Federal Urdu University

of Arts, Science and Technology

Syllabus

Inorganic Chemistry

(BS & MSc)

Department of Chemistry

2012

BS: 1st Year

Title of the Course: Inorganic Chemistry Code: CHEM-151
Credit Hours: (3+1) Marks: 100

The Periodic Law and Periodicity (4 credit)
Development of periodic table.s, p, d, and f block elements. Group trends and periodic properties in s, p, d and f block elements i.e., atomic radii, ionic radii, ionization potentials. Electron affinities, electronegativities, redox potential, melting and boiling points.

Chemical Bonding (5 credit)
Nature and types of chemical bonding, Lewis concepts, Valence Bond Theory (VBT), Molecular Orbital Theory (MOT). Interpretation of shapes of inorganic molecules on the basis of valence shell electron pair repulsion (VSEPR) theory and hybridization.

Chemistry of the s-block Elements (3 credit)
Anomalous behavior of Li and Be. General Characteristics of alkali metals and alkaline earth metals with reference to oxides, hydroxides and carbonates.

Chemistry of the p-block Elements
General characteristics of the following group of p-block elements with reference to the aspects given against each:

Boron and Aluminum **(3 credit)**
Group anomalies: Boron and aluminium hydrides: Structures and properties of Diborane only.

Carbon and Silicon **(3 credit)**
Group anomalies. Allotropic forms of carbon, fullerenes and their applications. Production of pure silicon for solar energy and silicon chips.

Nitrogen and Phosphorus **(3 credit)**
Group anomalies. Preparation, structures, properties of oxides and hydrides of nitrogen and Phosphorous. Oxy acids of Phosphorous.

Oxygen and Sulfur **(3 credit)**
Group anomalies. Preparation, structures, properties of oxides and oxyacids of sulphur and their uses. Commercial uses of Hypo.

The Halogens **(3 credit)**
Anomalous behaviour of fluorine. Preparation, structures, properties and uses of oxides, oxyacids of chlorine, interhalogens.

***The Noble Gases* (3 credit)**
Preparation, properties, structures and uses of xenon fluorides; Commercial uses of noble gases.

Chemistry of d-block Elements (10 credit)
Electronic configuration. General characteristics of d-block elements (Only first series elements) e.g. atomic size, ionization potential, melting point, boiling point, variable valency, colour complex formation. Coordination compounds. Werner's Theory, Valance bond theory (for co-ordination no. 4, 6), Crystal field theory, (for octahedral complexes only). Nomenclature. Introduction to chelates. Isomersim.

Metallurgy (5 credit)
General methods of extraction. Metallurgy of Aluminum, Iron (Steel) and Sodium.

PRACTICALS
Fifteen experiments shall be conducted based on the following:

1. Qualitative analysis
Analysis of four ions (two anions and two cations) from mixture of salts (06)
2. Quantitative analysis
a) Complexometry
* Estimation of Mg^{2+} in different samples using EDTA.
* Estimation of Ca^{2+} in different samples using EDTA.

b) Iodometry
* Estimation of $Cu^{2+}/CuSO_4$ in different samples using $Na_2S_2O_3$.

c) Redox titration
* Estimation of Fe^{2+}/Fe^{3+} ions using $K_2Cr_2O_7$ solution.
* Estimation of $C_2O_4^{2-}/K_2Cr_2O_4$ using $KMnO_4$ solution.

