School: Science	Programme: Master of Science (M.Sc.)
Year : First Year	Semester - I
Course: Physical Chemistry I	Course Code: PCH101
Theory: 4 Hrs/Week	Max. University Theory Examination: 50 Marks
Max. Time for Theory Exam: 3 Hrs	Continuous Internal Assessment: 50 Marks

Course Objectives	
1	To learn the energy and its transformation
2	To determine the spontaneity of given transformation and energy interaction
3	To Understand the conditions by which the reaction rate is altered and determine the rate of chemical reaction with respect to concentration
4	To understand atomic and molecular structures, properties as well as chemical reactivity
5	To study the molecular basis of thermodynamics and interaction between partials and thermodynamic properties

Unit Number	Details	Hours
1	**Thermodynamics** **A) I) Heat, Work and Conservation of Energy** The basic concepts, the first law of thermodynamics, infinitesimal changes, mechanical work, work of compression & expansion, free expansion, Expansion against constant pressure, reversible expansion, Heat: heat capacity, enthalpy. **II) State Functions and Differentials:** state functions, Exact & Inexact differential, changes in internal energy, temperature dependence of the internal energy, Temperature dependence of the enthalpy. Work of adiabatic expansion- Irreversible adiabatic expansion, reversible adiabatic expansion. B**) Second Law of Thermodynamics** Measuring the dispersal the entropy, The second law, the definition of entropy, the entropy changes in the system, natural events. Entropy changes in the universe – The enthalpy change when a system is heated, Entropy changes in surroundings, The entropy of phase transition, The entropy of irreversible changes. Concentrating on the system – The Helmoltz & Gibbs function, some remarks on the Helmholtz function, Maximum work, some remarks to Gibbs function, Evaluating the entropy & Gibbs function, The Third law of Thermodynamics, entropies standard molar Gibbs function.	**20**

2	**Thermodynamics & energy interaction** **A) Combining First and Second Law** One way of developing the fundamental equations, Properties of Gibbs function, The temperature dependence of the Gibbs functions, The pressure dependence of the Gibbs functions, The Chemical potential of a perfect gas, The open system & changes of composition. **B) Changes of State** Physical Transformation of pure materials. The stability of phases, Phase equilibrium & phase diagrams, The solid – liquid boundary, The liquid-vapour boundary, The solid- vapour boundary, The solid-liquid-vapour equilibrium. Colligate properties- The common features, the elevation of boiling point, The depression of freezing point, solubility, osmosis, Mixtures of volatile liquid–vapour pressure diagram–The representation of distillation, azeotropes, and immiscible liquids.	**10**
3	**Quantum Chemistry** Historical development of quantum theory principal of quantum mechanics, black body radiation, photoelectric effect, wave particle duality, uncertainty principles, Schrödinger equation, operators simple system– free particle, Particle in a box, Two dimensional Three dimensional box, Hydrogen like atoms (no derivation) atomic orbital.	**10**
4	**Chemical Kinetics** **A)** Reaction rate, rate law & rate constants, the determination of rate law, first order reactions, second order reactions, third order reaction, n^{th} order reaction, half life. **B)** Simple reactions, the temperature dependence of reaction rates, reaction approaching equilibrium consecutive reactions, the steady state approximations, pre-equilibira, unimolecular reactions, enzyme catalysis– Michaelis Menton mechanism, line weaver and Eadie plots, the kinetics of complex reaction, chain reactions, the structure of chain reactions explosions, fast reactions, flash photolysis, flow technique, relaxation methods	**10**
5	**Kinetic Theory of Gases & Reaction dynamics** **A) Kinetic Theory of Gases** Postulates of kinetic theory of gases, P-V-T relations for an ideal gas, non-ideal behaviour of gases, equation of state, compressibility factor, virial equation, van der Waal's equation, excluded volume and molecular diameter, relations of van der Waal's constants with virial	**10**

	coefficients and Boyle temperature. **B) Statistical thermodynamics** Molecular statistics, distribution of molecular states, Boltzmann distribution law, partition function of assemble, partition function of translational, vibrational and rotational of diatomic molecule, Maxwell-Boltzmann law for distribution of molecular velocities, experimental verification of the distribution law, Entropy of free energy, equilibrium constant from partition function, Fermidirac and Bose- Einstaine statistics	
	Total	**60**

