week	Hrs / Exam	Max. Marks			Credits
					Intl.	E.S.E	Total	
I	15PCY101	Organic Chemistry –I	5	3	25	75	100	5
	15PCY102	Inorganic Chemistry –I	5	3	25	75	100	5
	15PCY103	Major Elective –I	5	3	25	75	100	5
	15PCY107	Organic Chemistry Practical-I	5	--	--	--	--	--
	15PCY108	Inorganic Chemistry Practical-I	5	--	--	--	--	--
	15PCY109	Physical Chemistry Practical I	5	--	--	--	--	--
II	15PCY204	Organic Chemistry –II	5	3	25	75	100	5
	15PCY205	Physical Chemistry –I	5	3	25	75	100	5
	15PCY206	Spectroscopy	4	3	25	75	100	5
	15PCY2N1/ 15PCY2N2	Non-Major Elective: Chemistry in day today life / Chemistry in context	1	3	25	75	100	2
	15PCY207	Organic Chemistry Practical –I	5	6	40	60	100	3
	15PCY208	Inorganic Chemistry Practical -I	5	6	40	60	100	3
	15PCY209	Physical Chemistry Practical –I	5	6	40	60	100	4
III	15PCY310	Organic Chemistry –III	4	3	25	75	100	4
	15PCY311	Inorganic Chemistry –II	4	3	25	75	100	4
	15PCY312	Physical Chemistry – II	4	3	25	75	100	4
	15PCY313	Major Elective –II	5	3	25	75	100	5
	15PCY417	Organic Chemistry Practical –II	3	--	--	--	--	--
	15PCY418	Inorganic Chemistry Practical –	3	--	--	--	--	--
	15PCY419	Physical Chemistry Practical -II	4	--	--	--	--	--
	15PCY420	Project Work	3	--		--	--	--
IV	15PCY414	Inorganic Chemistry –III	5	3	25	75	100	4
	15PCY415	Physical Chemistry –III	5	3	25	75	100	4
	15PCY416	Major Elective –III	5	3	25	75	100	5
	15PCY417	Organic Chemistry Practical -II	4	6	40	60	100	3
	15PCY418	Inorganic Chemistry Practical -II	4	6	40	60	100	3
	15PCY419	Physical Chemistry Practical -II	4	6	40	60	100	4
	15PCY420	Project Work & Viva-Voce	3	--	40	160	200	8
Total							2200	90

Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	Effective from the year: 2015-16 onwards
Subject code	15PCY101	Semester: I
Title	Organic Chemistry I	
Hrs/Week	5	Credit: 5
Objectives	• To motivate the students to comprehend a knowledge on aromaticity and reaction mechanism. • To learn about addition reactions, electrophilic and nucleophilic substitution reactions. • To learn about the basic ideas about reaction intermediates and elimination reactions	
Unit	Content	Hrs
Unit I	**Aromaticity:** Introduction - Aromaticity of benzenoids and heterocyclic compounds. Non-benzenoid aromatics - annulenes. Azulenes and ferrocenes(synthesis not necessary). Antiaromatic and non aromatic compounds – Homoaromaticity. Study of reaction mechanisms-Kinetic methods: primary and secondary kinetic isotopic effects, non-kinetic methods: study of intermediates, isotopic labeling, stereochemical studies and cross over experiments. Hammond's postulate. Kinetic and thermodynamic control. Linear free energy relationship-Hammett equation (Taft equation not necessary).	13
Unit II	**Aromatic electrophilic substitution reactions:** Introduction - Mechanism of electrophilic substitution reactions such as halogenation, nitration, sulphonation and Friedel-Crafts alkylation and acylation reactions. Orientation and reactivity. Electrophilic substitution on monosubstituted and disubstituted benzenes. Typical reactions such as Gattermann reaction, Gattermann Koch reaction, Rimer -Tiemann reaction, Kolbe reaction, Hofmann-Martius and Jacobson's reactions.	13
Unit III	**Aliphatic nucleephilic substitution reactions and mechanisms:** SN1, SN2, SNi mechanisms. Factors affecting nucleephilic substitution reaction- nature of the substrate, solvent, nucleophile and leaving group, neighbouring group participation. Ambident nucleophiles and ambident substrates. Stereochemistry of nucleophilic substitution reactions. Substitution at vinyl carbon, allylic carbon and	13

	bridge head carbon. Typical substitution reactions-Von Braun reaction, Claisen condensation and hydrolysis of esters. SNAr and Benzyne mechanism (Zigler alkylation and Chichibabin reaction).	
Unit IV	**Elimination reactions:** El, E2, Ei, E1CB mechanisms, Stereochemistry of elimination reactions. Elimination Vs substitution. Typical elimination reactions-Chugaev reaction, Hofmann degradation and Cope elimination. Carbenes and nitrenes — structure, generation and reactions.	13
Unit V	**Free radical reactions:** Introduction -structure, stability and geometry of free radicals. Generations of long lived and short lived free radicals. Characteristics of free radical reactions, substitutions, additions and eliminations, rearrangements reactions of free radicals. Typical reactions - Sandmeyar, Gomberg, Pechmann, Ullman, Pschorr and Hunsdiecker reactions.	13
	Total hours/Semester	65
Text Books	1. Agarwal, O.P. (2014). *Reactions and Regents in Organic Chemistry*. 49th Edition. Goel publishing house 2. Ahluwalia, V.K. Rakesh K. Parashar (2010). *Organic Reaction Mechanisms*. 4th Edition. Narosa Publsihing House 3. Tewari, KS, Vishnoi (2006). NK A *Text book of Organic Chemistry*. 3rd Edition. Vikas Publication.	
Reference Books	1. Jerry March (2007) *Advanced organic chemistry*. 4th Edition, A Wiley-Interscience. 2. Finar, I.L. (2002) *Organic Chemistry*. *Vol.1*. 5th Edition. Pearson India Ltd. 3. Morrison, R.T, Boyd, R.N (2013) *Organic Chemistry*.7th Edition. Pearson India Ltd.	

