PG DEPARTMENT OF CHEMISTRY

SYLLABUS
2016-2018 BATCH

FACULTY MEMBERS

Dr. K. POONKODI, M.Sc.,M.Phil.,Ph.D.
Dr. S. SOUNDARAYA, M.Sc., Ph.D.
Ms. K. VIMALADEVI, M.Sc.,M.Phil.,
Ms. R. MINI, M.Sc.,M.Phil.,
Ms. M.RUBINI, M.Sc.,

NGM COLLEGE (Autonomous)
Affiliated to Bharathiar University
Re-Accredited with 'A' grade by NAAC & ISO 9001:2008 certified
90, Palghat road, Pollachi- 642001, Coimbatore (Dist)
Phone: 04259-234868. 234870 Fax: 04259-234869
Website: www.ngmc.org

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
II-M.Sc., Chemistry
(2016-18 Batch)

Semester	Course Code	Title of the Paper	Hrs / Week	Hrs / Exam	Max. Marks			Credits
					Intl.	E.S.E	Total	
I	16PCY101	Inorganic Chemistry –I	5	3	25	75	100	5
	16PCY102	Organic Chemistry –I	5	3	25	75	100	5
	16PCY103	Physical Chemistry –I	5	3	25	75	100	5
	16PCY207	Inorganic Chemistry Practical-I	5	--	--	--	--	--
	16PCY208	Onorganic Chemistry Practical-I	5	--	--	--	--	--
	16PCY209	Physical Chemistry Practical I	5	--	--	--	--	--
II	16PCY204	Inorganic Chemistry –II	5	3	25	75	100	5
	16PCY205	Organic Chemistry-II	5	3	25	75	100	5
	16PCY206	Physical Chemistry-II	5	3	25	75	100	5
	16PCY2N1/ 16PCY2N2	Non-Major Elective: Chemistry in day today life / Chemistry in context	1	3	--	100	100	2
	16PCY207	Inorganic Chemistry Practical –I	5	6	40	60	100	3
	16PCY208	Organic Chemistry Practical -I	5	6	40	60	100	3
	16PCY209	Physical Chemistry Practical –I	4	6	40	60	100	4
III	16PCY310	Organic Chemistry –III	5	3	25	75	100	4
	16PCY3E1	Major Elective-I - Spectroscopy	3	3	25	75	100	4
	16PCY311	Physical Chemistry – III	5	3	25	75	100	4
	16PCY3E2	Major Elective –II – Green and Nano chemistry	5	3	25	75	100	4
	16PCY414	Inrganic Chemistry Practical –II	3	--	--	--	--	--
	16PCY415	Organic Chemistry Practical –II	3	--	--	--	--	--
	16PCY416	Physical Chemistry Practical -II	4	--	--	--	--	--
	16PCY417	Project Work	2	--		--	--	--
IV	16PCY412	Inorganic Chemistry –III	5	3	25	75	100	4
	16PCY4E3	Major Elective –III – Applied electrochemistry	5	3	25	75	100	5
	16PCY413	Physical Methods in Chemistry	5	3	25	75	100	5
	16PCY414	Inrganic Chemistry Practical -II	4	6	40	60	100	3
	16PCY415	Organic Chemistry Practical -II	4	6	40	60	100	3
	16PCY416	Physical Chemistry Practical -II	4	6	40	60	100	4
	16PCY417	Project Work & Viva-Voce	3	--	40	160	200	8
Total							2200	90

Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	2016-17 Batch
Subject code	16PCY101	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** The nuclues-subatomic particles and their properties –binding energy- N-P ratio in stable and metastable nucluei-different types of nuclear forces-liquid drop model-shell model-mode of radioactive decay-α,β,γ decay – electron capture-nuclear isomerism-internal converstion. 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 particles- photo fission. Nuclear energy sources: Nuclear fission as the source of energy, Principles of nuclear reactor, Classification of nuclear reactors-Homogeneous thermal reactors- enriched uranium graphite reactors-stellar energy- thermonuclear reactions on the earth. Radioisotopes as tracers- Identification of reaction mechanism-analytical applications- medical and agricultural applications- Dating by ^{14}C isotope.	13
Unit V	**Modern concepts of Acids and bases** Acid-Base concepts: Arrehenius concept, Bronsted-Lowry concept, Levelling solvents, Lux-Flood concepts, Cady-Elsey concept, Lewis Concept, Usanovich concept, HSAB principle- Limitaions and Applications	13

	Non aqueous solvents- Levelling effects, Classification of solvents, Characteristic properties of ionizing solvents- Liquid ammonia, Liquid. HF, Liquid HCN, Liquid SO_2	
	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.	

