M.Sc.I (ANALYTICAL/INORGANIC/ORGANIC CHEMISTRY)
SEMESTER-II
(CBCS-2018 COURSE)

PGCH-201: PHYSICAL CHEMISTRY - II

Total Credits: 04 **Total Lectures: 60Hrs**

Course Learning Outcomes:

At the end of course student will be able to –

CO 1 : Recognize spectroscopy in microwave, Rotational spectra of rigid diatomic molecules, selection rules, interaction of spectral lines
CO 2 : Study of Vibrating diatomic molecule, energy levels of a diatomic molecule, simple harmonic and anharmonic oscillator, Scattering of light and Raman Spectrum. rotational and vibrational Raman Spectra
CO 3 : Learn Electronic spectra of diatomic molecules Born-oppenheimer approximation
CO 4 : Make Students aware of the fine structure of ESR absorption, Hyperfine structure, Double resonance in ESR, Techniques of ESR spectroscopy.
CO 5 : Understand Principles and Applications of Mossbauer spectroscopy
CO 6 : Understand concepts of Nuclear and Radiation Chemistry. Applications of Radioisotopes

Course Content:

1) **Microwave Spectroscopy**

Rotation of molecules, Rotational spectra of rigid diatomic molecules, selection rules, interaction of spectral lines, determination of bond lengths, effect of isotope substitution, non–rigid rotator and its spectrum, Linear polyatomic molecules, symmetric and asymmetric top molecules.

2) **(A) Infra – Red Spectroscopy**

Vibrating diatomic molecule, energy levels of a diatomic molecule, simple harmonic and anharmonic oscillator, Diatomic vibrating rotator, vibration – rotation spectra of carbon –monoxide, determination of force constant and bond strengths, interaction of radiation and vibrations, P, Q and R branches, fundamental vibration and overtone frequencies. Linear molecules, influence nuclear spin, Symmetric top molecules.

(B) Raman Spectroscopy:

Scattering of light and Raman Spectrum, Rayleigh scattering and Raman Effect, Classical and Quantum theory of Raman Effect, Pure rotational Raman Spectra, Linear, Symmetric top and asymmetric top molecules. Vibrational Raman Spectra Raman activity of vibrations, Rule of Mutual Exclusion Overtone and combination vibrations, Vibrational Raman Spectra, Rotational fine structures, Polarization of light

and Raman Effect. Vibration of spherical top molecules structure determination from Raman and Infrared spectra.

3) **Electronic Spectroscopy of Molecules**

Electronic spectra of diatomic molecules Born-oppenheimer approximation, Vibrational coarse structure, Franc-Condon Principle, Dissociation energy and dissociation products, rotational fine structure of electronic and vibrational transition, Fortrat Diagramme. Predisssociation, electronic structure of diatomic molecules, M.O. theory, Shapes of molecular orbitals.

4) **Electron Spin Resonance Spectroscopy:**

Introduction, The position of ESR absorption; the g factor, The fine structure of ESR absorption, Hyperfine structure, Double resonance in ESR, Techniques of ESR spectroscopy.

5) **Mossbauer Spectroscopy:**

Principles of Mossbauer spectroscopy, Applications of Mossbauer spectroscopy, The chemical shift, Quadrupole effects, effect of magnetic field.

Nuclear and Radiation Chemistry

1) **Radioactivity: Recapitulation**: **(06)**

Types of radioactive decay, decay Kinetics Detection and measurement of radiation (G.M. and scintillation counters)

2) **Elements of radiation chemistry:**

Interaction of radiation with matter, passage of neutrons through matter, interaction of y radiation with matter,units for measuring radiation absorption, radiation energy and radiation dosimetry-Fricke dosimeter, Radiolysis of water, Radiolysis of some aqueous solutions

3) **Applications of Radioisotopes:**

Physicochemical constants-Diffusion coefficient, surface area, solubility. Chemical pathways-Kinetic studies (isotope exchange reaction), organic reaction (Fridel craft reaction, oxidation of fumaric acid). Analytical applications-neutron activation analysis, dilution analysis, radiometric titration. Industrial-Radiation gauging, friction and wear out, gamma radiography, Carbon dating

Reference Book

1) Fundamentals of molecular spectroscopy, C.N.Banwell and E.McCasj, Tata McGraw Hill (1994)

2) Elements of Nuclear Chemistry H.J.Arnikar, 4th Edn. Wiley Eastern Ltd.