Resources	
Recommended Books	1. Physical Chemistry by P.W. Atkin, Julio de Paula, ELBS, 4th edition. 2.Physical Chemistry by R. J. Silbey, R. A. Alberty, M. G.Bawendi, Wiley 4th edition, 2005 3. Physical Chemistry by G. M. Barrow, Tata Mc – Graw Hill 1988. 4. Quantum Chemistry by I . Levine, Prentice Hall, 5th edition, 1999. 5. Physical Chemistry by Thomas Engel and Philip Reid, 3rdedition.
Reference Books	1. Principles of Physical chemistry by S. H. Maron and C .F .Pruton, 4th edition. 2. Chemicals Kinetics by K.J. Laidler, Tata Mc. Graw Hill, **1998**. 3. Basic Chemical Thermodynamics by E. Brian Smith, ELBS, **1990**. 4. Physical Chemistry Molecular Approach by D. Mcquarie and J. Simom (Viva) **2000**. 5. Physical Chemistry by Puri ,Sharma and Pathania

Course Outcomes	
1	Students able to understand the energy and its transformation
2	Students able to understand the spontaneity of given transformation and energy interaction
3	Students able to understand the conditions by which the reaction rate is altered and determine the rate of chemical reaction with respect to concentration
4	Students able to understand the atomic and molecular structures, properties as well as chemical reactivity
5	Students able to understand the molecular basis of thermodynamics and interaction between partials and thermodynamic properties

School: Science	Programme: Master of Science (M. Sc-I.)
Year : First Year	Semester - I
Course: Inorganic Chemistry I	Course Code: PCH102
Theory: 4 Hrs/Week	Max. University Theory Examination: 50 Marks
Max. Time for Theory Exam: 3 Hrs	Continuous Internal Assessment: 50 Marks

Course Objectives	
1	To learn the chemistry of various elements of periodic table
2	To Understand the basic concept of symmetry
3	To study Molecular symmetry and symmetry groups
4	To learn the Symmetry of crystal

Unit Number	Details	Hours
1	**Chemistry of Main Group Elements I** **A) Hydrogen & its compounds**: Position in periodic table, properties & applications of hydrogen, classification of binary compounds of hydrogen, PH_3, SbH_3, AsH_3, selenides, tellurides **B) Organometallic Compounds**: Classification of organometallic compounds, organometallic compounds of Li, Mg, Be, Ca, Na synthesis, properties, uses & structures **C) Alkali & alkaline earth metals**: Solutions in non-aqueous Media. Application of crown ethers in extraction of alkali & alkaline earth metals..	12
2	**Chemistry of Main Group Elements II** **A) Boron group**: Boron hydrides, preparation, structure & bonding with reference to LUMO, HOMO, interconversion of lower & higher boranes, wade's rule for skeletal electron counting, metalloboranes, carboranes, borazine **B) Carbon group**: Allotropes of carbon, C60 and compounds (fullerenes), intercalation compounds of graphite, carbon nanotubes, synthesis, properties, structure-single walled, multiwall, applications, organometallic compounds of B, Si, Sn, Pb, Ga, As, Sb, Bi, structures, synthesis, reactions.	12
3	**Chemistry of Main Group Elements III** **A) Nitrogen group**: Nitrogen activation, Boron nitride, Oxidation states of nitrogen & their interconversion PN & SN compounds Nos, & their redox chemistry **B) Oxygen group**: metal selenides & tellurides, oxyacids & oxoanions of S & N, ring, cage and cluster compounds of p-block elements, Silicates, Zeolites. **C) Halogen group** :Interhalogens, pseudohalogen, synthesis, properties & applications, structure, oxyacids & oxoanions of	12

	hallogens bonding.	
4	**Symmetry and Stereochemistry** Definitions and theorems of group theory, subgroups, classes. molecular symmetry and symmetry groups – symmetry elements and operations, symmetry planes, reflections, inversion centre, proper/ improper axes of rotation, products of symmetry operations, equivalent symmetry elements and atoms, symmetry elements and optical isomerism, symmetry point groups, classes of symmetry operations, classification of molecular point groups.	**12**
5	**Symmetry and Molecular Orbital Theory** **A) Molecular Orbital Theory**, Transformation properties of atomic orbital, MO's for Sigma bonding AB_n molecules, tetrahedral AB_4 case. **B) Crystallographic Symmetry**. Unit cell, screw axis, glide plane on unit cell, crystal lattice, space lattice, stereographic projectors, examples on crystallographic planes, cubic planes, Miller indices, Bravais lattices.	**12**
	Total	**60**

Course Outcomes	
1	Student able to explain the chemistry of various elements of periodic table
2	Student able to describe the basic concept of symmetry
3	Student able to analyze the molecular symmetry and symmetry groups
4	Student able to explain the symmetry of crystal

Resources	
Recommended Books	1. Chemical Application and Group Theory by F.A. Cotton, 3rd edition, **1999**. 2. Advanced Inorganic Chemistry by F. A. Cotton, G. Wilkinson, C.A. Murillo and M.Bochmann, 6th edition, 2003.
Reference Books	1. Symmetry in Chemistry by H. Jaffe' and M. Orchin. 2. Group Theory and its Chemical Application by P. K. Bhattacharya, Himalaya Publication, 2nd edition, **1989**. 3. Inorganic Chemistry by Shriver and Atkins, Oxford, 4th edition, **2003**.