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Department	CHEMISTRY	
Course :	**M.Sc., CHEMISTRY**	**2016-17 Batch**
Subject code	**16PCY102**	**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:** 1.Introduction- Criteria, Non-benzenoid aromatics – annulenes, Azulenes and ferrocenes (synthesis not necessary). Anti-aromatic and non aromatic compounds – Homoaromaticity. 2. Kinetic and nonkinetic methods of study of reaction mechanisms - Primary and secondary kinetic isotopic effects, non-kinetic methods of study of reaction mechanism — study of intermediates, isotopic labeling, stereochemical studies and cross over experiments. Hammond's postulate. Kinetic and thermodynamic control. 3. Linear free energy relationship — Hammett equation (Taft equation not necessary).	13
Unit II	**Aromatic electrophilic substitution reactions:** Aromatic electrophilic substitution reactions: Mechanism- such as halogenation, nitration, sulphonation- orientation and reactivity in mono substituted benzene rings. Activating and deactivating groups. Ortho/para ratio- *ipso* attack, orientation in disubstituted benzene rings. Typical reactions such as Friedel Crafts alkylation & acylation, Reimer- Tiemann, Vilsmeier- Haack reaction, Hofmann-Martius and Jacobsons reaction	13
Unit III	**Aliphatic nucleephilic substitution reactions and mechanisms:** SN_1, SN_2, SNi mechanisms. Factors affecting nucleephilic substitution reaction- nature of the substrate, solvent, nucleophile and leaving group, neighbouring group participation. Ambident nucleophiles and ambident substrates. Substitution at vinyl carbon and allylic carbon. Typical substitution reactions-Von Braun reaction, Claisen condensation and hydrolysis of esters ($A_{Ac}2$, $A_{Ac}1$, $B_{Ac}2$, $B_{Al}1$ only). SNAr, Benzyne mechanism, Zigler alkylation and Chichibabin reaction.	13
Unit IV	**Elimination reactions:** El, E2, Ei, E1CB mechanisms, Hoffman and Sayetzeff rules, Stereochemistry of elimination reactions. Elimination Vs substitution.	13

	Typical elimination reactions- Chugaev reaction, Hofmann degradation and Cope elimination. Carbenes and nitrenes -structure, generation and reactions.	
Unit V	**Free radical reactions:** Introduction, Types of free radicals, Generations of long lived and short lived free radicals, Stability of free radicals, Detection of free radicals, Characteristics of free radical reactions- addition and rearrangement reactions. Typical reactions-Sandmeyar, Gomberg, 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.	

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Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	2016-17 Batch
Subject code	16PCY103	Semester: I
Title	Physical Chemistry -I	
Hrs/Week	5	Credit: 5
Objectives	• To give a thorough introduction to the study of group theory. • To learn about Rate and order of the various reactions. • To Know about the various isotherms.	
Unit	Content	Hrs
Unit I	**Group theory-I**: Symmetry elements and symmetry operations – identity element – centre of symmetry – reflections symmetry planes- inversion center proper and improper rotation 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– matrix representations of symmetry operations.	13
Unit II	**Group theory-II:** Representation of point groups- Definition, types (reducible and irreducible representations) the Great orthogonality theorem, (proof not needed) –Character tables-construction of the character table for C_{2v} and C_{3v} point groups. Group theory and vibrational spectroscopy – Direct product representation- symmetry selection rule for IR, Raman spectra and rotational spectroscopy, Infrared spectralactivity of vibrational modes in NH_3 molecules, mutual exclusion principle, classification of vibrational modes. Application of group theory to bonding: hybridization scheme for orbital in, AB_4 (T_d, CH_4), AB_5 (D_{3h} $Fe(CO)_5$) and AB_6 (O_h $[Co(NH_3)_6]^{3+}$)	13
Unit III	**Chemical Kinetics-I:** Theories of reaction rates – Arrhenius theory, Collision theory-Classical Collision theory, Modified Collision theory, Causes of weaknesses of the Collision theory. Absolute reaction rate or Transition state theory- Statistical mechanical derivation of the rate equation- Thermodynamical formulation of reaction rate,	13