3) Source book on atomic energy-S.Glasstone (D.Van Nostrand company)
4) Chemical Application of radioisotopes H.J.M.Bowen Buttler and Tanner Ltd.
5) Introduction of Nuclear and Radiochemistry, G. Friedlaunder, T.W.Kennedy and J.M.Miller, John Wiley and sons 2nd Edn.
6) Nuclear Chemistry and its Applications, M.Haissinsky, Addison Welsley Publ. Company.

PGCH-202: INORGANIC CHEMISTRY - II

Total Credits: 04 **Total Lectures: 60Hrs**

Course Learning Outcomes:

At the end of course student will be able to –

CO 1 : Learn bonding in transition metal complexes, Valence bond theory, Crystal field theory, Molecular orbital theory
CO 2 : Study of structural trends, mononuclear oxocomplexes, polyoxometallates, intermediate oxidation states, metal-metal bonded compounds
CO 3 : Understand reaction mechanisms of d-metal complexes, Ligand substitution reactions. classification & theory of redox reactions, photochemical reactions
CO 4 : Study of structure, properties, reactions and synthesis of d-block carbonyls, Reactivity of d- and f-block organometallic compounds
CO 5 : Introduction, methods of separation and applications of Lanthanides, Actinides
CO 6 : Make aware of energy sources for life, metalloporphyrins, photosynthesis and Respiration, metalloenzymes, Nitrogen fixation basics of bioinorganic chemistry

Course Content:

1. **Coordination Chemistry :**
Introduction, Bonding in transition metal complexes, Valence bond theory, Crystal field theory, Molecular orbital theory. Electronic spectra and magnetic properties of transition metal compounds.

2. **Chemistry of Transition elements:**

Introduction, occurrence & recovery, High oxidation states, structural trends, mononuclear oxocomplexes, polyoxometallates, intermediate oxidation states, metal-metal bonded compounds, noble character.

3. **Reaction mechanisms of d-metal complexes.**

Introduction, Ligand substitution reactions, classification of mechanisms. The substitution of square-planar complexes, substitution of octahedral complexes, Rate

law and their interpretation, Activation of octahedral complexes, stereochemistry, Isomerization reactions, Redox reactions, classification & theory of redox reactions, photochemical reactions, d-d and charge-transfer reactions, Transitions in metal-metal bonded systems.

4. **d – block organometallic compounds:**

Bonding, valence electron count, d-block carbonyls, synthesis of carbonyls, structure, properties and reactions, Hydrogen and open-chain hydrocarbon ligands, cyclic polyene complexes, Reactivity of d-block and f-block organometallic compounds, Metal-metal bonding and metal clusters, structure and syntheses, Reactions of clusters, homogeneous catalysis

5. **f-block elements:**

Lanthaindes: Introduction, methods of separation of Lanthanides, Lanthanide contraction, applications of Lanthanides.

Actindes: Introduction, methods of preparation and separation of actinides, applications of actinides.

Transactinide elements: Introduction, applications of transactinide elements.

6. **Basics of Bioinorganic Chemistry:**

Introduction, Energy sources for life, metalloporphyrins, photosynthesis and Respiration, metalloenzymes, Nitrogen fixation, Biochemistry of Iron, Essential trace elements in biological systems, Biochemistry of non-metals.

Reference:

1. Concise Inorganic chemistry, J.D.Lee, 5th Edition, ELBS (1986).
2. Inorganic Chemistry: A.G.Sharpe, ELBS Edition (1984).
3. Inorganic Chemistry: D.F.Shriver, P.W.Atkins, 3rd Edition, Oxford University press (1999).
4. Inorganic Chemistry - Principles of structure and reactivity: J.E.Huheey, 3rd Edition (1983).
5. Inorganic Chemistry: D.F. Shriver, P.W.Atkins, C.H.Langford, ELBS, Oxford University press (1991).
6. Advanced Inorganic Chemistry: F.A.Cotton, R.G.Wilkinson, John Wiley (1984).
7. Structural Inorganic Chemistry: A.F. Wells, 5th Edition (1984).

PGCH-203: ORGANIC CHEMISTRY - II

Total Credits: 04 **Total Lectures: 60Hrs**

Course Learning Outcomes:

At the end of course student will be able to –

CO 1 : Learn Oxidation and reduction of organic compounds using variety of reagents
CO 2 : Understand Mechanism & Applications of different name reactions of Perkin, Michael, Mannich, Stobbe condensationetc
CO 3 : Determine and study of preparation of stabilized and destabilized 'P' and 'S' ylids. Their Reactions, applications
CO 4 : Study of organomettalics of Mg, Li, Zn and Ti with applications
CO 5 : Study and solve problems of Ultraviolet and Visible spectroscopy of organic molecules
CO 6 : Understand Infrared spectroscopy and its applications to structural problems.
CO 7 : Important terms and theory of Nuclear Magnetic Resonance spectroscopy. Its applications to structural problems.
CO 8 : Principle, working of Mass spectrometer, formation of different ions, Mclafferty rearrangement, fragmentation of alkanes, alkyl aromatics, alcohols, ketones and applications
CO 9 : Problems solved based on UV,IR, NMR & MS Spectroscopy to interpret structure.