d) Gravimetric Estimation
* Gravimetric Estimation of Ni^{2+}
* Gravimetric Estimation of Pb^{2+}
* Gravimetric Estimation of SO_4^{2-}
* Gravimetric Estimation of $C_2O_4^{2-}$

e) Preparations
* Preparation of inorganic compounds e.g. FeC_2O_4, $FeSO_4$

Recommended Literature

1. Huheey, J. E., Keiter, E. A. and Keiter, R. L., “Inorganic Chemistry: Principles of Structure and Reactivity”, 4th Ed., Harper and Row, New York, 2001
2. Cotton, F. A., Wilkinson, G. and Gaus, P. L., “Basic Inorganic Chemistry”, 3rd Ed., Wiley, New York, 1995.
3. Clyde Day, M. & Selbin, J., “Theoretical Inorganic Chemistry”, 2nd Ed., Van Nustrand Reinhold, 1969.
4. Lee, J.D., “Concise Inorganic Chemistry”, Chapman and Hall, 5th Edition,1996.
5. Shriver, D. F., Atkins, P. W. and Langford, C. H., “Inorganic Chemistry”, Oxford University Press, 2nd Edition, 1994.
6. Bassette, J., Denney, G. H. and Mendham, J., “Vogel’s Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis” English Language Book Society, 4th Edition, 1981.
7. Vogel, A. I., “A Textbook of Micro and Semi-micro Qualitative Inorganic Analysis” Longman Green & Co. 1995.

BS: 3rd Year, Semester V
M.Sc. (Previous), Semester-I

Title of the Course: Inorganic Chemistry Code: CHEM-251
Credit Hours: (3+1) Marks: 100

1. PRINCIPLES OF CHEMICAL BONDING (9 credits)

- Types of Chemical bonding
- The localized bond approach VB theory “hybridization and resonance”.
- The delocalized approach to bonding, molecular orbital theory “MOT” as applied to homonuclear and heteronuclear diatomic molecules.
- Metallic bonding “conductors, insulators and semiconductors”.
- Hydrogen bonding

2. CHEMISTRY OF NON TRANSITION METALS

- **Hydrogen (3 credits)**
  Position in the periodic table, properties, Hydrogen ions, Reactive forms, preparation properties and uses of “ionic, covalent and metallic” hydrides.

- **Boron (4 credits)**
  Boranes “Preparation, properties, structure and uses”.

- **Phosphorous (4 credits)**
  Preparation, properties, structure and applications of Hydrides, halides, oxides and oxyacids.

- **OXYGEN (3 credits)**
  Preparation, Properties, structure and application of oxides

- **HALOGENS (6 credits)**
  Gradation and comparison in properties, Anomalous behavior of fluorine, oxides, halides, interhalogens, pseudohalogeus “preparation, properties structure and uses”.

- **NOBLE GASES (4 credits)**
  Monoatomic nature, history, Isolation, compounds of noble gases – “Valence bond approach”, clathrates

3. Periodic relationship of the transition elements (6 credits)

- General properties and comparison of first, second and third series of transition elements with reference to atomic radii, ionization potential or energies, melting and boiling points, reactivity, oxidation states, complex formation, standard electrode potentials, reducing properties, colour, magnetic properties, catalytic properties, non-stoichio-metry, Nomenclature.

4. GENERAL DISCUSSION OF LANTHANIDES AND ACTINIDES (6 credits)

- Electronic configuration and position in the periodic table, oxidation states, magnetic property, lanthanide contraction and its effect, occurrence and preparations complexes, comparison of lanthanides and actinides, applications of lanthanides and actinides and their compounds.

PRACTICALS

Fifteen experiments shall be conducted based on the following:
Semi micro qualitative analysis of mixtures containing six radicals.

Recommended Literature

1. Inorganic Chemistry by James and Huhey
2. Inorganic Chemistry by B.Z. Shaw
3. Coordination Chemistry by Basalo and Johnson
4. Coordination Chemistry S.F.A. Kettle
5. Modern coordination chemistry by Lenis and Wilkins
6. Valency and Molecular structure by Cartmell and Fowles
7. Quantitative Inorganic Analysis by Vogel
8. Mechanism of Inorganic reaction by Basalo and Pearson
9. Books Published from Tasneef-O-Taleef F. Urdu University
10. Amli kimya by Syed Ziauddin Mehmood and Arshia Salahuddin
11. Inorganic Chemistry by R.D Madan
12. Advance Inorganic Chemistry by Cotton & Wilkinson