	Comparison of Collision theory and absolute reaction rate theory. Kinetics in liquid solution- Collision in solution, Salt effect – primary salt and secondary salt effects, significance of salt effect. Effect of pressure on rates of reactions in solutions, Linear Free Energy Relationship (LFER) - Hammett equations, Secondary Isotope effects and Solvent isotope effects.	
Unit IV	**Chemical Kinetics-II:** Theories of Unimolecular reaction: Lindemanns Theory, Hinselwood Theory,Kassel and Rice and Ramsperger Theory, The RRKM method, the Slater treatment. Experiment method to study of Fast reactions- Shock tubes and Pulse radiolysis Techniques. Surface phenomenon and heterogenous catalysis: Physisorption and Chemisorption. – Adsorption isotherms - Langmuir, Freundlich and BET adsorption isotherm, Measurement of surface area – kinetics of Heterogeneous catalysis - Langmuir-Hinshelwood, Rideal-Eley mechanisms.	13
Unit V	**Polymer Kinetics**: Classification of polymers- 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 and chain polymerization (derivation of rate equation, kinetic chain length and degree of polymerization), Process of polymerization- bulk, solution, suspension and emulsion.	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. Gurudeep Raj (2014). *Chemical kinetics*, Krishna Educational Publishers. 4. Kalidas. C. (2005) *Chemical Kinetic Methods: Principles of Fast Reaction Techniques And Applications*, New Age International.	
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 Cotton, F.A. (1990) *Chemical applications of group theory*, 3rd Edition, A Wiley Interscience Publication. 3. Laidler. K. J (1987) *Chemical Kinetics* 3rd Edition. Pearson Education India.	

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Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	2016-17 Batch
Subject code	16PCY204	Semester: II
Title	Inorganic Chemistry - II	
Hrs/Week	4	Credit: 5
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, square planar and tetrahedral complexes, strong and weak ligands – spectrochemical series -high and low spin complexes- Factors affecting delta- distorted of octahedral complexes – Jahn-Teller effect – CFSE and its applications – Failures of CFT, Comparison of Valence bond and CFT Ligand Field theory (LFT) – Formation of molecular orbitals in octahedral complexes, pi bonding in octahedral complexes, Spectrochemical series, Application of LFT in Coordination compounds.	11
Unit II	**Electronic spectra of the complexes** Introduction, selection rules for electronic transitions, Band width and shapes, Charge transfer spectra, Effect of Jahn-Teller distortion and spin orbit coupling on spectra – Nephelauxetic effect – Orgel diagrams for d^1, d^2 and d^4 systems – Tanabe-Sugano diagrams (d^2 and d^5 systems only) - calculation of 10Dq and B for values for V^{3+} (oct) and Ni^{2+} (oct) complexes . Magnetic properties of transition metal complexes, Magnetic Susceptiblity: Measuremnt by Gouy and Curie methods. orbital magnetic moments and spin magnetic moment, diamagnetism, paramagnetism, ferromagnetism, anti-ferromagnetism.	10
Unit III	Synthesis, reactions, bonding and structure in metal alkyl, alkene, alkyne, allyl and dienyls complexes. carbocyclic pi compounds. Preparation, properties, Structure and Bonding in cyclopentadienyl complexes (Ferrocene) arene complexes (Di benzene Chromium) Cyclo hepta trienyl complexes.	10
Unit IV	**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- catalysed aquation type, base hydrolysis reaction – SN_2 and SN_1CB mechanism – anation reactions. Ligand substitution reactions in square planar complexes – Trans effect – Trans effect series – theories of trans effect (pi- bonding and Electrostatic polarization theory- Uses of trans effect.	11

Unit V	**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 in coordination compounds – mechanism of electron transfer reactions – outer sphere and inner sphere mechanisms, factors influencing outer sphere mechanism, complimentary and non -complimentary electron transfer reactions.	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.	