Course Content:

(1) **Oxidation – Reduction**

Oxidation:-

(A) Olefin:- Alkaline KM_nO_4, OsO_4, Peracid, H_2O_2 and NaOH
(B) Alcohol:- Jone's reagent, Collin's reagent, MnO_2 and Oppenauer oxidation.
(C) Glycol – LTA.
(D) Ketone:- Baeyer –Villiger oxidation and SeO_2.

Reduction:-

$LiAlH_4$, $NaBH_4$, Clemmenson's reduction, Wolf Kishner reduction, Birch, Lindlar and MPV.

(2) **Name Reactions.**

Mechanism & Applications of –:
Perkin, Michael, Mannich, Stobbe condensation, Dieckmann Condensation, Vilsmayer, Dakin & Gatteamann – Koch.

(3) **Phosphorous & sulfur ylids**.

Preparation of stabilized and destabilized 'P' and 'S' ylids. Reactions, applications, stereochemistry and Emmons modification.

(4) **Organometallics**.
Mg, Li, Zn and Tl with applications.

(5) **Ultraviolet and Visible spectroscopy (UV-VIS).**

Introduction, Beer Lamberts law, instrumentation, Calculation for absorptron maxima of dienes, enones and aromatic ketones, Applications.

(6) **Infrared spectroscopy (IR).**

Introduction, instrumentation, Sampling technique selection rule, types of bonds,absorption of common functional groups, Factors affecting IR frequencies. Application to structural problems.

(7) **Nuclear Magnetic Resonance spectroscopy (NMR).**

Magnetic & non-magnetic nuclei, Larmor frequency, absorption of radio frequency,sample preparation, chemical shift, anisotropic effects, spin–
spin coupling, couplingconstants,applicationstostructural problems.

(8) **Mass spectroscopy (MS).**
Principle, working of Mass spectrometer, formation of different ions, Mclafferty rearrangement, fragmentation of alkanes, alkyl aromatics, alcohols, ketones and applications. Simple structural problems based on IR, UV, NMR and MS.

(9) **Problems based on UV,IR, NMR & MS Spectroscopy**.

Reference Books

1) Advanced organic chemistry by Jerry March, 4th edition, Mc Graw – Hill, 1988.
2) Advanced organic chemistry (Part-A) by F.A.Carey and R.J. Sundberg, 3rd edition, plenum press, New York and London, 1990.
3) Modern synthetic reactions by H.O. House, 2nd edition, Benjamin / Cummings Publishing Company, 1976.
4) Spectroscopic methods in organic chemistry by Williams & Fleming, Tata – McGraw Hill, 4th edition, 1988.
5) Spectroscopy of organic Compounds by P.S.Kalsi, New Age International, 2nd edition, 1995.
6) Spectroscopic Identification of organic compounds by R.M.Silverstein and G.C.Bassler, 5th edition, 1991.

PGCH-204: FUNDAMENTALS OF ANALYTICAL CHEMISTRY

Total Credits: 04 **Total Lectures: 60Hrs**

Course Learning Outcomes:

At the end of course student will be able to –

Unit-I

CO 1 : Role of analytical chemistry,Types of instrumental analysis. Selecting an analytical method. Laboratory operations and practices.

CO 2 : Statistical Analysis, Collection, treatment and presentation of analytical data in different forms

Unit-II

CO 1 : General principles, Classification, Techniques and applications of Chromatography

CO 2 : Basic principles, Significance of various terms and Techniques ofSolvent Extraction

Unit-III

CO 1 : Learn Spectrophotometry and Colorimetry, Applications of quantitative and qualitative analysis, Problems

CO 2 : Understand Instrumentation, experimental techniques, Interferences, analytical applications of AAS and FES

Unit-IV

CO 1 : origin of waste water, types, water pollutants and their effects. Measurements of DO, BOD, COD and their significance as pollution indicators

CO 2 : Make aware of Greenhouse effect, Sources of air pollution, air quality standards and sampling. Analysis of air pollutants

Unit-V

CO 1 : Learn Cell Structure and its Functions. building blocks of bio-macromolecules proteins, enzymes, DNA and RNA

CO 2 : Learn Chemical and enzymiatic hydrolysis of proteins to peptides, amino acid sequencing

CO 3 : Understand these Nucleic Acids and Chemical and enzymatic hydrolysis. Structure and function of RNA and DNA.