BS: 3rd Year, Semester VI
M.Sc. (Previous), Semester-II

Title of the Course: Inorganic Chemistry Code: CHEM-351
Credit Hours: (3+1) Marks: 100

CHEMISTRY OF COORDINATION COMPOUNDS

1. Theories of bonding in complexes (10 credits)

I. Werner's theory
II. Valence bond theory
III. Crystal field theory, crystal field stabilization energy
IV. Molecular orbital theory

John teller theorem
Isomerism in complexes
Stereochemistry, geometry of complexes having co-ordination number 2 to 9

2. Techniques for studying complexes and application of co-ordination compounds (3 credits)

3. Reaction mechanism in coordination compounds (4 credits)

General Discussion
Basic principles of chemical kinetics
Stability constant
Factors on which feasibility of reaction depends

4. Substitution reaction in Octahedral Complexes (10 credits)

Dissociative mechanism
Associative mechanism
Substitution reactions in octahedral complexes
Water exchange reactions
Aquatin
Base hydrolysis
Anation reactions

5. Substitution reactions in square planar complexes (4 credits)

Trans effect
Inert and labile complexes

6. Redox reactions in complexes (4 credits)
Inner sphere electron transfer mechanism
Outer sphere electron transfer mechanism

7. Chemistry of metal carbonyls (10 credits)
Mono nuclear and poly nuclear metal carbonyls
The eighteen electrons rule as applied to metal carbonyls
Rationalization of molecular structure
Evaluation of structure based on spectroscopic evidence
Chemistry of metal carbonyls and their derivatives “nitrosyls, halides and hydrides”.

PRACTICALS

Fifteen experiments shall be conducted based on the following:

1. Synthesis of complex (at least two) and estimation of its components.
2. Gravimetric estimation of Ba^{+2} as $BasO_4$
3. Gravimetric estimation of $C_2O_4^{-2}$ as CaC_2O_4.
4. Redox titration of Cu (II) against KIO_3.
5. Redox titration of Fe (II) against ceric sulfate.
6. Confirmation of cations by paper chromatography.
7. Estimation of two halides by adsorption indicator.
8. Complexometric titration
9. Spectrophotometric determination of ions

Recommended Literature

1. Huheey, J. E, Keiter, E. A. and Keiter, R. L., “Inorganic Chemistry: Principles of Structure and Reactivity”, 4th Ed., Harper & Row, New York, 2001.
2. Cotton, F. A., Wilkinson, G., Murillo, C. A. and Bochmann. M., “Advanced Inorganic Chemistry”, 6th Ed., Wiley-Intersceince, New York, 1999.
3. Greenwood, N. N., and Earnshaw, A., “Chemistry of the Elements”, 2nd Ed., Pergamon Press, New York, 1992.
4. Willium W. Porterfield. Inorganic chemistry, Unified approach, Elsevier company, Delhi, (2005)
5. Mackay, K. M., Mackay, R. A. and Henderson, W., “Introduction to Modern Inorganic Chemistry”, 5th Edition, Stanley Thomas Publisher Ltd. 1996
6. Bassette, J., Denney, G. H. and Mendham, J., “Vogel’s Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis” English Language Book Society, 4th Edition, 1981.

BS 4th Year Semester-VII
M.Sc. (Final), Semester-I

Title of the Course: Solid State Chemistry & Magneto Chemistry

Code: CHEM-452

Credit Hours: (4+0) Marks: 100

Introduction (15 Credits)

General differences b/w solid, liquid & gases – types of solids on basis of, Structure, Bonding and Conductance. Molecular orbital theory for solids, Formation of band, Dependence of band width on strength of interaction between atoms, Density of states, Fermi level, Types of solids based on electrical conductivity (Insulators, Conductors and Semi conductors),Temperature dependence on electrical conductivity, Dividing lines between insulators/conductors/semiconductors.

