VEER NARMAD SOUTH GUJARAT UNIVERSITY
M.Sc.-II (INORGANIC CHEMISTRY)
TO COME IN FORCE FROM JUNE-2011
PAPER-I

Max. Marks: 70 **Total Periods: 45**

SEMESTER – III

Unit-I: Chemistry of Non – Transition Elements (15 periods)

General discussion on the properties of the non – transition elements, special features of individual elements, synthesis, properties and structure of halides and oxides of the non – transition elements, Polymorphism in carbon, phosphorous and sulphur, Synthesis, properties and structure of boranes, carboranes, silicates, carbides, phosphazenes, sulphur –nitrogen compounds, peroxo compounds of boron, carbon,sulphur, structure and bonding in oxyacids of nitrogen, phosphorous, sulphur and halogens, interhalogens, pseudohalides.

References:

1) A. F. Wells, Structural Inorganic Chemistry – 5th edition (1984)
2) J. H. Huheey, Inorganic Chemistry - Principles, structure and reactivity, Harper and Row Publisher, Inc. New York (1972)
3) J. D. Lee, Concise inorganic Chemistry, Elbs with Chapman and Hall, London
4) M. C. Day and J. Selbin, Theoretical Inorganic Chemistry, Reinhold, EWAP
5) F. A. Cotton, R. G. Wilkinson. Advanced Inorganic chemistry
6) Willam L. Jooly, Modern Inorganic Chemistry

Unit-II: Organometallic Compounds (15 periods)

1. Introduction, definition and scope of organometallic Chemistry
    a) valence electron count
    b) 18 and 16 electron complexes
2. d-block carbonyls:
    a) coordination modes
    b) characterization
    c) synthesis
    d) reactions
    e) carbonyl metallates
    f) ligands related to CO
3. σ-organyls: Synthesis, bonding, Properties and applications of
    a) alkyls
    b) aryls
    c) alkenyls
    d) acyl
    e) alkynyls
4. Metal-Carbon multiple bonded compounds: Synthesis, bonding, Properties and applications of

b) carbenes
c) carbines

5. Π-complexes
   a) alkene
   b) d—and polyenes

6. η^{n}-C_nR_n carbocyclic polyenes : Synthesis, bonding, Properties and applications of
   a) allyls η^{3}-C_3R_5
   b) pentadienyls η^{5}-C_5R_7
   c) cyclopropenyls η^{3}-C_3R_3
   d) cyclobutadienes η^{4}-C_4R_4
   e) cyclopentadienyls η^{5}-C_5R_5
   f) arenas η^{6}-C_6R_6
   g) cycloheptatrienyls η^{7}-C_7R_7
   h) cyclooctatetraenes.

7. Metal-Metal Bonds and Transition Metal atom clusters.

References:

1. Inorganic Chemistry 3rd edn. D. F. Shriver and P. W. Atkins, Oxford University Press, 1999, Chapter 16.
2. Organotransition Metal Chemistry, Anthony F. Hill, Royal Society of Chemistry, Tutorial Chemistry Text, 2002. Chapters 1 to 7.
3. Organometallics: A concise Introduction, Ch. Elshebroicn and A. Salzer, VCH, Chapters 12 to 16.
4. Organotransition Metal Chemistry: Applications to Organic Synthesis, S. G. Davies, Pergamon 1982.

Unit-III: Bioinorganic Chemistry (15 periods)

1. Recapitulation of Biological Roles of Metals & Ligands
   a) Structural Information
   b) Metal Activity, Specificity & Selectivity
   c) Biochemical Evolution of Metals in Biological System

2. Biological Chemistry of Iron
   a) Transport of Iron
   b) Hemoglobin & Myoglobin (including their model compounds)
   c) Storage & Transport Proteins of Iron viz,. Ferritin & Transferrin
   d) Cytochromes
   e) Iron-Sulfur Proteins