Department	CHEMISTRY	
Course :	**M.Sc., CHEMISTRY**	**Effective from the year: 2015-16 onwards**
Subject code	**15PCY102**	**Semester: I**
Title	**Inorganic Chemistry - I**	
Hrs/Week	**5**	**Credit: 5**
Objectives	• To introduce the principles and applications of nuclear chemistry. • To have knowledge about chains, rings, cages, nuclear model, modes of decay and detection, measurement of radio activity, nuclear reactors and applications	
Unit	**Content**	**Hrs**
Unit I	**Inorganic chains, cages and clusters:** Chains- catenation, heterocatenation, isopolyanions, heteropolyanions, Cages- Phosphorous compounds, boranes, carboranes, Metallocene carboranes. Metal clusters- dinuclear, trinuclear, tetra nuclear and hexa - nuclear clusters.	13
Unit II	**Inorganic rings and metallic state** Rings- Borazines- phosphonitrilic compounds- sulphur - nitrogen ring compounds, S_4N_4 Metallic state- free electron and band theories - non stochiometry – point defects in solids-Schotty - Frenkel defects – line and dislocation defects	13
Unit III	**Nuclear chemistry- I** Nuclear force- stability of nuclei, packing fraction, even- odd nature of nucleons- n/p ratio- binding energy and exchange forces- shell model and liquid drop model- similarities between the nucleus and liquid drop- the constant of the nuclear radius- merits and limits of the liquid drop, decay of radio nuclei- rate of decay- half life- average life- determination of decay constant and half life Modes of decay- alpha decay, beta decay and gamma decay- gamma photon, gamma photon emission, internal conversion and decay constants. particle acceleration and counting techniques: linear accelerator- cyclotron and synchrotron- betatron- G.M. counter- proportional and scintillation counters.	13
Unit IV	**Nuclear chemistry- II** Nuclear fission: the energy released in fission, fission products- types of fission- spontaneous fission- fission by fast neutrons- charged	13

	particles- photo fission. Nuclear energy sources: Nuclear fission as the source of energy, nuclear chain reaction and controlled chain reactions- principles of nuclear reactor, classification of nuclear reactions. Homogeneous thermal reactions- enriched uranium graphite reactors- scheme of a typical reaction- stellar energy- thermonuclear reactions on the earth. Radioisotopes as tracers- reaction mechanism- analytical applications- medical, agricultural and industrial applications- age determination- dating by ^{14}C	
Unit V	**Chemistry of f-block elements** 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. Uses of lanthanides. Actinide series – sources of actinide-preparation of transuranic elements – electronic configurations – oxidation state – colour and complex formation – comparison of lanthanides and actinides, extraction of thorium from monazite sand and isolation of uranium from pitchblende.	13
	Total hours/Semester	**65**
Text Books	1. Gurdeep Raj. (2014). *Advanced inorganic Chemistry*. 12th Edition. Geol Publishing House 2. Madan. R.D. (2011). *Advanced Inorganic Chemistry*. 3rd Edition. S. Chand & company, New Delhi. 3. Arnikar, H.J. (2000). *Essentials of Nuclear Chemistry*. 4th Edition. New Age International	
Reference Books	1. Keith F. Purcell, John. C. Kotz. (1980). *Inorganic chemistry*, Holt- Saunders International Editions 2. James E. Huheey. (1997). *Inorganic chemistry Principles of structure and reactivity*, 4th Edition. Pearson India Limited.	

Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	Effective from the year: 2015-16 onwards
Subject code	15PCY103	Semester: I
Title	Major Elective Course – I Polymer Technology	
Hrs/Week	5	Credit: 5
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. • To acquire a clear idea about various properties of polymers, fibres, elastomers and their applications in industries	
Unit	Content	Hrs
Unit I	**Introduction to polymers** Definitions-Industrial Polymers-Plastics-Fibers-Rubber-Coatings and adhesives-Chemical structure and properties of polymers- Glass Transition Temperature(Tg) Stereochemistry- crystallanity-Mechanical properties-thermal Stability- Flammability and Flame resistance-Chemical resistance-Degradability-Electrical Conductivity. Degrading agencies and mechanism of degradation: Thermal, mechanical, ultrasonic degradation, degradation by high-energy radiation, photo degradation, oxidative and hydrolytic degradation.	13
Unit II	**Individual polymers** Production, properties and uses of ethenic polymers – polythene (HDPE & LDPE), polypropylene, polystyrene, PVC, polyvinyl acetate, polyvinyl alcohol, 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.	13
Unit III	**Fabrication process** Two-dimensional processes – Casting (Die casting, rotational and film casting), Calandering, Lamination. Three-dimensional processes – Moulding (Compression, Injection, Reaction injection, Blow, Transfer, and Rotational moulding) processes.	13

	Forming (atmosphere pressure and Fluid pressure forming) processes and Foaming process.	
Unit IV	**Fibre technology** 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 wet spinning. Treatment of fibres – sizing, dyeing, finishing, scouring and lubrication	**13**
Unit V	**Elastomer technology** 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	**13**
	Total hours/Semester	**65**
Text Books	1. Billmeyer, F. W. (1984) *Text book of polymer science*, 3rd Edition, John Wiley & Sons 2. Gowariker (V.R) & Viswanathan, N.V (1984) *Text book of Polymer science* 1st Edition, New Age International Private Ltd.	
Reference Books	1. J.R. Fried. (2014) *Polymer Science & Technology*, 2nd Edition, Prentice Hall of India Private Ltd. 2. George Odian. (2004) *Principles of Polymerization*, 3rd Edition, John Wiley & Sons, INC	

Department	CHEMISTRY	
Course :	**M.Sc., CHEMISTRY**	**Effective from the year: 2015-16 onwards**
Subject code	**15PCY204**	**Semester: II**
Title	**Organic Chemistry II**	
Hrs/Week	**5**	**Credit:5**
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,	
Unit	**Content**	**Hrs**
Unit I	**Molecular rearrangements:** Introduction - Wagner - Meerwein rearrangements, Neber rearrangement, Baeyer-Villiger rearrangement. Rearrangements to electron deficient nitrogen and oxygen-Dienone phenol, Favorski, Fries, Wolf, Benzidine, Stevens rearrangements, Curtius, Chapman nabd Wallac rearrangements.	13
Unit II	**Concerted reactions:** 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.	13
Unit III	**Organic photochemistry:** Laws of photochemistry: Beer-Lambert, Grothus-Draper laws, light absorption, electronic excitation, quantum yield, physical and chemical actinometry, Jablonski diagram, photosensitization, photophysical processes, energy transfer, photochemical reactions of ketones, Norrish type I and type II reactions, Patterno-Buchi reaction, photoreduction, photo oxidation, photolysis, Cis and trans isomerization,	13