School: Science	Programme: Master of Science (M.Sc.)
Year : First Year	**Semester - I**
Course: Organic Chemistry I	**Course Code: PCH103**
Theory: 4 Hrs/Week	**Max. University Theory Examination: 50 Marks**
Max. Time for Theory Exam.: 3 Hrs	**Continuous Internal Assessment: 50 Marks**

Course Objectives	
1	To learn a chemical bonding in molecules
2	To learn a basic concepts as well as various principles of stereochemistry
3	To learn an aliphatic substitution, nucleophilic substitution, elimination & aromatic electrophilic substitution reactions

Unit Number	Details	Hours
1	**Nature of Bonding in Organic Molecules** **A) Delocalized Chemical Bonding**: conjugation, cross conjugation, resonance, inductive effect, hyper conjugation, tautomerism **B) Reactive Intermediates**: Generation, structure, stability and chemical reactions involving carbocations, carbanions, free radical, carbenes and nitrenes **C)** Introduction to aromaticity, aromaticity in Benzenoid and non–benzenoid compounds, reactive intermediate-benzyne, alternant and non-alternant hydrocarbon, Huckel rule, bonds weaker than covalent–crown ether, cryptands, cyclodextrins, catenanes, rotaxanes and bonding in fullerenes.	**18**
2	**Stereochemistry** Basic introduction of stereochemistry, isomerism, constitutional isomerism, stereoisomerism, chirality, stereogenic centre, pptical activity, representation of three dimensional molecules, R-S system of nomenclature, two stereogenic centers, E-Z notation for geometrical Isomers.	**12**
3	**Stereo chemical Principles** Enantiometric relationships, diastereomeric relationships, dynamic stereochemistry, prochiral relationship, stereo-specific and stereo selective reactions, introduction of optical activity in the absence of chiral carbon (biphenyls, spiranes, allenes and helical structures),	**6**

	introduction to chiral synthesis (chiral auxiliary).	
4	**Aliphatic Nucleophilic Substitution** The SN2, SN1, mixed SN1 and SN2 and SET mechanism, the neighboring group mechanism, the neighboring group participation by sigma bonds, anchimeric assistance, classical and non-classical carbocations, phenonium ions, norbornyl system, carbocation rearrangements in neighboring group participation, The SNi mechanism, nucleophile substitution at an allylic, aliphatic trigonal and vinylic carbon, reactivity effects of structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalyst, ambident nucleophile and regioselectivity.	**12**
5	**Elimination and Aromatic Electrophilic Substitution Reactions** **A) Elimination Reactions** E2, E1, E1cb mechanisms, orientation, stereochemistry in elimination, reactivity-effect of structure, attacking nucleophile and leaving groups, competition between substitution & elimination, syn eliminations. **B) Aromatic Electrophilic Substitution** The arenium ion mechanism, orientation and reactivity, energy profile diagram, the ortho/ para ratio, ipso attack, orientation in other ring systems-naphthalene, anthracene, six and five member heterocycles, diazonium coupling, Vilsmeier reaction, Gattermann – Koch reaction and Riemer-Tieman reaction.	**12**
	Total	**60**

Course Outcomes	
1	Student able to understand and explain chemical bonding in molecules
2	Student able to explain basic concepts and various principles of stereochemistry
3	Student able to explain aliphatic, nucleophilic, substitution, elimination & aromatic electrophilic substitution reactions with mechanism

Resources	
Recommended Books	1. Advanced Organic Chemistry: Part B-Reactions and Syntheiss by F. A. Carey and R. J. Sundberg, Kluwer Academic/Plenum Publication, Part B, 4th edition, **2001**.
Reference Books	1. Organic Chemistry by Morrison and Boyd, Prentice Hall of India Prt Ltd, New Delhi, 6th edition, **2001**. 2. A guide book to Mechanism in Organic Chemistry by Peter Sykes, 6th Edition. 3. March's Advanced Organic Chemistry by M. Smith and J. March, Wiley-Interscience, 7th edition, **2007**.