Semi Conductors (10 Credits)

Definition, types, mechanism, Acceptor/p-type doping, donor/n-type doping, Applications of semi cond. Pn-Junction, biasing (forward/reverse), Control valency semi conductosr, Colour in inorganic solids-d-d-transition, change transfer effect, transition of electrons b/w energy bands, Solid solutions (substitutional , interstitial)

Super conductors (05 Credits)

low temp, High temp, cooper pair mechanism, meissner effect, applications.

Crystallography (15 Credits)

Basic terms: Crystals, crystal lattice, lattice,sites, crystal faces, unit cell, inter facial angle, International table for crystallography Bravais lattice & crystal system, Crystal structure of metals, Crystal structure of ionic compounds.

Calculations of : lattice type from density and unit cell dimensions, no. of atoms in body centred cubic structure (B.C.C), no. of atoms in face centred cubic structure (F.C.C), avagadro's no. from density and unit cell dimensions (in B.C.C & F.C.C), Unit cell dimensions, radius from length of cell (in B.C.C & F.C.C), metallic radius of metal (in B.C.C & F.C.C), density from cell dimension, No. of ions in a unit cell of ionic crystal, ionic radius, avagadro's constant in ionic crystals, length of Edge of unit cell

Crystal Defects (05 Credits)

Definition, Importance & types (Intrinsic: Schottky & frenckel defects ,Extrinsic defects, Atom Interchange defeets, Extended defects, Colour centre.

MagnetoChemistry: (10 Credits)

Introduction to magnetochemistry, Theory of magnetism, Magnetic states, Types of magnetism (Paramagnetism, Diamagnetism, Ferromagnetism, Ferrimagnetism, Anti-Ferro magnetism), Magnetic moments, Magnetic susceptibility (Temp dependence), Importance of magneto Chemistry, Study of magnetism in transition metal complexes with the help of magnetic moments, Gouy's method

Books Recommended

- Solid state chemistry and its applications by Anthony R. west
- Inorganic material chemistry by Mark T. weller
- Material science & Engineering by William D. Callisters Jr.
- Chemistry (Structure & Dynamics) by James N. Spancer
- Chemistry (the central science) by Theodor L. Brown
- General Chemistry by Kenneth whiter, Deris pecle
- Inorganic Chemistry by shriver & Atkins
- Consise inorganic chemistry by J.D. Lee
- Basic Inorganic Chemistry by cotton & willinson
- Modern Inorganic Chemistry by William L. Jolly
- Advanced Chemistry by Philip Matthews.

BS 4th Year Semester-VII
M.Sc. (Final), Semester-I

Title of the Course: Group theory and basics of IR Code: CHEM-453

Credit Hours: (4+0) Marks: 100

Introduction: Symmetry as a universal theme, Symmetry in Chemistry, Coordinate System **(02 Credits)**

The relation between symmetry and optical activity (**03 Credits)**

Symmetry elements and symmetry operations: Rotation about a symmetry axis, Mirror Plane, inversion, Improper rotation and Identity. **(11 Credits)**

Symmetry properties of orbitals **(03 Credits)**

Point group and classification of molecules **(15 Credits)**

According to point group: Multipilcity table**,** Character table and its importance, Reducible and irreducible character**(06 Credits)**

Application of group theory on: (a) Atomic and Molecular orbital, (b)Detection of Hybrid orbitals of group theory, (c) Reducible representation and prediction of IR and Raman spectra and their selection rules **(10 Credits)**

Prediction of Chirality and optical activity of the molecules by using their point group. **(10 Credits)**

Books Recommended

- Symmetry in Chemistry by Jaffe and Cheng

BS 4th Year Semester-VII
M.Sc. (Final), Semester-I

Title of the Course: Organometallic Chemistry Code: CHEM-454
Credit Hours: (4+0) Marks: 100

Introduction and application of organometallics (05 Credits)

Classification of organometallics (05 Credits)

a) On the basis of Ligand (Charge, hepaticity, nature of bonding i.e. σ/π, number of electrons)
b) On the basis of periodic table((ionic, Covalent, volatile and transition metal organometallics)