Unit IV	**Addition Reactions:** Electrophilic and nucleophilic, Addition to double and triple bonds- hydration, hydroxylation, Michael addition, hydroboration and epoxidation. Addition to carbonyl compounds: Mannich reaction, Dieckmann, stobbe, knovenagal, Darzen, Wittig, Thorpe and Benzoin reactions	13
Unit V	**Stereoisomerism:** Configurational & conformational isomerism- Molecular representation (Fischer, Newmann and Sawhorse projection formula) optical isomerism- nitrogen and sulphur compounds- the role of nitrogen inversion Configurational nomenclature: D & L, R & S and E& Z. Conformations of acyclic, cyclic, ethane, 1, 2 disubstituted ethanes. Configurations and confirmations of cyclohexanes, mono and disubstituted cyclo hexanes. Configurations and confirmations of fused polycyclic systems- decalin, perhydrophenanthrene and aldohexopyranose (Glucose). Stereo selective and stereospecific reactions.	13
	Total hours/Semester	65
Text Books	1. Mukerjee S.M. & Singh, S.P. (2013) *Reaction mechanism in organic chemistry*, 3rd Edition, McMillan India Ltd 2. Ahluwalia, V.K. Rakesh K. Parashar (2010). *Organic Reaction Mechanisms*. 4th Edition. Narosa Publsihing House. 3. Kalsi. P.S. (1995). *Stereochemistry, Conformation and Mechanism*. 3rd edition. John Wiley sons. *4.* Nasipuri. D (1994). *Stereochemistry of Organic Compounds* New age International.	
Reference Books	*1.* Depuy, C.H. & Chapman. O.S. (1972) *Molecular reactions and photochemistry*. Prentice Hall. *2.* Eliel. E.L, Wilen. S.H. (1994) *Stereochemistry of Organic Compounds.* Wiley International 3. Potapov, V.M. Beknazarov. A. (1980) *Stereochemistry*. Mir Publications. Russia. 4. Jerry March (2007) *Advanced organic chemistry*. 4th Edition, A Wiley-Interscience. 5. Finar, I.L. (2002) *Organic Chemistry. Vol.1.* 5th Edition. Pearson India Ltd.	

Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	Effective from the year: 2015-16 onwards
Subject code	15PCY205	Semester: II
Title	Physical Chemistry - I	
Hrs/Week	5	Credit: 5
Objectives	• To motivate the students to comprehend a knowledge on symmetry elements and symmetry operations. • To learn the concepts of Group theory and quantum chemistry	
Unit	Content	Hrs
Unit I	**Group theory-I**: Symmetry elements and symmetry operations – identity element – centre of symmetry – plane of symmetry and 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 – Construction of group multiplication table for C_{2v} and C_{3v} point group – symmetry classification of molecules into point groups (Schoenflies symbol only). Matrices: definition of matrix, square matrix, diagonal matrix, null matrix, unit matrix, row matrix, column matrix, symmetric matrix, skew symmetric matrix and conjugate matrices — determination of inverse of a matrix, block multiplication of matrices – addition and subtraction of matrices – matrix representations of symmetry operations. Group theory and dipole moment.	13
Unit II	**Group theory-II:** 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.	13
Unit III	**Quantum Chemistry-I:** Success of quantum theory and the failure of classical mechanics in explaining black-body radiation, heat capacity of solids, photo-electric effect and the H-atom spectrum (derivation of Plank's distribution law and Einstein's heat capacity equation not needed).	

	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, requirements of the acceptable wave function. Algebra of operators, sum and product of operators, commutator, linear operators, eigen functions and eigen values, correspondence between physical quantities in classical mechanics and operators in quantum mechanics, Hamiltonian operator, angular momentum operator, quantization of angular momentum and its spatial orientation, average (expectation) value.	13
Unit IV	**Quantum Chemistry-II:** Particle in a one-dimensional box, quantization of energy, normalization of wave function, orthogonality of particle in a one-dimensional box wave functions, illustration of the uncertainty principle and correspondence principle with reference to the particle in a one-dimensional box, particle in a three-dimensional box, separation of variables. 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), energy levels.	13
Unit V	**Quantum Chemistry-III:** 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.	13
	Total hours/Semester	65
Text Books	1. Raman, K.V. (1996), *Group Theory and its applications to chemistry*, Tata McGraw Hill publishing company Ltd,. 2. Bhattacharya, P.K. (1986) *Group theory and its chemical applications*, Himalaya Publishing House. 3. Chandra, A.K (1994) *Introductory Quantum Chemistry*, 3rd Edition, Tata McGraw Hill Publishing Company.	
Reference Books	1. Cotton, F.A. (1990) *Chemical applications of group theory*, 3rd Edition, A Wiley Interscience Publication 2. Hanna. M (1969) *Quantum Mechanics in Chemistry*, 2nd Edition. Addison Wesley Longman 3. Mcquarrie, D.A. (2008) *Quantum Chemistry*. 2nd Edition University Science Book	

Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	Effective from the year: 2015-16 onwards
Subject code	15PCY206	Semester: II
Title	Spectroscopy	
Hrs/Week	4	Credit: 5
Objectives	• To interpret and solve problems using various spectra. • To acquire knowledge in the structural determination of unknown compounds and various spectroscopic methods.	
Unit	Content	Hrs
Unit I	**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 in microwave oven. **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, finger print region - Fermi Resonance - sampling techniques-applications of infrared to organic compounds.	10
Unit II	**UNIT – II** **UV and visible spectroscopy** 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 maximum of dienes, polyenes and α, β-unsaturated ketones.	10
Unit III	**Mass Spectrometry** 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 peak abundance, Retro-Diels Alder Reaction,	11

	McLafferty rearrangement, double bond and ring equivalence. Fragmentation associated with functional groups (aliphatic and aromatic) – hydrocarbons, unsaturated hydrocarbons, aldehydes, ketones, carboxylic acids, esters, amides, alcohols and ethers	
Unit IV	**Nuclear Magnetic Resonance Spectroscopy -^{1}H NMR** Magnetic properties of nuclei – theory of nuclear resonance, Instrumentation, Relaxation mechanisms(spin-spin & spin-lattice)- Chemical shifts- Electronegative effect, Vander Waal's deshielding, Hydrogen bonding effect, Anisotropy, spin-spin coupling, geminal, vicinal, Long range, dynamic NMR, deuterium exchange – solvents used in NMR, 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). Applications of NMR to organic compounds.	**11**
Unit V	**^{13}C NMR**: 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, 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, resonance with other nuclei (^{31}P & ^{19}F). Solving problems using IR, UV, NMR and mass spectra for simple organic molecules.	**10**
	Total hours/Semester	**52**
Text Books	1. Banwell. C.N. (1994) *Fundamentals of molecular spectroscopy*,3rd Edition, Tata McGraw Hill Publishing Company Ltd. 2. Jagmohan, (2005) *Organic Spectroscopy Principles and Applications*, 2nd Edition , Narosa publishing house 3. Sharma, Y.R. (2005) *Elementary Organic Spectroscopy*, 3rd Edition, S. Chand & Company Ltd.	
Reference Books	1. Silverstien, Bassler and Morril, (2014) *Spectrometric identification of organic compounds*, 8th Edition, John Wiley and Sons, INC 2. Kemp, W. (1991) *Organic Spectroscopy*, 3rd Edition, Mc Millan Press Ltd. 3. Dyer, J. (1965) *Application of absorption spectroscopy of organic compounds*, Prentice and Hall of India, Pvt., New Delhi.	

Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	Effective from the year: 2015-16 onwards
Subject code	15PCY2N1	Semester: II
Title	CHEMISTRY IN DAY TO DAY LIFE Non Major Elective-I	
Hrs/Week	1	Credit: 2
Objectives	• After completion of the course the students should have understood industrial preparations. • To enable the student to understand about the manufacture of commercial products	
Unit	Content	Hrs
Unit I	Water Analysis-Study of water samples -Acidity, Alkalinity, Free chlorine, chlorine demand, Calcium, Magnesium, Iron, Manganese, Zinc, Ammonia, Nitrate, Sulphate and Fluoride. DOC, BOD, COD.	3
Unit II	Fertilizer type-Need for fertilizers-Essential requirements-NPK ratio-Sources of fertilizers. Effect of Nitrogen, potassium and phosphorous on plant growth.	3
Unit III	Pesticides –classification of Insecticides, fungicides, herbicides as organic and inorganic – general methods of application and toxicity. Safety measures when using pesticides.	3
Unit IV	Paints, varnish and lacquers-ingredients, characteristics and their uses. Cleansing agents- Importance of cleansing; Soaps – classification, Manufacture, Dry cleaning-properties.	2
Unit V	Milk and Milk products-Composition of Milk; Flavour and aroma of Milk; Physical properties of Milk; Effect of heat on Milk; pasteurization; Homogenization; milk products; Cream; butter; ice Cream; milk powder	2
	Total hours/Semester	13
Text Books	1. Jayashree Ghosh, S. (2005) *Fundamental Concepts of Applied Chemistry*, Chand, Publications.	
Reference Books	1. Bailey, Clark, Ferris, Isrause, Strong, (2001) *Chemistry of the environment* 2nd Edition Elsevier publications. 2. Jain.P.C. and Monica Jain (2005) *Engineering chemistry* 17th Edition, Dhanpat Rai, Publishing Company (P) Ltd.	

Department	CHEMISTRY	
Course :	**M.Sc., CHEMISTRY**	**Effective from the year: 2015-16 onwards**
Subject code	**15PCY2N2**	**Semester: II**
Title	**CHEMISTRY IN CONTEXT** **Non Major Elective-II**	
Hrs/Week	**1**	**Credit: 2**
Objectives	i.To enable the student to understand about ecological systems ii.After completion of the course the students should have understood biological effects ,energy sources and plastics	
Unit	**Content**	**Hrs**
Unit I	The air we breathe - composition of air - burning of hydrocarbons - fog - air quality - ozone - oxygen / ozone screen - biological effect of UV radiation - ozone formation and distribution in the atmosphere - paths of ozone destruction - chloroflurocarbons and their interactions with ozone - the Antartic ozone hole.	3
Unit II	Chemistry of global warming - green house effect - earth's energy balance - vibrating molecules and the green house effect - molecular response to radiation - methane and other green house gases - climate modeling.	3
Unit III	Solar energy - fuel from sun light - splitting of water - hydrogen from sunlight - hydrogen economy - fuel cells - batteries - photovoltaics - stealing the sun	3
Unit IV	Nuclear energy - nuclear fission and fusion - production of electricity by a nuclear reactor - radioactivity and the hazards of radioactivity - living with nuclear power	2
Unit V	The world of plastics and polymers - polymers - polyethylene - plastics and recreation - paper or plastics - disposal of plastics	2
	Total hours/Semester	13
Text Books	1.Jayashree Ghosh, S. (2005) *Fundamental Concepts of Applied Chemistry*, Chand, Publications.	
Reference Books	1. Conard L. Stanitski. Luey Pyrde Eubenks. Catherine H. Middle Camp and Wilmer J. Stratton (2000) *Chemistry in Context: Applying Chemistry to Society*, 3rd Edition, Tata Mc Graw Hill. 2. Bailey, Clark, Ferris, Isrause, Strong, (2001) *Chemistry of the environment* 2nd Edition Elsevier publications.	

Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	Effective from the year: 2015-16 onwards
Subject code	15PCY207	Semester: I&II
Title	Organic Chemistry Practical- I	
Hrs/Week	5	Credit: 3
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.	
	Content	Hrs
	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 hydration from Benzil and urea.	
	Total hours/Semester	**65**

Reference Books	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

Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	Effective from the year: 2015-16 onwards
Subject code	15PCY208	Semester: I&II
Title	Inorganic Chemistry Practical -I	
Hrs/Week	5	Credit: 3
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.	
Unit	Content	Hrs
	A. Semimicro QualitativeAnalysis: Analysis of mixtures of common metal cations and the following less familiar metal cations - Thallium, Tungsten, Selenium, Tellurium, Molybdenum, Cerium, Thorium, Titanium, Zirconium, Vanadium, Beryllium, Uranium 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: Lead tetraacetate, Dipyridiniumhexachloroplumbate, Hydroxyl-aminehydrochloride, Ortho and para – hydroxy phenyl mercuric chloride, Potassium cupric chloride, Chrome alum Copper(I)Chloride, Trithio urea copper(I), Potassium trioxalato – aluminate(III), Potassium trioxalatochromate(III), Potassiumtrioxalatoferrate(III), hexaminecobalt(III)chloride,Chloropentamminechromium(III)chloride, Aquopentamminechromium(III)nitrate,Tetramminecopper(II)Sulphate, Ammonium hexachloro stannate (IV). **C. Colorimetric Estimations** (using photoelectric colorimeter) Estimation of Copper, Iron, Nickel, Manganese and Chromium.	
	Total hours/Semester	**65**

Text Books	1. V.V.Ramanajum, (1985)*Semimicro Qualitative Inorganic Analysis*. 2. V.Venkateswaran, R.Veeraswamy and A.R. Kulandaivelu, (1997) *Principles of Practical Chemistry Sultan* Chand & Sons. 2nd Edition 3. Giri. S. Bajpai D.N. & Panday, O.P. *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