School: Science	Programme: Master of Science (M.Sc.- I) in Chemistry
Year : First Year	**Semester - I**
Course: Analytical Chemistry I	**Course Code: PCH104**
Theory: 4 Hrs/Week	**Max. University Theory Examination: 50 Marks**
Max. Time for Theory Exam.: 3 Hrs	**Continuous Internal Assessment: 50 Marks**

Course Objectives	
1	To understand the basic concept of analytical chemistry
2	To learn chromatographic techniques
3	To study separation techniques
4	To learn the hyphenated techniques

Unit Number	Details	Hours
1	**Concepts of Analytical Chemistry** **A) Error in Chemical Analysis:** Errors & precision, classification of errors, determinate errors, determination of accuracy of quantitative analytical methods, accuracy sought. **B) Accuracy and Precision:** The test of statistics precision, averages, study of an analytical procedure, sampling errors, presentation of results**.** **C) Principles and Methods of Sampling :** Introduction, theory of sampling, pit falls is sampling, technique of sampling gases, liquids and solids, transmission and storage of samples, sources specific sampling information.	**12**
2	**Chromatographic Techniques** **A) Paper Chromatography:-** Preparation of sample solution, solvent selection, development of chromatogram, location of spot of paper chromatography **B) Thin layer chromatography:-** Preparation of sample solution, solvent selection, development of chromatogram, location of spot of thin layer chromatography **C) Column Chromatography:-** Types of column, adsorbents, eluents, column resolution on chromatogram and applications of chromatography	**12**
3	**Gas Chromatography** Gas chromatography theory and instrumentation, column types, solid/liquid stationary phases, column switching techniques, basic and specialized detectors, elemental detection, chiral separations, pyrolysis gas chromatography and its application	**12**

4	**Electrophoresis** Principle & instrumentation, types of electrophoresis, moving boundary electrophorosis, zone electrophoresis, polyacrylamide gel electrophoresis, paper electrophoresis, isoelectric focusing electrophoresis, two dimensional electrophoresis, capillary electrophoresis, application of electrophoresis.	**12**
5	**Separation & Hyphenated techniques** **A) High Performance Liquid Chromatography :** HPLC theory and instrumentation, adsorption chromatography, liquid-liquid partition techniques, microbore and capillary chromatography, affinity techniques, size exclusion, ion pair separations, chiral and isotope separations, applications and problems. **B) Hyphenated Techniques :** Mass spectrometry principle, instrumentation, ionization methods–EL, CI, FAB, arc & spark, photoionization, thermal ionization, FI & FD, laser induced, photoelectic ionization, SIMS, mass analyzers – magnetic, double focusing, time of flight, quadrupolar, ion cyclotron resonance analyzer, coupled techniques, GC- FTIR, GC- MS (Use of stable isotopes), HPLC-MS.	**12**
	Total	**60**

Course Outcome	
1	Student able understand fundamentals of analytical chemistry
2	Student able to understand and explain the principle behind the separation of organic or inorganic mixtures by chromatographic techniques
3	Knowledge about electrophoresis techniques will help to in academic as well in research
4	Student will learn about hyphenated analytical

Resources	
Recommended Books	1. Analytical Chemistry by G. D. Christian, Wiley, 6th edition. 2. Computational Chemistry by G. Grant and W. Richards, Oxford University press. 3. Computer Programming in Fortran 77 and Fortran 90 by V. Rajaraman, Prentice Hall India. 4. Practical Aspects of Gas chromatography/ Mass spectrometry. 5. G. M. Message, John Wiley & Sons, New York, 1984.
Reference Books	1. Spring International, 3rd Edition, New Delhi, StudentsEdn, 1994. 2. HPLC: Analytical Chemistry by Open Learning, John Wiley & Sons, New York, 1991. 3. Protein Purification: Principles & Practice.