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Department	CHEMISTRY	
Course :	**M.Sc., CHEMISTRY**	**2016-17 Batch**
Subject code	**16PCY205**	**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, Dienone phenol, Wolf, Favorski Neber rearrangement, Baeyer-Villiger rearrangement, Stevens, Chapman, Benzidine, Fries, Ardnt Eister Synthesis Lossen and Wallac rearrangements.	10
Unit II	**Organic photochemistry:** Laws of photochemistry: Beer-Lambert, Grothus-Draper laws, electronic excitation, Excited states, Energy transfer, quantum efficiency, Jablonski diagram, chemical actinometry, photosensitization, photochemistry of carbonyl compounds-Photoreduction, Norrish type I and type II reactions, Patterno-Buchi reaction, Photochemistry of olefins- Cis and trans isomerization. Dimerization reactions.	11
Unit III	**Pericyclic reactions:** Conservation of molecular orbital symmetry. Symmetry properties of molecular orbital's. Electrocyclic reactions – 1,3-diene and 1,3,5-triene systems, correlation diagram and FMO method, Woodward-Hoffman selection rule for Electrocyclic reactions. Cycloadditions reactions: Correlation diagram and FMO approach, $\pi 2s + \pi 2s$, $\pi 2s + \pi 4s$ (Diels-Alder reaction) systems. Woodward-Hoffman selection rule for cycloaddition reactions Sigmatropic rearrangements- analysis of sigmatropic rearrangements by FMO method, 1,3 & 1,5 sigmatropic rearrangements, other sigmatropic shifts- Cope and Claisen rearrangements.Woodward-Hoffman selection rule for sigmatropic rearrangements.	10
Unit IV	**Addition Reactions:** Electrophilic and nucleophilic, Addition to double and triple bonds- hydration, hydroxylation, Michael addition, hydroboration and epoxidation. Addition to carbonyl compounds-michael additions. **Condensation reactions:** Benzoin, Dieckmann, Darzen, Knovenagal, Mannich, stobbe, Thorpe and Wittig reactions.	10

Unit V	**Stereochemistry:** Configurational & conformational isomerism- Molecular representation (Fischer, Newmann and Sawhorse projection formula) optical isomerism in nitrogen compounds (Amines and Quaternary ammonium salts) and sulphur compounds (Sulphoxides and Sulphonium salts) Configurational nomenclature: D & L, R & S and E& Z systems. Conformations of ethane, 1,2 disubstituted ethanes, aldohexopyranose (Glucose). Configurations and confirmations of cyclohexanes, mono and disubstituted cyclohexanes. Configurations and confirmations of fused polycyclic systems-decalin, perhydrophenanthrene. Stereo selective and stereospecific reactions.	11
	Total hours/Semester	52
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.	

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Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	2016-17 Batch
Subject code	16PCY206	Semester: II
Title	Physical Chemistry - II	
Hrs/Week	5	Credit: 5
Objectives	• To motivate the students to comprehend a knowledge on quantum mechanics • To learn the concepts of electro chemistry.	
Unit	Content	Hrs
Unit I	**Electrochemistry-I:** Debye-Huckel-Onsager equation-Falkenhagen effect, Wien effect, activity and activity co-efficient, ionic strength, Debye-Huckel limiting law and its verifications. 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:** Voltametry, Excitation signal in Voltametry, Cyclic voltammetry Polarography, 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, primary and secondary titrations – simple applications. Conductometric titrations: types, Advantages and disadvantages of conductometric titrations	10
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, 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) values.	10
Unit IV	**Quantum Chemistry-II:** Particle in a one-dimensional box, normalization and orthogonality, particle in a three-dimensional box, Characterization of wave functions, illustration of the uncertainty principle and correspondence principle with reference to the particle in a one-	11

	dimensional box, separation of variables, Electron in a ring, The rigid rotator. Solving of Schrodinger equation for a rigid rotor, Schrodinger equation for the H- atom (or H - like species) One dimensional harmonic oscillator model of a diatomic molecule, solving of Schrodinger equation for the one-dimensional harmonic oscillator, illustration of the uncertainty principle with reference to harmonic oscillator. Selection rule for harmonic oscillator.	
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 time independent perturbation theory (first order only), application of the perturbation method to hydrogen atom, Variation theorem, application of variation method to hydrogen atom, Born – Oppenheimer approximation, Treatment of the H_2^+ ground state by LCAO–MO method.	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.Chandra, A.K (1994) *Introductory Quantum Chemistry*, 3rd Edition, Tata McGraw Hill Publishing Company.	
Reference Books	1. Hanna. M (1969) *Quantum Mechanics in Chemistry*, 2nd Edition. Addison Wesley Longman. 2. Mcquarrie, D.A. (2008) *Quantum Chemistry*. 2nd Edition University Science Book. 3. John O' M. Bockris, Amulya K.N. Reddy, Maria Gamboa-Aldeco, Maria E. Gamboa- Aldeco (1986). *Modern Electrochemistry*, Volume 2, Part 1 2nd Edition Springer International.	

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Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	2016-17 Batch
Subject code	16PCY2N1	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 of materials of application in day today life. • To enable the student to understand about the manufacture of commercial products.	
Units	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. Ronald Bailey, Herbert Clark, James Ferris,Sonja Krause, Robert 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.	