Department	CHEMISTRY	
Course :	**M.Sc., CHEMISTRY**	**Effective from the year: 2015-16 onwards**
Subject code	**15PCY209**	**Semester: I&II**
Title	**Physical Chemistry Practical- I**	
Hrs/Week	**5**	**Credit: 4**
Objectives	• To promote an awareness about Potentiometric titrations to the students. • To know, 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.	
Unit	**Content**	**Hrs**
	<u>Non Electrical Experiments</u> 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 $KI + I_2 \leftrightarrow KI_3$ **<u>Electrical Experiments</u> -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	

	Total hours/Semester	**65**
Text Books	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

1. CIA Practical exam – 25 2. Observation note book – 10 3. Attendance – 5	1. Experiment – 40 2. Record – 10 3. Viva-Voce - 10

Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	Effective from the year: 2015-16 onwards
Subject code	15PCY310	Semester: III
Title	Organic Chemistry -III	
Hrs/Week	4	Credit: 4
Objectives	• To promote 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.	
Unit	Content	Hrs
Unit I	Terpenoids: Isolation and classification of terpenoids- Isoprene rule, Gem-dialkyl rule, structural eIucidation and synthesis of zingiberene, eudesmol, juvenile hormone, abeitic acid and caryophyllene.	10
Unit II	Steroids: Introduction — structural elucidation of cholesterol (synthesis not required), ergosterol, equilenin, estrone, testosterone and progesterone	10
Unit III	Alkaloids: Introduction – isolation of alkaloids, structural elucidation and synthesis of morphine, reserpine. Quinine, atropine and glaucine.	10
Unit IV	Proteins and nucleic acids: Classification and characteristics (structure) of proteins — synthesis of polypeptides and oxytocin, enzymes and coenzymes. Structure of RNA and DNA and their biological importance. Heterocyclic compounds: Structure, synthesis and reactions of flavones, isoflavones, purines (adenine and guanine) and anthocyanins (cyanin and pelargonin).	11
Unit V	Reactions and reagents: Reactions in organic synthesis: Oppanauer oxidation, Barbier – Wieland degradation, Barton reaction, Jones oxidation and Vilsmeier reaction. Reagents in organic synthesis : Preparations and synthetic applications of DDQ(2,3-dichloro-5,6-dicyano-1,4-benzoquinone), DBU(1,5-diazabicyclo[5.4.0]undecene-5), DCC(dicyclohexylcarbodiimide) NBS, PCC, PDC and crown ethers.)	11
	Total hours/Semester	52

Text Books	1. Finar , I. L.(1998) *Organic Chemistry Vol. II*, Longman Publishing Group. 2. Agarwal O. P. (2001) *Natural product Chemistry*, 20th Edition, Goel Publishing house. 3. Gurdeep Chatawal(2001) *Organic Chemistry of Natural Products Vol I & II*, Himalaya Publishing House. 4. Ahluwalia, V.K. Rakesh K. Parashar (2010). *Organic Reaction Mechanisms*. 4th Edition. Narosa Publsihing House	
Reference Books	1. Jerry March (2007). *Advanced organic chemistry*. 4th Edition, A Wiley-Interscience 2. Newman, A.A (1972). *Chemistry of Terpenes and Terpenoids*, Academic press publishers. 3. Barry Victor Charlwood & Banthorpe, D. V. (1991) *Terpenoids.* Academic press publishers**.**	

Department	CHEMISTRY	
Course :	**M.Sc., CHEMISTRY**	**Effective from the year: 2015-16 onwards**
Subject code	**15PCY311**	**Semester: III**
Title	**Inorganic Chemistry - II**	
Hrs/Week	**4**	**Credit: 4**
Objectives	• To promote awareness about bonding in coordination complexes and acid base concepts to the students. • To know 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	**Content**	**Hrs**
Unit I	**Bonding in coordination complexes** Crystal field theory (CFT) – important features of CFT, crystal, field splitting of metal d-orbital in octahedral, tetragonal, square planar and tetrahedral complexes, strong and weak ligands – spectrochemical series -high and low spin complexes – magnetic properties of transition metal complexes – distortion of octahedral complexes – Jahn -Teller theorem – CFSE and its applications – limitations of CFT, evidences for metal-ligand covalent bonding in complexes, Molecular orbital theory (MOT) – formation of molecular orbital – MOT energy level diagram of octahedral, tetrahedral and square planar complexes – sigma and bi bonding ligands.	11
Unit II	**Electronic spectra of the complexes** Ground term states of d^n ions- derivation of term states – electronic spectra of coordination compounds – selection rules – effect of Jahn-Teller distortion and spin orbit coupling on spectra – Nephelauxetic effect – Orgel diagrams for d^1 to d^9 systems – Tanabe-Sugano diagrams (d^2 and d^6 systems only) - calculation of 10Dq and B for values for V^{3+} (oct) and Ni^{2+} (oct) complexes – charge transfer spectra. Magnetic properties of transition metal complexes, origin of magnetism, orbital magnetic moments and spin magnetic moment, diamagnetism, paramagnetism, ferromagnetism, anti-ferromagnetism.	10
Unit III	**Reactions of coordination compounds-I** Ligand substitution reactions in octahedral complexes, labile and inert complexes – types and mechanism of substitution reactions – SN_1 and SN_2 type mechanisms – acid hydrolysis reaction – simple acid hydrolysis type and catalysed aquation type, base hydrolysis reaction –	10

	SN_2 and SN_1CB mechanism – anation reactions. Ligand substitution reactions in square planar complexes – trans effect – trans directing series – theories of trans effect – applications of trans effect.	
Unit IV	**Reactions mechanism of coordination compounds-II** Stability constants – step-wise and overall stability constants, relation between step-wise formation constants and overall formation constants, methods of determination of stability constants (Potentiometric and spectrophotometric methods). Electron transfer reactions – mechanism of electron transfer reactions – outer sphere and inner sphere mechanisms, factors influencing outer sphere mechanism, complimentary and non - complimentary reactions.	11
Unit V	**Acid base concept** Lewis concept of acids and bases, relative strength of acids and bases – generalized acid base concept for cations and anions, hard and soft acids and bases – Pearson concept, HSAB principle and its applications, symbiosis, Lux-Flood concept. Non aqueous solvents – classification of solvents – characteristic properties of a solvent – liquid ammonia – anhydrous HF, liquid SO_2 and molten salts as non aqueous solvents.	10
	Total hours/Semester	**52**
Text Books	1. Gurdeep Raj. (2014). *Advanced inorganic Chemistry*. 12th Edition. Geol Publishing House 2. Madan. R.D. (2011). *Advanced Inorganic Chemistry*. 3rd Edition. S. Chand & company, New Delhi. 3. Malik, U.K, Tuli, G.D & Madan, R.D (2010) *Selected Topics in Inorganic Chemistry*, S. Chand Publication.	
Reference Books	1. Keith F. Purcell, John. C. Kotz. (1980). *Inorganic chemistry*, Holt-Saunders International Editions 2. James E. Huheey. (1997). *Inorganic chemistry Principles of structure and reactivity*, 4th Edition. Pearson India Limited. 3. Basolo, F. & Pearson. R.G. (1967) *Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution*. Wiley Eastern Limited.	

Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	Effective from the year: 2015-16 onwards
Subject code	15PCY312	Semester: III
Title	Physical Chemistry - II	
Hrs/Week	4	Credit: 4
Objectives	• To enable a comprehensive knowledge on quantum mechanics to the students. • To give a thorough introduction to the study of electrochemistry. • To understand quantum theory, Schrödinger equation, approximation methods, theories of double layer and electrophoresis.	
Unit	Content	Hrs
Unit I	**Chemical Thermodynamics:** A general review of enthalpy, entropy and free energy concepts, thermodynamics of systems of variable compositions-partial molar quantities and their determination-chemical potential-Gibbs Duhem equation-Duhem Margules equation-fugacity and its determinations-activity and activity coefficients- determination of solvent activity by vapour pressure method, cryoscopic method. Equilibrium Thermodynamics- Gibbs Phase rule and its application to two component simple eutectic systems - three component systems.	10
Unit II	**Third law & Statistical Thermodynamics-I**: 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. Quantum statistics: Maxwell-Boltzmann statistics. 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.	11
Unit III	**Statistical Thermodynamics-II:** Quantum statistics: Distribution laws- Lagrangians undetermined multiplier factor- Maxwell-Boltzmann distribution law - Evaluation of alpha and beta in M.B. distribution law - Bose-Einstein distribution law - Entropy of Bose-Einstein gas, Plank distribution law	11

	for black-body radiation –Bose Einstein Condensation- Fermi-Dirac distribution law - Entropy of a Fermi-Dirac gas, Heat capacity of the electron gas and the heat capacity of metals, Negative absolute temperature. Heat capacities of solids: Einstein's and Debye's theories of heat capacities of solids.	
Unit IV	**Statistical Thermodynamics-III:** Partition function – definition, justification of nomenclature, micro canonical and canonical ensembles. Equipartition principle. Molecular partition function and canonical partition function. The relation between the total partition function of a molecule and the separate partition function. Translational partition function, rotational partition function, Vibrational partition function, Electronic partition function. Effect of molecular symmetry on rotational partition function, Ortho and Para hydrogen, Evaluation of thermodynamic properties E, H, S, A, G, Cp and Cv from monoatomic and diatomic ideal gas molecule partition functions. Thermodynamic properties of polyatomic ideal gases, Calculation of equilibrium constants of reactions involving ideal gases from partition functions.	**10**
Unit V	**Fundamentals of Photochemistry:** 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.	**10**
	Total hours/Semester	**52**
Text Books	1. Puri B.R & Sharma. L R. (2009) *Advanced Physical Chemistry*, 2nd Edition., Milestone Publishers & Distributors 2. Gupta, M.C. (1990) *Statistical thermodynamics* Wiley Eastern Limited. 3. Rajaram Kuriacose (2006) *Statistical thermodynamics*, 4th edition Shoban lal & Co. 4. Bajpai, D.N. (1992) *Advanced Physical Chemistry,* S. Chand Publishing Limited. 5. Rohatgi, Mukherjee. K.K. (1992). *Fundamentals of Photochemistry* Wiley eastern limited.	
Reference Books	1. Klotz, L. M, Rosenberg R.M. & Benjamin, W.A. (1974) Chemical thermodynamics, 3rd Edition Pearson publications. 2. Glasstone, (1964). *Thermodynamics for chemists* 2nd Edition, Van Nostrands (1964). 3.Nash, L.K. (1976) *Chemical Thermodynamics* 2nd Edition, Addision Wesley Publishing.	

Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	Effective from the year: 2015-16 onwards
Subject code	15PCY313	Semester: III
Title	Major Elective Course – 1I Physical Methods in Chemistry	
Hrs/Week	5	Credit: 5
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 • To gain knowledge in ESR and Mossbauer spectroscopy, AAS and polarimetry	
Unit	Content	Hrs
Unit I	**Error analysis:** 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, student's t-values for various probability levels and varying degrees of freedom, tests of significance - t-test and f-test -minimization of errors- significant figures, rounding off the numerical expressions, reporting of analytical data.	13
Unit II	**Chromatographic methods**: 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.	13
Unit III	**Thermal analysis** 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.	13

Unit IV	**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- Doppler effect, Isomer shift – quadruple interactions – magnetic interactions – applications.	**13**
Unit V	**Solid state Chemistry:** Solid state and Chemical Crystallography – Diffraction methods – X-ray – Structure of NaCl , KCl and CsCl – Determination of lattice type and unit Cell dimensions – Power Camera – indexing the powder pattern – An elementary discussion of structural factors and scattering factor – Structures of rutile , fluorite , Antifluorite , zinc blende ,wurtzite , diamond and graphite.	**13**
	Total hours/Semester	**65**
Text Books	1. Gurdeep R. Chatwal & Anand, S.K. (2003) *Instrumental Methods of Chemical Analysis*, Himalaya Publishing House. 2. Sharma, B.K. (1999) *Instrumental methods of Chemical analysis*, 18th Edition. Goel Publishing house	
Reference Books	1. Skoog, D.A. West, D.M, Holder F.J & Grouch, S.R. *Analytical chemistry an Introduction*, 6th Edition, Saunders College publishing 2. Willard, H.H, Merrit L.L & Dean, J.A. *Instrumental method of analysis*, 7th Edition, CBS Publishers & Distributors. 3. Drago, R.S.(1964) Physical methods in Inorganic chemistry, 1st Edition, W. B. Saunders Company	

Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	Effective from the year: 2015-16 onwards
Subject code	15PCY414	Semester: IV
Title	Inorganic Chemistry -III	
Hrs/Week	5	Credit: 4
Objectives	• To allow the students to get introduced to the study of organometallic complexes. • To acquire 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	Content	Hrs
Unit I	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. Complexes of molecular nitrogen and oxygen (synthesis and reactions)	10
Unit II	Synthesis, reactions, bonding and structure in metal alkyl, alkene, alkyne, allyl and dienyls complexes. carbocyclic pi compounds. Synthesis, reactions, bonding and structure of cyclopentadienyl complexes (Ferrocene) arene complexes (Di benzene Chromium) complexes formed by 7 and 8 member aromatic rings.	10
Unit III	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 (2005 Nobel prize) – isomerisation of alkenes – hydrogenation (Wilkinson's catalyst) – hydroformylation and hydrosilation of alkenes.	11
Unit IV	Carbonalization of methanol and methyl acteate- Mechanism of Zieglar Natta's Polymerization- Photochemical water splliting- Monsato acetic acid synthesis- Oxo process (Sodium, Cobalt complex system) Reppe's synthesis- Nickel based catalyst, Vaska Process, Ruthenium complexes in solar energy, Types of coupling reactions- Suzuki Miyara coupling (Pd, C-C coupling)	10
Unit V	Bioinorganic chemistry metal ions in biology – metalloporphyrins (heme and non-heme proteins) – cytochromes, heomoglobin, myoglobin, chlorophyll, ferridoxins, rubredoxins,	11

	enzymes- Vitamin B_{12} and B_{12} coenzymes (structure and functions) – nitrogen fixation (invitro and invivo) – Metallo drugs for cancer theraphy (Types of theraphy)	
	Total hours/Semester	52
Text Books	1. Gurdeep Raj. (2014). *Advanced inorganic Chemistry*. 12th Edition. Geol Publishing House 2. Madan. R.D. (2011). *Advanced Inorganic Chemistry*. 3rd Edition. S. Chand & company, New Delhi. 3. Malik, U.K, Tuli, G.D & Madan, R.D (2010) *Selected Topics in Inorganic Chemistry*, S. Chand Publication.	
Reference Books	1. Keith F. Purcell, John. C. Kotz. (1980). *Inorganic chemistry*, Holt-Saunders International Editions 2. James E. Huheey. (1997). *Inorganic chemistry Principles of structure and reactivity*, 4th Edition. Pearson India Limited. 3. Basolo, F. & Pearson. R.G. (1967) *Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution*. Wiley Eastern Limited. 4. Bertini. I (2007) *Biological Inorganic Chemistry*, University Science Books.	

Department	CHEMISTRY	
Course :	**M.Sc., CHEMISTRY**	**Effective from the year: 2015-16 onwards**
Subject code	**15PCY415**	**Semester :IV**
Title	**Physical Chemistry -III**	
Hrs/Week	**5**	**Credit: 4**
Objectives	• To give a thorough introduction to the study of electrochemistry • To learn about rate and order of the various reactions • To know about the various isoterms	
Unit	**Content**	**Hrs**
Unit I	**Electrochemistry-I:** 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, the dynamics of electron transfer - Butler-Volmer equation, electrophoresis and electro osmosis.	10
Unit II	**Electrochemistry-II:** 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.	10
Unit III	**Chemical Kinetics-I:** 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.	10

	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 effect.	
Unit IV	**Chemical Kinetics-II:** 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 chemisorption. – 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	11
Unit V	**Polymer Kinetics**: 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.	11
	Total hours/Semester	52
Text Books	1. Puri B.R & Sharma. L R. (2009) *Advanced Physical Chemistry*, 2nd Edition., Milestone Publishers & Distributors 2. Bajpai, D.N. (1992) *Advanced Physical Chemistry,* S. Chand Publishing Limited. 3. Laidler. K. J (1987) *Chemical Kinetics* 3rd Edition. Pearson Education India. 4. Kalidas. C. (2005) *Chemical Kinetic Methods: Principles of Fast Reaction Techniques And Applications,* New Age International. 5. Gurudeep Raj (2014) *Chemical kinetics*, Krishna Educational Publishers.	
Reference Books	1. Jeffery, J. Bassett, G.H, Mendham, J & Denney, R.C (1989) Vogel's *Textbook of Quantitative Chemical Analysis*. 5th edition Longman Scientific & Technical. 2. John O' M. Bockris, Amulya K.N. Reddy, Maria Gamboa-Aldeco, Maria E. Gamboa- Aldeco *Modern Electrochemistry*, Volume 2, Part 1 2nd Edition Springer International.	

Department	CHEMISTRY	
Course :	**M.Sc., CHEMISTRY**	**Effective from the year: 2015-16 onwards**
Subject code	**15PCY416**	**Semester: IV**
Title	**Major Elective –III** **Water Pollution and Industrial Effluents treatment**	
Hrs/Week	**5**	**Credit: 5**
Objectives	• To have a good knowledge of water, air and soil pollutants • Basic ideas about various water treatment techniques	
Unit	**Content**	**Hrs**
Unit I	Characteristics of water – Introduction – sources of water – Hardness of water - Units of hardness – problems on calculation of hardness – Disadvantages of hard water – Scale and sludge formation in boiler – Boiler Corrosion - Softening methods – problems on softening – desalination of Brackish water: Distillation, Electro dialysis and reverse osmosis.	**13**
Unit II	Water Pollution: Introduction – Definition of water pollution – water Pollutants – physical and chemical pollution of water – ground water pollution – harmful effects of ground water pollution – surface water. River water and sea water pollution, Oil pollution of water. Effects oil pollution in marine water – Radioactive materials in water.	**13**
Unit III	Complete physico chemical Examination of water: collection of samples – colour – odour Turbidity pH – temperature – Soilds: Total Solids, Dissolved solids, suspended solids, settable solids – Acidity – Free carbon dioxide – Alkalinity – Hardness – calcium,Magnesium, Sodium - Potassium - Iron – Aluminum – Sulphate – Silica – Heavy metal such as Arsenic, Calcium, chromium – copper – lead - Manganese – Mercury – Nickle – Selenium – Tin and Zinc – Dissolved Oxygen, BOD, COD, Permanganate value – Ammonia Nitrogen – Albuminoidal nitrogen – Total Kjeldhal Nitrogen etc.	**13**
Unit IV	Industrial Effluents: Pulp and paper industries Cotton Processing – Cane sugar industry - Distillery –Dairy– Iron production. Electroplating industry – oil field and oil refinery – Fertilizer industry - Pesticide manufacture - Rubber wastes – Slaughter House and Meat packing – Soaps and Detergents manufacture - Soft Drinks Manufactures. Viscose rayon Manufacture – Radio active Pollution.	**13**