School: Science	Programme: Master of Science (M.Sc.)
Year: First Year	Semester-I
Course: Physical and inorganic chemistry Laboratory I	Course Code: PCH111
PG- 4Hrs/Batch (20 Students)	Practical Examination: 50 Marks
	Term Work: 50 Marks

Course Objective	
1	To study chemical kinetics of reactions
2	To learn analysis of ores
3	To learn various instrumental methods

Sr. No.	Description
1	**Chemical Kinetics**: Determine the order of reaction between potassium persulphate and potassium iodide
2	**Chemical Kinetics**: The influence of ionic strength on the rate constant of the reaction between potassium persulphate and potassium iodide
3	**Spectrophotometry** : Simultaneous determination of cation from their mixture spectrophotometrically
4	**Colorimetry** : Copper EDTA photometric titration
5	**Conductometry**: Determination of equivalence conductivity at infinite dilution and dissociation constant of acetic acid
6	**Non-Instrumental**: Determine the radius of glycerol molecule from Viscosity measurement
7	**Study of a Redox Reaction:** Standardization of potassium permanganate by oxalic acid Standardization of potassium permanganate by oxalic acid
8	**Ore Analysis**: Determination of silica and manganese in pyrolusite.
9	**To analyse the given sample of haematite ore for its** (A) Acid insoluble analysis (B) Iron by redox titrations
10	**Metal ion Estimation**: To analyze the binary mixture of copper and Zinc
11	**pH Metry** : To titrate the given mixture of CO_3^{2-} and HCO_3^- ions against a strong acid HCl using pH meter and to determine the strength of it
12	**Colorimetry** : Determination of aluminium

Course Objective	
1	Students able to determine chemical kinetics of reactions
2	Students able to perform analysis of ores
3	Students able to use various instrumental methods of chemical analysis

Term Work:
Term Work assessment shall be conducted for the Project, Tutorials and Seminar. Term work is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Term Work shall be assigned based on the performance of the student and is to be submitted to the University.

Notes	
1	The experiments from the regular practical syllabus will be performed (30 Marks).
2	The regular attendance of students during the syllabus practical course will be monitored and marks will be given accordingly (10 Marks).
3	Good Laboratory Practices (10 Marks)

Practical/Oral/Presentation:
Practical/Oral/Presentation shall be conducted and assessed jointly by internal and external examiners. The performance in the Practical/Oral/Presentation examination shall be assessed by at least a pair of examiners appointed as examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University, authenticate and seal it. Sealed envelope shall be submitted to the head of the department or authorized person.

Notes	
1	Two experiments from the regular practical syllabus will be conducted. (Total 40 Marks).
2	Complete laboratory journal/records (05 Marks).
3	Viva-voce (05 Marks).

School: Science	Programme: Master of Science (M.Sc.)
Year: First Year	Semester-I
Course: Organic and Analytical chemistry Laboratory I	Course Code: PCH112
PG- 4 Hrs/Batch (20 Students)	Practical Examination: 50 Marks
	Term Work: 50 Marks

Course Objectives	
1	To learn the separation and purification techniques in organic chemistry
2	To synthesis different organic derivatives
3	To learn various instrumental methods

Sr. No.	Description
1	**A) Qualitative Analysis (Separation and Purification Techniques):** 1 Thin Layer Chromatography (TLC) 2. Recrystallization: 3. Distillation 4. Column Chromatography
2	Preparation of 2,4-Dinitrophenylhydrozones
3	Preparation of Semicarbazoles derivative
4	Preparation of Oxime
5	Preparation of Nitro derinative
6	**Volumetry**: Estimation of iron from the given drug sample
7	**Gravimetry**: Estimation of barium as barium sulphate
8	**Titrimetric Analysis** : Determination of the total Hardness of Water
9	**Separation Technique**: Qualitative separation of metal ions by paper
10	**Conductometry**: Analysis of commercial vinegar by conductometric titration
11	**Colorimetry**: Estimation of iron in wastewater sample using 1,10-phenanthroline

Course Outcomes	
1	Student able to separate and purify compound using TLC
2	Student able to synthesize organic derivatives
3	Student able to perform chemical analysis using instrumental methods

Term Work:
Term Work assessment shall be conducted for the Project, Tutorials and Seminar. Term

work is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Term Work shall be assigned based on the performance of the student and is to be submitted to the University.

Notes	
1	The experiments from the regular practical syllabus will be performed (30 Marks).
2	The regular attendance of students during the syllabus practical course will be monitored and marks will be given accordingly (10 Marks).
3	Good Laboratory Practices (10 Marks)

Practical/Oral/Presentation:
Practical/Oral/Presentation shall be conducted and assessed jointly by internal and external examiners. The performance in the Practical/Oral/Presentation examination shall be assessed by at least a pair of examiners appointed as examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University, authenticate and seal it. Sealed envelope shall be submitted to the head of the department or authorized person.

Notes	
1	Two experiments from the regular practical syllabus will be conducted. (Total 40 Marks).
2	Complete laboratory journal/records (05 Marks).
3	Viva-voce (05 Marks).