Unit-VI

CO 1 : Basic structure and functioning of computers. Introduction to UNIX and WINDOWS. Data processing.

CO 2 : Development of small computer codes involving simple formulae in chemistry, such as Vander Waal's equation, pH titration, kinetics, radioactive decay.

Course Content:

Unit-I

A Role of analytical chemistry, classification of analytical methods classical and instrumental. Types of instrumental analysis. Selecting an analytical method. Laboratory operations and practices. Analytical balances (Semmicro and Micro balance) and their use in analytical chemistry. Techniques of weighing and errors. Volumetric glassware – cleaning and calibration of glassware. Methods of sampling,

Problems associated with Stoichiometric calculations based on gravimetry and titrimetry analysis of commercial samples. Transmission and storage of samples. Effects of sampling uncertainties samplers responsibility, sampling hazards.

B Statistical Analysis: (Emphasis should be placed on numerical problems) Collection, treatment and presentation of analytical data. True, standard and observed value. Definition of terms in mean and median. Errors in Chemical analysis, classification of errors, nature and origin of errors. Accuracy and precision. Average deviation and standard deviation and its physical significance. Normal Distribution curve and its properties. Co-efficient of variation. Confidence burt and probabiulity. Probability theorem, Probability curves, Comparison of analytical results. Tests for rejection of data. T-Test, F-test and Q-Test Significant figures and computation rules. Least squares method for deriving calibration graph. Curve fitting, Correlation co-efficient Limit of detection. Regression analysis and Statistical analysis of Chemical analysis.

Unit-II

Modern methods of separation:

A. Chromatography : General principles, Classification, Partition Chromatography, Adsorption Chromatography. Principles, Techniques and applications of Paper, Thin-Layer, Column, HPLC, Gas Chromatography and Electro Chromatography.

B. Ion-Exchange : Cation and Anion exchangers, Action of ion exchange resins. Ion-exchange equilibria and ion exchange capacity. Strongly and weakly acidic cation exchangers. Strongly and weakly basic anion exchangers. Liquid ion exchangers, chelating ion exchangers, techniques of ion exchange and application in analytical Chemistry. Separation using solvent mixtures.

C. Solvent Extraction: Basic principles, Significance of various terms. Classification, Factors favouring solvent extraction, Extraction equilibria. Synergetic effects, ion-pair extraction, salting out effect and stripping. Techniques of extraction by high molecular weight amines i.e. crown ethers, cryptands and calixarenes.

Unit-III

Optical Methods:

A. Spectrophotometry and Colorimetry. Interaction of radiations with matter, Fundamental laws of Spectrophotometry. Beer – Lambert's law and its limitations Verification of Beer's law and deviation fromBeer's law. Choice of solvent. Ringbom's plot. Photometric titrations. Pk value of indicator. Outline of construction and working of the UV – Visible spectrophotometers. (Single and double beam). Applications of quantitative and qualitative analysis, Problems. Theory, instrumentation and applications of fluorimetry, turbidimetry and Nephelometry.

B. Flame Emission and atomic spectrometry :

Flame photometry : Elementary theory of flame photometry, instrumentation and experimental techniques. Interferences, analytical techniques and applications Atomic Absorption Spectrometry (AAS); Introduction, Principle, Advantages of AAs over FES, Instrumentation, Flame atomization. Hollow cathod lamps, intereferences and applications.

Unit-IV

Environmental Chemistry:

A. Water pollution: origin of waste water, types, water pollutants and their effects. Sources of water pollution, domestic, industrial agricultural soil and radioactive wastes as sources of pollution.

Objectives of analysis, parameter for analysis colour, conductivity, acidity, alkalinity, hardness, chloride, sulphate, Fluoride, Silica, Phosphates and different forms of nitrogen. Heavy metal pollution

Public health significance of Lead, Manganese, Mercury and Arsenic. General survey of instrumental technique for water and aquatic life. Measurements of DO, BOD, COD and their significance as pollution indicators, Pesticides as water pollutants

B. Air Pollution: green house effect, Sources of air pollution, air quality standards and sampling. Analysis of air pollutants (CO, No_x, So_x and Hydrocarbons and particulates) Effects of air pollution, Acid rain, Photochemical smog and air pollution control.