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Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	2016-17 Batch
Subject code	16PCY2N2	Semester: II
Title	CHEMISTRY IN CONTEXT Non Major Elective-II	
Hrs/Week	1	Credit: 2
Objectives	• To enable the student to understand about ecological systems. • 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.	

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Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	2016-17 Batch
Subject code	16PCY207	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).	
	Total hours/Semester	**65**
Text Books	1.Ramanajum V.V, (1985) *Semimicro Qualitative Inorganic Analysis*. 2.VenkateswaranV.Veeraswamy R and Kulandaivelu A.R, (1997) *Principles of Practical Chemistry Sultan* Chand & Sons. 2nd Edition 3. Giri. S. Bajpai D.N. & Panday, O.P. (1990). *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

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Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	2016-17 Batch
Subject code	16PCY208	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.	
	Total hours/Semester	**65**
Reference Books	1. Gnanprakasam and Ramamurthy (1998). *Organic Chemistry Laboratory Manual*, Ananda Book Depot, Chennai. 2. Vishnoi N.K (2001). *Advanced Practical Organic Chemistry*, Vikas Publishing House,1992. 3. Jagmohan. R (2002). *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

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Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	2016-17 Batch
Subject code	16PCY209	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
	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 **D. Colorimetric Estimations** (using Photoelectric colorimeter) Estimation of Copper, Iron, Nickel, Manganese and Chromium.	
	Total hours/Semester	**65**
Text Books	1. Palit S.R and De S.K (2003) *Practical Physical Chemistry*, Science Book Agency, Calcutta. 2. Sharma P.C and Agarwal (1996). *Practical Chemistry*, Goel Publishing House, Meerut. 3. Venkateswaran Vand Kulaindaivelu A.R (1987). *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 -30 marks 2.Colorimetric Estimation - 15 3Record – 5 4. Viva-Voce - 10

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Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	2016-17 Batch
Subject code	16PCY310	Semester: III
Title	Organic Chemistry -III	
Hrs/Week	4	Credit: 4
Objectives	• To promote an awareness in the student about natural products and their synthesis • 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**.**	

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Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	2016-17 Batch
Subject code	16PCY3E1	Semester: III
Title	Major elective-I Spectroscopy	
Hrs/Week	4	Credit: 4
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	**IR Spectroscopy** Molecular vibrations-vibrational degrees of freedom-vibrational frequency-force constant- factors influencing vibrational frequencies -the simple harmonic oscillator- selection rules-vibrational frequency of SHO-Pattern of vibrational spectrum of SHO-complexity of spectrum-anharmonic oscillator- overtone and combination frequencies - finger print region - the diatomic rotator-vibration of polyatomic molecule (fundamental vibrations and their symmetry)-identification of functional groups- sampling techniques-applications of infrared to organic compounds.	10
Unit II	**UNIT – II** **UV and visible spectroscopy** Theory- Lambert law, Lambert-Beer's law – theory of electronic spectra of diatomic molecules.- types of electrons – types of electronic transitions-selection rule-transition probability-chromophore- auxochrome-intensity shifts-types of absorption bands-Born-Oppenheimer approximation- vibrational coarse structure-intensity of vibrational electronic spectra(Franck-Condon principle)-– dissociation energy(evaluation by Birge –Sponer method)-Rotational fine structure of electronic vibration spectrum- Fortrat diagram-predissociation-types of transition-Woodward-Fieser rules for calculating absorption maximum of dienes, polyenes and α, β-unsaturated ketones.	10
Unit III	**Mass Spectrometry** Basic principles- Theory of mass spectrum, instrumentation, double focusing mass spectrometer, ion source, mass analyzer, ion detector, Types of ions- Molecular ion or Parent ion, Fragment ion, Metastable ion, Molecular ion peak, Base peak and Metastable ion peak, Determination of molecular formula, Nitrogen Rule, Retro-Diels Alder Reaction, McLafferty rearrangement. General fragmentation modes Fragmentation associated with functional groups- Benzyl alcohol, Phenol, Methyl phenyl ether, Benzaldehyde, 2-hexanone, benzoic acid, n-propyl ethanoate, and benzamide.	11
Unit IV	**Nuclear Magnetic Resonance Spectroscopy -^{1}H NMR** Magnetic properties of nuclei – theory of nuclear resonance – Instrumentation –CW and FT NMR- Chemical shift and its measurement – Factors influencing chemical shift – Chemical equivalence and magnetic equivalence – solvents and NMR spectra –	11

	Spin –Spin coupling – Spin-Spin splitting systems – Proton exchange reactions – Heteronuclear coupling – Deuterium exchange – Double resonances – Chemical shift reagents – Nuclear Overhauser Effect (NOE)-Applications to organic and inorganic compounds.	
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, peak assignments using DEPT spectrum. 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 alcohols, amides, aliphatic aldehides and ketones.	**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.	