Synthesis of organometallics (10 Credits)

a) Metal-carbon σ bond:
   - Metal alkyls and aryls:
     - Direct reaction of metal with organic halides (Li, Na, Mg, Hg, Al, Si)
     - Transmetallation (Metals of Group IA, IIA & IIIA except B)
     - Metathesis (Metalloids of Group IIIA, IVA & VA)
     - Oxidative addition (One electron and two electron oxidative additions in d^7, d^8 & d^{10} systems)
     - Metallation (Lithiation)
     - Hydrometallation (Hydroboration and hydrosilation)
   - Metal Carbonyls (neutral and anionic) including carbonyl hydrides and halides
b) Metal-carbon π bond:
   - Metal olefins & acetylenes (addition and substitution)
   - Metal η^3-allyls through σ bonded η^1-allyl intermediate
   - Metallocenes of Fe, Mo
   - Bisarenes of Cr, Mo & W (Fischer Aluminum reduction & Metal vapor method)

Fundamental reactions of organometallics (10 Credits)

a) Migratory insertion (Migration vs. insertion, carbonyl & alkene migratory insertions)
b) Elimination (α-hydride, β-hydride, carbonyl & methyl eliminations)

c) Oxidative addition (with non-electrophilic, non-electrophilic intact & electrophilic substrates)
d) Reductive elimination
e) Ligand addition and substitution

18 & 16 Electron Rule, Effective atomic number (EAN), oxidation states, stability, nomenclature, structure and bonding (VBT, MOT, CFT) in mono and polynuclear (cluster) organometallics and sandwich structures (10 Credits)

Experimental techniques in organometallics (10 Credits)

Ttechniques using Schlenk glassware, chemical analysis, IR Raman, photoelectronic, Mossbauer and NMR spectroscopy, X-ray & neutron diffraction.

IR spectroscopy of Metal carbonyls (10 Credits)

Factors affecting IR stretching frequencies (π back-donation, bonding modes, ligand donation effect)

Recommended Books:

1. **Douglas B., Mc Daniel D. & Alexander J.** "*Concepts and Models of Inorganic Chemistry*" John Wiley & sons, Inc. 3rd Ed. (1994).
2. **Huheey J. E.** "*Inorganic Chemistry Principles of Structure and Reactivity*" 2nd Ed. Harper & Row publishers (1978).
3. **Mackay K. M, Mackay R. A. & Handerson W.** "*Introduction to Modern Inorganic Chemistry*", 5th Ed. Stanley Thornes (publishers) ltd. (1996).
4. **Purcell, K.F., Kortz, J.C.** "*An Introduction to Inorganic Chemistry*" Saunders college publishers (1980).
5. **Shriver D.F., Atkins P.W. and Langford C.H.** "*Inorganic Chemistry*" Oxford University press (1990).

BS 4th Year Semester-VII
M.Sc. (Final), Semester-I

Title of the Course: Advance Practical-I Code: CHEM-451
Credit Hours: (0+4) Marks: 100

A. 1. Lab Safety measurements
2. Management of experiments
3. Preparation of solutions
4. Awareness about accuracy & precision, error minimization
5. Preparation of Lab reports

B. 1. Synthesis of complexes and inorganic compounds
Characterization of synthesized complexes y classical method of analysis and instrumental method of analysis

2. Quantitative Analysis of:
Caustic Soda
Washing Soda

3. Analysis of Acid Mixtures
Mixture of HCl & H_2SO_4
Mixture of H_2SO_4 & $H_2C_2O_4$
Mixture of H_2SO_4 & $H_2C_2O_4$ & H_3BO_3

4. Analysis of H_2O_2
Analysis of H_2O_2 as a reducing agent by $KMnO_4$
Analysis of H_2O_2 as a Oxidizing agent by iodometry