Unit-V :

A. Cell Structure and Functions:

Structure of prokaryotic and eukaryotic cells, intracellular organelles and their comparison. Origin of life-unique properties of carbon, chemical evolution and rise of living systems. Introduction of biomolecular, building blocks of bio-macromolecules proteins, enzymes, DNA and RNA). Helix coil transition.

B. Structure and biological functions of glucosaminoglycans or mucopolysaccharides. Carbohydrates of glycoproteins and glycolipids. Roll of sugars in biological recognition. Blood group substances. Ascorbic acid (Carbohydrate metabolism – Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphates pathway].

C. A mino-acids, Peptides and Proteins
Chemical and enzymiatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins, forces responsible for holding of secondary structures, a-helix, b-sheets, super secondary structure, triple helix structure of collagen. Tertiary structure of proteinfolding and domain structure. Quaternary structure.

Amino acid metabolism–degradation and hiosynthesis of amino acids, sequence determination. Chemical/enzymatic/mass spectral, recemiozation / detection.

D. Nucleic Acids.

Purine and pyrimidine bases of nucleic acids, base pairing via H-bonding. Structure of ribonucleic acids (RNA) and deoxyribonucleic Acids (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code.

Unit-VI :

A. Introduction to computers and computing.

Basic structure and functioning of computers with a PC as an illustrative example. Memory, I/O devices. Secondary storage. Computer Languages. Operating system with DOS as an example. Introduction to UNIX and WINDOWS. Data processing, principles of programming. Algorithms and flow-charts.

B. Programming in Chemistry.

Development of small computer codes involving simple formulae in chemistry, such as Vander Waal's equation, pH titration, kinetics, radioactive decay. Evaluation of lattice energy from experimental data. Linear simultaneous equation to solve secular equation within the Hockle theory. Elementary structural features such as bond lengths, bond angles of molecules extracted from data base such as Cambridge data base.

References:

1. Modern Spectroscopy – J.M.Hollas, John Wiley.
2. Applied Electron Specteroscopy for Chemical Analysis Ed.H.Windawi & F.L.Wo.Wiley Interscience.
3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V.Parish, Ellis Harwood.
4. Physical Methods in Chemistry – R.S.Drago, Saunders College.
5. Chemical Applications of Group Theory – F.A. Cotton.
6. Introduction to molecular Spectroscopy – G.M.Barrow, McGraw Hill.
7. Text book of Biochemistry, E.S.West; W.R.Todd; H.S.Mason, J.T.V.Bruggen oxford & IBH publishing co.pvt. Ltd.
8. Principles of Biochemistry, A.L.Lehniger, Worth Publisher.
9. Biochemistry, J.David Rawn, Neil Patterson.
10. Biochemistry, L.Stryer, W.H.Freeman.
11. Biochemistry, Vote and Voet, John Wiley.
12. Outlines of Biochemistry, E.E.Conn and P.K.Stmpf, John Wiley.
13. Environmental Chemistry, S.E.Manahan, Lewis Publishers.
14. Environmental Chemistry, Sharma & Kaur, Krishna Publishers.
15. Environmental Chemistry, A.K.De, Wiley Eastern.
16. Environmental Pollution Analysis, S.M.Khopkar, Wiley Eastern.
17. Environmental Toxicology, Ed. J.Rose, Gordon and Breach Science Publication.

18. Elemental Analysis of Airborne Particles, Ed.S.Landberger and M.Creatchman, Gordon and breach Science Publication.
19. Atmospheric Pollution, W.Buch, McGraw Hill, New York.
20. Fundamentals of Air Pollution, S.J.Williamson, Addison – Wesley Publishers.
21. Analytical Aspect of Environmental Chemistry, D.F.S.Natusch and P.K.Hopke, Hohn Willey & Sons. New York.
22. Analytical Chemistry – Problems and Solution – S.M.Khopkar, New Age International Publication.
23. Day & Underwood : Quantitative Analysis (Prentice Hall India Limited).
24. Findley: Practical Physical Chemistry:
25. A.I.Vogel A text book of quantitative inorganic Chemistry, ELBS, London.
26. Strouts Galfillal: Analytical Chemistry (Clarendon Press).
27. Yu.Lyalikov: Physicochemical Analysis (Mir Publishers).
28. Strouts Wilson & Parry Jones: Chemical Analysis Vol.I (Clarendon Press).
29. Meite4s and Thomas: Advanceds Analytical Chemistry, (McGraw Hill).
30. Willard Merritt and Dean: Instrumental methods of Analysis (Can Nostrand).
31. B.L.Kraayer, H.H.Willard, L.Merrit, J.A.Dean & F.A.Settle: Instrumental Methods of Analysis (CBS Pulishers, Delhi, 1986).
32. L.R.Shyder & C.H.Harvath: An Introduction to Separation Science (Wiley Interscience).
33. R.D.Brown Instrumental Methods of Chemical Analysis (Tata McGra Hill).
34. F.J.Wicher Robert : Standard Methods of Chemical Analysis.
35. Dr.G.L.David Krupadanam, D.Vijay Prasad, K.Varaprasad Rao, KLN. Reddy, C.Sudhakar, Analytical Chemistry.