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Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	2016-17 Batch
Subject code	16PCY311	Semester: III
Title	Physical Chemistry -III	
Hrs/Week	4	Credit: 4
Objectives	• To enable a comprehensive knowledge on quantum mechanics to the students. • To understand quantum theory, Schrödinger equation, approximation methods, theories of double layer and electrophoresis.	
Unit	Content	Hrs
Unit I	**Themodynamics and Non-ideal systems:** Chemical potential and the definition of fugacity. Determination of fugacity of gases by graphical method and from equations of state. Variation of fugacity with temperature. fugacity and the standard state for non-ideal gases. Definition of activity. Activity coefficient. Temperature coefficient of activity. Standard states. Applications of activity concept to solutions. The rational and practical approaches. Measurement of activity of solvent from colligative properties. Determination of activity of solute.	10
Unit II	**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 exception. Mathematical Introduction: Theories of permutation & combination, Laws of probability. Distribution laws. Gaussian distribution.	11
Unit III	**Quantum statistics:** Maxwell - Boltzmann statistics. Thermodynamic probability. Thermodynamic probabilities of systems in equilibrium. Boltzrnann expression for entropy. Stirling's approximation. States of maximum thermodynamics probability. Legrangian multipliers, thermodynamic probabilities of systems involving energy levels. Maxwell - Boltzmann distribution law. Evaluation of alpha and beta in M.B. distribution law.	11
Unit IV	**Partition function**: Partition function - definition, justification of nomenclature, microcanonical and canonical ensembles. Molecular partition function and canonical function. The relation between the total partition function of a molecule and the separate partition functions. 'Translational partition function, rotational partition function. Effect of molecular symmetry on rotational partition function. Ortho and para hydrogen. Vibrational partition function. Electronic partition function. Evaluation of thermodynamic properties E, H, S, A, G, Cv and Cp from monoatomic and diatomic ideal gas molecule partition functions	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	10

	photophysical pathways-Fluorescence emission-Phosphorescence-Photophysical kinetics of unimolecular processes-Stern-Volmer equation-quenching-Delayed fluorescence-study of excited states – Flash photolysis.	
	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. 3.Nash, L.K. (1976). *Chemical Thermodynamics* 2nd Edition, Addision Wesley Publishing.	

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Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	2016-17 Batch
Subject code	16PCY3E2	Semester: III
Title	Major Elective – II GREEN AND NANO CHEMISTRY	
Hrs/Week	5	Credit: 4
Objectives	• To stimulate students to have in-depth knowledge in green chemistry. • To introduce the various type of greener reactions, materials. • To acquire a clear idea about various synthesis of nanomaterials and techiniques • To know about literature review, writing a project etc..	
Unit	Content	Hrs
Unit I	**Green Chemistry Principles** Definition, need of green chemistry, twelve basic principles of green chemistry-planning a green synthesis in a chemical laboratory-solvent-less reactions, selection of appropriate solvent, use of microwaves-fundamentals of closed-vessel heating and sonication. Atom efficient processes and atom efficiency, atom economy (with specific reaction).	10
Unit II	**Greener Reactions** – Water as greener solvent- reactions in ionic-liquid, solvent free reaction- solid supported organic synthesis, phase transfer catalyst (PTC), use of microwaves and sonication (any four specific reactions with mechanism).	10
Unit III	**Nano Science-** 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- Plasmon resonance. **Preparation of Nano Structured Materials** – Bottom up and Top down approaches- methods of preparation of nano materials – plasma arching, chemical vapour deposition, electrodeposition, sol-gel synthesis, ball-milling and use of natural nano particles.	10
Unit IV	**Chemical Synthesis of Nanomaterials** - 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), Scanning Tunnelling Microscopy (STM) and ESCA **Applications of Nanomaterials**- catalysis, environmental and biomedical (drug delivery) applications. Nanomaterials-environmental hazards.	11