5. Estimation of following mixture of cations in a solution through volumetric, Gravimetric, instrumental mthod.
Fe^{+2}, Fe^{+3}, Al^{+3}
Ca^{+2}, Mg^{+2}, Mn^{+2}
Ni^{+2}, Ca^{+2}
Na^{+2}, K^{+}, Ca^{+2}

C. 1. Continuous Assessment Quiz
2. Literature Survey
3. Seminars

Recommended Literature

- Quantitative Vogel's Analysis
- An introduction to chemical analysis by Harris CO. E
- Practical Inorganic Chemistry by Marr. G. & Rocke H B.W.
- Experimental Chemistry by Hatch R.C

BS 4th Year Semester-VIII
M.Sc. (Final), Semester-II

Title of the Course: Kinetics and Mechanism of Inorganic Reactions

Code: CHEM-552

Credit Hours: (4+0) Marks: 100

Revision of basic concepts of (05 Credits)

Reaction kinetics with particular reference to the effect of concentrations of reacting species (order of reaction), effect of temperature and pressure (entropy, enthalpy and volume of activation), Ionic strength and diffusion controlled rates.

Methods of measurement of reaction rates of (10 Credits)

Slow reactions, initial rate methods, absorbance, conductance and other conventional techniques. Fast reactions using stopped-flow, pulse radiolysis, flash photolysis and relaxation methods (T-jump and p-jump).

Relationship b/w rate law and reaction mechanism (05 Credits)

Single and multiterm rate laws, fractional and inverse order reactions and their implications on mechanism, steady state approximation and rapid equilibrium prior to rate determining step, inert and labile comlpexes.

Substitution reactions (10 Credits)

Classification (associative, dissociative & interchanged mechanisms), Effect of non-labile ligands (trans effect, cis effect, electronic/steric effect), nucleophilic reactivity, role of leaving group & metal centre, field considerations, solvent effects, activation parameters. Selected examples from octahedral and square planar systems (acid & base hydrolysis, aquation, anation), stereochemical changes in substitution reactions.

Redox reactions (10 Credits)

Precursor and successor complexes, inner sphere & outer sphere electron transfer reactions, role of bridging ligand, factors contributing to activation energy in the pre-exponential and exponential terms, adiabatic and non-adiabatic electron transfer, Marcus-Hush theory.

Photochemistry (10 Credits)

key definitions (fluorescence, phosphorescence), intersystem crossing, quantum efficiency, Einstein, Stern-Volmer plots etc), Jablorski's diagram modes of excitation of transition metal complexes. Selection rules: Thermal and antithermal substitution reaction, photochemically induced redox reactions, attempts to split water molecule for H_2 production using solar energy.

Catalysis of organic reactions by inorganic systems (10 Credits)

Catalytic efficiency, selectivity and half life of catalyst, catalytic cycle /steps (oxidative addition, reductive elimination, migratory insertion of ligands), selected examples of homogeneous catalysis (oxidation of alkene into aldehyde, Monsanto acetic acid synthesis, Wilkinson's catalyst), selected examples of heterogeneous catalysis (synthesis of ammonia and sulfuric acid).

Books recommended:

- **Shriver DF, Atkins PW & Langford CH** "Inorganic chemistry" (1994) Oxford University Press
- **Jordan RB** "Reaction mechanisms of inorganic & organometallic systems" 2nd Ed (1991) Oxford University Press, Inc
- **Cotton FA, Wilkinson G, Murillo CA & Bockhmann M** "Basic inorganic chemistry" 2nd Ed (1987) John Wiley & Sons, Inc
- **Wilkins RG** " Kinetics & mechanism of reactions of transition metal complexes" 2nd thoroughly revised Ed (1991) VCH publishers, Inc
- **Bond GC** "Heterogeneous catalysis" 2nd Ed (1987) Clarendon Press Oxford
- **Cox & Camp TJ** "Principles and applications of photochemistry (1988) Oxford university Press