N.B.: Select any two units.

M.Sc.I (ANALYTICAL/INORGANIC/ORGANIC CHEMISTRY)
(CBCS-2018 COURSE)

(SEMESTER-I & II)

PGCH-206: PHYSICAL CHEMISTRY PRACTICAL 2Credits

Course Learning Outcomes:

At the end of course student will be able to –

CO 1 : Calculate molar and normal solution of various concentrations. Analysis of a given binary mixture by colorimetry
CO 2 : Find out the acidity, Basicity and PKa Value on pH meter.
CO 3 : Determination of ionic product of water and Titration of a mixture by conductometrically.
CO 4 : Study the stability of complex ion and stranded free energy change and equilibrium constant by potentiometry.
CO 5 : Study the energy of activation and second order reaction
CO 6 : Determine the half wave potential and unknown concentration of ion polargraphically.
CO 7 : Illustrate the experiment of non instrumental methods like chemical kinetics,

viscosity, partial molar volume and steam distillation.

A) **Colorimetry**

1. pk Value of an acid base indicator.
2. Analysis of a given binary mixture by colorimetry.
3. Copper – EDTA Photometric Titration.

B) **pH Metry**

4. Hydrolysis of metal ions by pH – metry.
5. Determination of the acid and base dissociation constants of an amino acid and hence the isolectric point of the acid.
6. Dissociation constant of a weak acid using Henderson's equation.
7. Titration of a tribasic acid (Phosphoric acid) against sodium hydroxide and determination of pka values.

C) **Conductometry**

8. Determination of ionic product of water conductometrically.
9. Hydrolysis of Sodium Acetate/Aniline Hydrochloride.
10. Titration of a mixture of a Strong Acid & Weak acid against a Strong base.

D) **Potentiometry**

11. Determination of ionic product of water potentiometrically.
12. Solubility of sparingly soluble salt.
13. Esttimation of halide in a mixture
14. Determination of the dissociation constant of monobasic 1 dibasic acid by Albert – Serjeant method.

E) **Chemical Kinetics**

15. Bronsted primary salt effect.
16. Calculation of energy of activation by clock reaction of reaction between potassium Persulphate and potassium iodide.
17. Kinetics of iodination of acetone / aniline by colorimetry.
18. Determination of an order of a reaction between potassium persulphate and potassium iodide.

F) **Polarography**

19. Determine the half wave potential and unknown concentration of ion polargraphically.

G) **Noninstrumental**

20. Determination of surface area of given sample (Industrial pigment) by B.E.T method.

21. Radius of glycerol molecule by viscosity measurements.
22. Latent heat of fusion of naphthalene in Benzene / Toluene.
23. Heat of ionization.
24. To determine molecular weight of given organic liquid by steam distillation method.
25. Freundich and Langmuir isotherms for adsorption of acetic acid on charcoal.
26. Statistical Treatment of experimental data.

Each candidate should perform a minimum of 18 experiments with at least one experiment from each technique.

References

1) Practical Physical Chemistry, A. Finday, T.A. Kitchnner (Longmans, Green and Co.)

2) Experiments in Physical Chemistry J.M.Wilson, K.J.Newcomble, A.R.Denko, R.M.W. Richett (Pergamon Press).

3) Senior Practical Physical Chemistry, B.D.Khosla and V.S.Garg (R.Chand and Co., Delhi).

4) Advanced Practical in Physical Chemistry, Pande Datar Bhadance, Manali Prakashan.

PGCH-207: INORGANIC CHEMISTRY PRACTICAL 2Credits

Course Learning Outcomes:

At the end of course student will be able to –

CO 1 : Study the gravimetric and volumetric analysis of ores and alloy.
CO 2 : Prepare and characterize various inorganic complexes and determine its % purity.
CO 3 : To understand the chromatographic techniques.
CO 4 : Learn to calculate and understand equilibrium constant, Simultaneous determination and Effect of Temperature, time and pH on the stability of M-L systems by Colorimetry
CO 5 : Study experiments based on Thermochemistry
CO 6 : Complexometric determination using potentiometry, analysis and interpretation learn

I. **Ore Analysis (any two of the following):**

1) Determination of Mn from pyrolusite by a) gravimetric & b) volumetric methods.