Unit V	**Research Methodology**- problem selection- literature survey- primary sources-journals, patents, journals of different fields of chemistry (organic, inorganic, physical, polymer, analytical and nano) - secondary sources- books, indexes, chemical abstracts, review articles - literature searching online. Writing a project report – dissertation-style and conventions – title, abstract, introduction, review of literature, experiments, results and discussion, foot notes, figures, presenting data, tables, summary and bibliography.	**11**
	Total hours/Semester	**52**
Text Books	1. Pradeep.T (2007) *Nano The Essentials*, McGraw Hill Education (India) Pvt.Ltd. 2. Pradeep.T (2012) *Text Book of Nano science and Nanotechnology*, McGraw Hill Education (India) Pvt.Ltd. 3. Karkare. M, *Nanotechnology Fundamentals and Applications* (2008), K. International Pvt. Ltd. 4. Kothari. C.R, *Research Methodology* (2004) New Age International (P) Limited 5. Ahluwalia, V.K. & Kidwai. M, *New Trends in Green Chemistry* (2004) Springer Science &Business media. 6. Ahluwalia. V.K, *Green Chemistry (Environmental benign Reactions)* (2006) Ane Books Pvt. Ltd.	
Reference Books	1. Poole C.P & Owns F.J, Introduction to Nanotechnology (2003) John Wiley & Sons	

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Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	2016-17 Batch
Subject code	16PCY412	Semester: IV
Title	Inorganic Chemistry -III	
Hrs/Week	5	Credit: 5
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	**Homogeneous catalyst by organometallics:** Types of reactions in Homogeneous catalyst, Olefin Hydrogenation, olefin dimerization and metathesis, Monsanto acetic acid synthesis, Olefin Isomerization, Wacker Oxidation of alkenes, Hydroformylation, Water gas shift reaction, Template synthesis. Alkene hydrosilation, Acetic acid from ethylene. Zeise salt, Vaska complexes. Heterogeneous catalysis: Zieglar- Natta Catalysis	10
Unit III	**Inorganic Photochemistry and Insertion reactions** Introduction, $[Ru(bipy)_3]^{2+}$ complexes in solar energy, Photochemical reactions of metal carbonyls, Photolysis of water. Photochemistry of Metal beta diketonates. Photochemical reactionjs of metal Carbonyls. Insertion reaction- CO insertion and SO_2 insertion reactions, Insertion involving alkenes	11
Unit IV	**Bioinorganic chemistry:I** Essential and non-essential elements, Biochemistry of Sodium, potassium and chloride- The sodium-potassium pump, ATP cycle, Biochemistry of Calcium and Copper, Biological Function and toxicity of Some Elements (Cr, Mn, Co, Ni, Se, Mo, Cd, Pb)	10
Unit V	**Bioinorganic chemistry:II** Metalloporphyrins (heme and non-heme proteins) – cytochromes, heomoglobin, myoglobin, chlorophyll, ferridoxins, rubredoxins,- Vitamin B_{12} and B_{12} coenzymes (structure and functions) – nitrogen fixation (invitro and invivo) – Metallo enzymes: Carboxypeptidase , Cytochrome-P-450 and Carbonic anhydrase- Metallo drugs for cancer theraphy (Cis-platin).	11
	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. (1997). *Inorganic chemistry*, Holt-Saunders International Editions. 2.James E.Huheey, **Inorganic Chemistry**, Fourth edition, HarperCollins College Publishers, 1993. (Units I, II, III, IV) 3. Basolo, F. & Pearson. R.G. (1967) *Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution.* Wiley Eastern Limited. 4Ivano Bertini, Harry B. Gray, Stephen J.Lippard, and Joan Selverstone Valentine, **Bioinorganic Chemistry**, VIVA books private Ltd., 1998. (Units III, IV)	

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Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	2016-17 Batch
Subject code	16PCY413	Semester: IV
Title	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, Mossbauer spectroscopy and AAS.	
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.	11
Unit II	**Chromatographic methods**: Chromatography – Principles, theory, instrumentation and applications in chemical analysis of the following – column, paper, thin layer and ion-exchange – GC, GLC and HPLC. Purification of common organic solvents.	10
Unit III	**Thermal analysis** Thermogravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Derivative thermogravimetry (DTG) and Differential Scanning Calorimetry (DSC) and – thermometric titrations – Basic principles-instrumentation-factors affecting and applications.	10
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.	10
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.	11
	Total hours/Semester	52

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 (2000) *Analytical chemistry an Introduction*, 6th Edition, Saunders College publishing 2. Willard, H.H, Merrit L.L & Dean, J.A (2002). *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.	