Unit V	Treatment of Industrial Effluents: Primary Treatment: Screening – Sedimentation – Equalization – Neutralization – Coagulation. Secondary Treatment: Aerated Lagoons – Trickling Filtration – Activated sludge process – Oxidation. Ditch – Oxidation Ponds - Anaerobic digestion. Tertiary Treatment: Evaporation – Reverse osmosis – Dialysis – Ion Exchange – chemical precipitation Activated Carbon Treatment. Tolerance limits for Industrial Effluents.	**13**
	Total hours/Semester	**65**
Text Books	1. Agarwal. S.K. (2005) *Water Pollution,* APH Publishing 2. Chakrabarty, B.N. (1981) *Industrial Chemistry*, Oxford & IBH Publishing Co., New Delhi. 3.Singh, P.P. Joseph, T.M. Dhavale, R.G (1983) *College Industrial Chemistry*, Himalaya Publishing House, Bombay, 4th Edition 4. De. A.K. (1989) *Environmental Chemistry*, 11th Edition, Wiley Eastern Ltd. Meerut	
Reference Books	1. Mukhlyonov. I(1979) *Chemical Technology*, , Moscow, 3rd Edition. Mir publication 2. Norris Shreve. R &. Brink, J.A (1977) *Chemical Process Industries.* 4th Edition. McGraw Hill, Tokyo	

Department	CHEMISTRY	
Course :	**M.Sc., CHEMISTRY**	**Effective from the year: 2015-16 onwards**
Subject code	**15PCY417**	**Semester: III & IV**
Title	**Organic Chemistry Practical-II**	
Hrs/Week	**4**	**Credit: 3**
Objectives	• To attain knowledge in estimating organic compounds quantitatively. • To learn and practice the methods of preparation of some organic compounds	
Unit	**Content**	**Hrs**
	A. Quantitative estimations: Estimation of phenol, aniline, ethyl methyl ketone, Glucose (iodimetry method and Bertrand's method). **B. 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 or from a natural source. **D. Analysis of oil:** (Not for ESE examination) Reichart – Meisel value, soponification value and acetyl value.	
	Total hours/Semester	**52**
Reference Books	1. B.B. Day and M.V. Sitaram and T.R. Govindachari, Laboratory Manual of Organic Chemistry, Allied Publishers Limited. 2. Gnanprakasam and Ramamurthy, Organic Chemistry Laboratory Manual Ananda Book Depot, Chennai. 3. Jagmohan, Advanced Practical Organic Chemistry Vol. I & II	

Distribution 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

Department	CHEMISTRY	
Course :	**M.Sc., CHEMISTRY**	**Effective from the year: 2015-16 onwards**
Subject code	**15PCY418**	**Semester: III & IV**
Title	**Inorganic Chemistry Practical-II**	
Hrs/Week	**4**	**Credit: 3**
Objectives	• To get an idea about the industrial analysis of alloys. • To know and apply the principle of complexometric titration. • To understand some chromatographic techniques. • To get an idea about the quantitative analysis of mixture of cations using volumetric and gravimetric principles.	
Unit	**Content**	**Hrs**
	A. Industrial analysis: (Not for ESE) Analysis of any two of the following alloys Brass, Bronze, Stainless steel, Solder & Type metal. **B. Titrimetry:** Complexometric titration involving EDTA. Estimation of Calcium, Magnesium, Nickel, Zinc and Hardness of water **C. Chromatography**: Column, Paper, thin layer and ion – exchange. (Demonstration only) **D. Preparation**: Analysis and study of the properties of at least five coordination Complexes (single stage / two stage preparations) **E. Quantitative estimation**: Mixture of cations involving volumetric and gravimetric estimation: Copper & Nickel, Iron & Nickel, Iron & Magnesium and Calcium & Barium	
	Total hours/Semester	**52**
Reference Books	1. Venkateswaran, V. Veeraswamy., R and. Kulandaivelu, A.R (1997) *Principles of Practical Chemistry* 2nd Edition 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

Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	Effective from the year: 2015-16 onwards
Subject code	15PCY419	Semester: III & IV
Title	Physical Chemistry Practical - II	
Hrs/Week	4	Credit: 4
Objectives	• To arm the future chemist with the knowledge of electrical conductance measurement and conductometric titrations. • To gain knowledge to make and record observations on conductometric titrations and chemical kinetics.	
Unit	Content	Hrs
	Electrical Conductance measurements 1. Determination of cell constant 2. Verification of Debye-Huckel Onsager equation 3. Ostwald's dilution law 4. Verification of Kohlrausch's law 5. Solubility Product of sparingly soluble salt **Conductometric Titrations** ***Acid-Base titrations*** 6. Strong Base Vs Weak Acid 7. Strong Base Vs Mixture of (weak and strong) Acids ***Precipitation titrations*** 8. $AgNO_3$ Vs mixture of halides (KCl & KI) 9. $BaCl_2$ Vs $MgSO_4$ 10. Buffer Vs Strong acid **Chemical Kinetics** 11. Acid hydrolysis of an ester – Relative strength of acids 12. Reaction kinetics of KI and $K_2S_2O_8$ 13. Iodination of acetone **Adsorption** 14. Adsorption of oxalic acid on charcoal	
	Total hours/Semester	52
Reference Books	1. Palit S.R. and De S.K. Practical Physical Chemistry, Science Book Agency, Calcutta 2. Sharma P.C. and Agarwal, Practical Chemistry, Goel Publishing House, Meerut. 3. Venkateswaran and Kulaindaivelu, Practical Physical Chemistry S. Chand & Co 4. Yadav, J.B. 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	**15PCY420**	Project Work & Viva-Voce

Credits: 8

Component for Project:

CIA / ESE	Particulars	Project Out of 200 Marks
CIA	Literature Review & Presentation	40
	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

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

Theory

Maximum marks 75

Section – A (10 X 1 = 10 marks)
Q.No.1 to 5: Multiple choice Questions with four choices,one question from each unit
Q.No.6 to 10: Short answer –one question from each unit

Section – B (5 X 5 = 25 marks)
Q.No.11 to 15: either or type questions (one question 'a' or 'b' from each unit)

Section – C (5 X 8 = 40 marks)
Q.No.16 to 20: either or type questions (one question 'a' or 'b' from each unit)
Section-C One of the questions shall be application oriented question (or) a problem.

QUESTION PAPER PATTERN FOR **ESE**
(Non-Major elective)

Maximum marks 100

Section – A (10 X 1 = 10 marks)
Q.No.1 to 5: Multiple choice Questions with four choices,one question from each unit
Q.No.6 to 10: Short answer –one question from each unit

Section – B (5 X 6 = 30 marks)
Q.No.11 to 15: either or type questions (one question 'a' or 'b' from each unit)

Section – C (5 X 12 = 60 marks)
Q.No.16 to 20: either or type questions (one question 'a' or 'b' from each unit)
Section-C One of the questions shall be application oriented question (or) a problem

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