2) Determination of Fe from haematite by a) gravimetric & b) volumetric methods

3) Determination of Cu from chalcopyrite by a) gravimetric & b) volumetric method.

4) Determination of Ti from ilmenite by a) gravimetric & b) volumetric methods

II. Alloy Analysis (any two of the following)

1) Determination of Tin and Lead from solder.
2) Determination of Copper & Nickel from cupronickel.
3) Determination of Chromium & Nickel from nichrome.

III. Preparation and characterization of inorganic compounds by physical or chemical methods (any five of the following)

1. Reinecke's salt.
2. Potassium trisoxalato aluminate (III).
3. Potassium trisoxalato ferrate (III).
4. Trisethylene diammine nickel (II) thiosulphate.
5. Tristhiourea copper (I) chloride.
6. Potassium trisoxalato manganate (III).
7. Chloropentammine cobalt (III) chloride.

IV. Colorimetry (two of the following)

1. Equilibrium constant for M-L systems such as

   (i) Fe (III) – Salicylic acid.
   (ii) Fe (III) – Sulphosalicylic acid.
   (iii) Fe (III) – β – resorcilic acid

   By Job's method and mole – ratio method.

2. Determination of

   (i) Ni^{+2} with Dimethyl glyoxime.
   (ii) Ti^{+4} with Hydrogen peroxide.
   (iii) Simultaneous determination of the following (any two).

   (a) Cr^{+6} and Mn^{+7} from given mixture.
   (b) Ti^{+4} and V^{+5} from given mixture.
   (c) Co^{+2} and Ni^{+2} from given mixture.

3. Effect of Temperature, time and pH on the stability of M-L systems such as

(i) Fe (III) – Sulphosalicylic acid.
(ii) Co (II) – R – Nitroso salt.
(iii) Fe (III) – thiocyanate.

4. Effect of impurity on Beer's law for

(i) Ni^{+2} on Co^{+2} – R – Nitroso salt.
(ii) Fe^{+3} on V^{+5} – Hydrogen peroxide.
(iii) Cu^{+2} on Fe^{+3} – Sulphosalicylic acid.

5. Photometric titrations such as

(i) Cu^{+2} – EDTA.
(ii) Fe^{+3} – sulphosalicylic acid.
(iii) Co^{+2} – R – nitroso salt.
(iv) Ni^{+2} – ethylenediammine.

V. Thermochemistry (any two of the following).

1. Lattice energy of binary salts by heat of dissolution systems such as $CaCl_2$, $CuCl_2$, $MnCl_2$, $CoCl_2$, $NiCl_2$.
2. Thermometric titrimetry of M – L systems such as

(i) Cu (II) – ammonia.
(ii) Hg (II) – iodide.
(iii) Ni (II) – EDTA.

3. Spectrochemical series: Systems such as

(i) Cu (II), Ni (II), Co (II) with conc. HCl, ammonia, EDTA.

VI. Potentiometry (any one of the following) :

1. Complexometric determination using disodium – EDTA of

(i) Ni (II)
(ii) Co (II)
(iii) Al (III)
(iv) Cu (II).

2. Determination of Zn with K_4 [Fe $(CN)_6$].

VII. Conductometry (any one of the following:

1. Electrolytic nature of transition metal compounds such as $[Co(NH_3)_6]$. Cl_3; K_3 $[Co(NO_3)_6]$; K_3 [Al $(C_2O_4)_3$].
2. Conductometric titration of H_3PO_4 with NaOH.

Reference :-

1. A test-book of quantitative inorganic analysis : A.I.Vogel, ELBS, 4th Edition.
2. Instrumental methods of analysis: H.H. Willard, J.A. Dean & L.L. Merit. (CBS).
3. Instrumental methods of analysis: Chatwal and Anand.
4. Principles of Instrumental analysis: D.Skoog and D.West.

PGCH-208: ORGANIC CHEMISTRY PRACTICAL 2Credits

Course Learning Outcomes:

At the end of course student will be able to –

CO 1 : Summarize the purification technique, separation and identification technique i.e. Recrystallization, distillation fractional distillation, chromatography and solvent extraction are used for all types of organic compound.
CO 2 : Analyze the preparation process such as nitration, oxidation and reduction, esterification, and chalcone formation
CO 3 : Preparation of organic compounds and derivatives, their purifications and run TLC
CO 4 : Judge the reaction mechanism and synthesis process.
CO 5 : Determination of physical constant: Melting point, Boiling point.
CO 6 : Learn and understand different separation techniques.