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Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	2016-17 Batch
Subject code	16PCY4E3	Semester: IV
Title	Major Elective –III Applied electrochemistry	
Hrs/Week	5	Credit: 4
Objectives	• To have a good knowledge of electrochemical cells, batteries and electroplating. • To know about about corrosion and its control.	
Unit	Content	Hrs
Unit I	Current–voltage relationships – mass transfer – diffusion limited currents – kinetic currents – adsorption currents – Polarography – DC and pulse polarographic methods – Cyclic voltametry – Rotating disc electrodes – Chronoamperometry – Chronopotentiometry – Chronocoulometry (Basic principles and applications only in all the above methods).	10
Unit II	Electrochemical cells – components of electrochemical cells – Types of cells – divided and undivided cells – Chlor-alkali cells mercury, diaphragm and membrane cells – electro-inorganic chemicals – Chlorates, perchlorates – electrosynthesis of fluorine – electro-organic chemicals – electro-reduction of nitro and carbonyl groups – Kolbe synthesis – electrodimerisation – adiponitrile.	10
Unit III	**Electrometallurgy and Electroplating –** Electro winning and electro refining of Cu and Ni, production of aluminium – Hall-Heroult process – Electrolytic production of magnesium and sodium – Electroplating operations – Preplating operations – electroplating of nickel and chromium – precious metal plating – anodizing of Al.	11
Unit IV	**Batteries** – Thermodynamics of batteries and fuel cells – half cell reactions in batteries – characteristic requirements of a battery system – components of batteries – porous electrodes – separators –evaluation of batteries – charge – discharge characteristics – primary batteries, lead acid batteries – Leclanche cells - lithium cells – Ni-Cd cells – High temperature batteries – sodium-sulphur system.	10
Unit V	**Corrosion and Corrosion Control** – Thermodynamics of corrosion – Pourbaix diagrams – kinetics of corrosion – evans diagram – corrosion current and corrosion potential – Metal oxidation – atmospheric corrosion – crevice corrosion – bimetallic corrosion – stress corrosion – cracking – corrosion control and corrosion inhibitors – painting for corrosion control – cathodic protection – protection by sacrificial anodes.	11
	Total hours/Semester	52

Text Books	1.F.A. Cotton and Wilkinson,(1999) *Advanced Inorganic Chemistry*, 6th edition, Wiley and sons 2.Emeleus and Sharpe, *Modern Aspects of Inorganic Chemistry Fourth Edition* 3.H. J. EmeUus and A. G. Shorpe, University of Cambridge. A Halsted Press, Book, John Wiley & Sons, 1973. 3. Basolo, F. & Pearson. R.G. (1967) *Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution.* Wiley Eastern Limited. 4.J.D. Lee, *Concise Inorganic Chemistry* (1999) 5th Edition . John Wiley & Sons	
Reference Books	1.S.F.A. Kettle, *Co-ordination Compounds.*. 2.W.L. Jolly, *Modern Inorganic Chemistry*. 3.Cartmell and Fowles, *Valence and Molecular Structure*	

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Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	2016-17 Batch
Subject code	16PCY414	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 2. Giri. S, Bajpai. D.N and Panday O.P (1997). *Practical Chemistry* Vol. I & II, S.Chand & Co. 3. Bassart J. Dennay. R.C. Jeffery G.H. and Mendham (2004). *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

Compiled by Name with Signature	Verified by HOD Name with Signature	CDC	COE

Department	CHEMISTRY	
Course :	M.Sc., CHEMISTRY	2016-17 Batch
Subject code	16PCY415	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	
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. Day. B.B and Sitaram M.V and Govindachari T.R (1999). *Laboratory Manual of Organic Chemistry*, Allied Publishers Limited. 2. Gnanprakasam and Ramamurthy (2000). *Organic Chemistry Laboratory Manual* Ananda Book Depot, Chennai. 3. Jagmohan (2004). *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

Compiled by Name with Signature	Verified by HOD Name with Signature	CDC	COE

Department	**CHEMISTRY**	
Course :	**M.Sc., CHEMISTRY**	**2016-17 Batch**
Subject code	**16PCY416**	**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	**120**
Reference Books	1. Palit S.R. and De S.K (2003). *Practical Physical Chemistry*, Science Book Agency, Calcutta. 2. Sharma P.C. and Agarwal (1998). *Practical Chemistry*, Goel Publishing House, Meerut. 3. Venkateswaran and Kulaindaivelu (2005). *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

Compiled by Name with Signature	Verified by HOD Name with Signature	CDC	COE

Semester	Course code	Course Title
III & IV	**16PCY417**	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 (5x5=25)

Answer any of the following questions
(5 out of 8)

Section – B (5 X 15 = 75 marks)

Answer any five of the following questions
(5 out of 8 questions)

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