BS 4th Year Semester-VIII
M.Sc. (Final), Semester-II

Title of the Course: Applications of Instrumental Techniques

Code: CHEM-553

Credit Hours: (4+0) Marks: 100

Nuclear Magnetic resonance spectroscopy: theory, techniques, applications and problems related to NMR. **(20 credits)**
Electron spin resonance spectroscopy: theory, various techniques, applications and problems related to ESR. **(10 credits)**
Rotational and vibrational spectroscopy: Infra red and Raman spectroscopy theories and derivation of related equations. **(12 credits)**

Characterization of complexes with respect to IR & Raman Spectra. **(03 credits)**

Detection of Functional groups and study of finger print region. **(03 credits)**

UV-Visible spectra of Transition Metal complexes with reference to d-d Transitions. Interpretation of spectra of complexes with the help of Tanabe Sugano Diagram. **(12 credits)**

Books Recommended

1. Lee JD “Concise Inorganic Chemistry” Chapman and Hall 5th Ed (1995)
2. Shriver DF, Atkins PW, and Langford CH “Inorganic Chemistry” (1994) Oxford University Press
3. Gould ES “Inorganic Reactions and Structures” Revised Ed (1962) Holt, Rinehart and Winston, Inc
4. Harrington TJ and Earnshaw A “The Chemistry of the Transition Elements” (1973) Oxford University Press.
5. RH Pavia “Introduction to analytical chemistry” (3rd addition)

BS 4th Year Semester-VIII
M.Sc. (Final), Semester-II

Title of the Course: Bioinorganic Chemistry Code: CHEM-554
Credit Hours: (4+0) Marks: 100

Development and Importance of Bio-inorganic Chemistry **(04 credits)**

Introduction to Micro & Macro nutrients of biological importance **(6 credits)**

Role of different metals (essential & toxic) in biological system **(14 credits)**

Metal deficiencies and metal overload in biological system, **(6 credits)**

Protein peptides, Metalloproteins **(5 credits)**

Transferrin and Ferritin, Iron Sulphur proteins, Iron transport mechanism, **(4 credits)**

Metallo-enzymes and metal activated enzymes, Carbonic anhydrase, Carboxy peptidase, Alkaline phosphatase **(6 credits)**

Chlorine and prophyrin metal complexes, Oxygen carriers **(5 credits)**

Cytochrome, myoglobin and haemoglobin, haemocyanin vitamin B_{12} **(5 credits)**

Nitrogen Fixation**,** Chelation Therapy**,** Metallotherapy, Photosynthesis **(5 credits)**

Books Recommended

1. Hay RW “Bio-Inorganic Chemistry” (1987) Ellis Horwood Limited
2. Lippard S J and Berg JM “Principles of Bioinorganic Chemistry” University Science Books

BS 4th Year Semester-VII
M.Sc. (Final), Semester-I

Title of the Course: Advance Practical-II Code: CHEM-551

Credit Hours: (0+4) Marks: 100

This laboratory course would be based on the introduction of fundamental techniques of instrumental analysis. The instruments include single beam spectrophotometer, double beam spectrophotometer, atomic absorption spectrophotometer,fluorimeter, ion chromatograph and high performance liquid chromatograph and introduction to statistical treatment of analytical data.Determination of wavelength of maximum absorption, construction of calibration curves by Beer's law, standard addition method, internal standard method, photometric titrations, simultaneous determination of metals ions, determination of metal-to ligand ratio by Job's plot and molar ratio method, trace analysis by atomic absorption using flame, hydride generation for As and cold vapor technique (for Hg),fluorometric determination of acetylsalicylic acid in analgesic tablets, analysis of mixture by HPLC or ion chromatography.

Recommended Literature

1. Harris D "Quantitative Chemical Analysis" 5th Ed (1998) W.H. Freeman and Company
2. Mendham J,Denney RC, Barnes JD and Thomas MJK "Vogel's Quantitave Analysis" 6th Ed (2000) prentice Hall.