Content:

(1) Techniques:- Crystallisation, fractional crystallization, simple distillation, fractional distillation, vacuum distillation, steam distillation, sublimation and TLC.
(2) Derivatives:- 2,4 DNP, Semicarbazone, Acetyl and Oxime.
(3) Single stage preparations. (Any five)

(i) Benzaldehyde to Cinnamic acid.
(ii) Benzil to Benzilic acid.
(iii) Benzoin to Benzil.
(iv) Cyclohexanol to Cyclohexanone.
(v) Phthalimide to Anthranilic acid.
(vi) Benzoic acid to Benzamide.
(vii) Cyclohexanone to Adipic acid.
(viii) Nitrobenzene to Aniline.

(4) Two stage preparations (Any three)

(i) Cyclohexanone $\longrightarrow$ oxime $\longrightarrow$ Caprolactum.
(ii) Nitrobenzene $\longrightarrow$ m-dinitrobenzene $\longrightarrow$ m-nitroaniline.
(iii) Aniline $\longrightarrow$ benzenediazonium chloride $\longrightarrow$ Iodobenzene.

(iv) Benzaldehyde ⟶ chalcone ⟶ Epoxide.

(v) Chlorobenzene ⟶ 2,4 dinitrochlorobezene ⟶ 2,4 dinitrophenol.

(5) Binary mixtures (Ether separation only) (Any six).

Separation & characterization of two Components.

Solid –Solid, Solid – Liquid, Liquid – Liquid (non-volatile)

(6) Computer applications: (1) Conformational energetics of simple organic molecules through molecular mechanics force fields.
(2) Insights for reaction mechanisms of simple SN1 and SN2 reactions.

Reference Books –

1) A text-book of practical organic chemistry by A.I.Vogel,4th edition, ELBS / Longman.
2) A hand book of quantitative and qualitative analysis by H.T.Clarke, Orient Longman.
3) Practical organic chemistry by Mann and Saunders.
4) Practical organic chemistry by O.P.Agarwal.

PGAEC-209: SCIENTIFIC WRITING

Total Credits: 02 **Total Lectures: 30Hrs**

Course Learning Outcomes:

At the end of course student will be able to –

CO 1 Learn to write different scientific documents
CO 2 Understand report writing of project work, presentations
CO 3 Learn writing of paper as per format

Course Content:

UNIT I: General aspects.

Organising time, Organizing information and ideas eg. writing - adopting a scientific style, Developing technique, Getting Started Revising your text with

the help of words and phrases, sentences, paragraphs, using dictionaries, using a thesaurus, using guides for written English.

UNIT II: Review writing

Organizing time, making a plan Construct possible content and examples, construct an outline, Start writing, Reviewing your write-up.

UNIT III: Reporting practical and project work

Practical & project reports Thesis Structure of reports of experiment works - Title, Authors & their institution, Abstract Summary, List of Contents. Abbreviations, Introduction, Materials and Methods Results Discussion / conclusions, Acknowledgements, Literature cited (Bibliography) Production of a practical report choose the experiment, make up plants, write, Revise, prepare final version. Submit Producing a Scientific paper Assessing potential content, choosing a journal, writing, submitting. Responding to referees comments checking proofs & waiting for publication.

UNIT IV: Writing literature surveys

Selecting a topic Scanning the literature and organizing references, Deciding on Structure and content Introduction, Main body of the text, conclusion, References, Style of literature surveys.

UNIT V: Organizing a poster display

Preliminaries, Design, Layout, Title Text, Sub titles and headings, Colour Content. Introduction, Materials and Methods, Results and conslusion. The poster session.

UNIT VI: Giving an oral presentation.

Preparation - Preliminary information, Audio - Visual aids, Audience. Content - Introductory remarks, the main message. Concluding remarks on presentation.

UNIT VII: Writing research paper:

Title, Authors and address, Abstract, Key words, Introduction, Materials and Methods, Results & Discussion / conclusions, Acknowledgements, Literature cited (Bibliography)

Literature Cited

1. Day Robert A. : How to write and publish a scientific paper.
2. Gibaldi Joseph: MLA handbook for Writers of Research Papers.
3. Kothari R. C. : Research Methodology, Methods and Techniques, 2nd revised edition, New Age International.
4. Ranjit Kumar: Research Methodology.