3. Biochemistry of Cobalt
    a) B12 Coenzymes and Model compounds
    b) Actions of Cobalmins & Cobinamides
    c) Adenosylcobalmin as a Coenzyme
    d) Ribonucleotide reductase
    e) Methylcobalmin as cofactor
4. Biological Chemistry of Copper
    a) Type I, II & III
    b) Blue Copper Proteins (Plastocyanins Azurins & Blue Oxidases)
    c) Models of Blue Copper Compounds
    d) Non-blue copper proteins e.g. Tyrosinase, Galactose Oxidase, SOD etc.
5. Biological Chemistry of Molybdenum
    a) Antagonism between Cu & Mo
    b) Mo cofactors
    c) ESR Spectra features
    d) Hydroxylase Enzymes
6. Biological Chemistry of Vanadium and Chromium
    a) Vanadium proteins including bromoperoxidases
    b) Glucose Tolerence Factor
    c) Vanadium Nitrogenase
7. Biological Chemistry of Zinc
    a) Carboxypeptidase and Carbonic anhydrase enzymes

References:

1. Bioinorganic Chemistry: A Short Course –Rosette M.Roat-Malone, Wiley Interscience, 2002.
2. Biological Inorganic Chemistry –An Introduction, Robert Crichton, Elsevier Science, 2007
3. The Biological Chemistry of the Elements- The Inorganic Chemistry of Life J. J. R. Frausto da Silva and R. J. P.Williams Clarendon Press, Oxford,1991.

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PAPER-I

Max. Marks: 70 **Total Periods: 45**

SEMESTER – IV

Unit-I: Photochemistry of Inorganic compounds and coordination compounds **(15 periods)**

Introduction: Photochemical laws and photochemical kinetics: Absorption of light, quantum yield and reactivity, life times, kinetic aspects of photochemical process, temperature dependence of photochemical process and photochemical equipment.

Photo physical process: Introduction, theory and relative processes stimulated absorption, spontaneous emission, selection rules, oscillator strength and radioactive life time, Frank condom principle, theory of non-radiative processes, radiation less transitions and bimolecular.

Characteristic of the electronically excited states of coordination compounds: energy, structure, lifetime, electron distribution and chemical reactivity (Ligand field excited state, Charge transfer excited state and Internal ligand excited state)

Reference book:

1. Fundamentals of photochemistry, K. K. Rohatgi Mukerjee. Wiley Eastern Limited, New Delhi, (1978).
2. Photochemistry, J. G. Calvents and J. N. Pitts. John-Wiley & Sons.
3. Introduction to photochemistry. Wells
4. Photochemistry of solutions. C. A. Parker, Elsevier.
5. Photochemistry of coordination compounds, V. Balzani and V. Carassitti, Academic Press, London (1970).
6. Concept of Inorganic photochemistry. Edited by A. W. Adamson & Paur D. Fleischauer, A Wiley Interscience Publication, New Delhi (1975).

Unit-II: Environmental Chemistry **(15 periods)**

Various type of pollution: Introduction, definition and classification

(A) **Air Pollution:** Sources and sinks of gases pollutants on living and non-living things. Air quality: Standards and sampling. Pollution problem in industrial area, Green House Effect, Acid rain, Ozone layer Depletion and their consequences on environment. Effect of air pollution, photochemical smog, and major air pollution disaster.

(B) **Method of control of air pollution:** Different methods of control of air pollution, precipitation wet and dries scrubber, filters, gravity and cyclonic separation, adsorption, absorption and condensation of gaseous effluent.

(C) **Water pollution:** origin of waste water, types, sources and classification of water pollution, constituent, and oxygen controls of water and aquatic life, oxygen electrode and its use. Effect of water pollutants on life and environment

(D) **Method of control of water pollution:** Water and waste water treatment, aerobic and anaerobic, aeration of water. Principle of coagulation, flocculation, softening, disinfection, demineralization and fluoridation. Objective analysis: Parameter for analysis; color, turbidity, total solids, conductivity, acidity, alkalinity, hardness, chlorine, sulphate, fluoride, silica, phosphate and different form of nitrogen. Heavy metal pollution: Public health signification Cd, Cr, Zn, Pb, Mn, Mg and As. Oxygen controls & aquatic life: DO, BOD, COD and their significance. Pesticides as water pollutants and their analysis.

Reference book:

1. Water pollution. J. E. Jajic, Marcel-Dekker,
2. Air pollution. H. W. Parker, Prentice-Hace
3. Environmental chemistry. A. K. De, Wiley Eastern Ltd, New Delhi.
4. Environmental pollution control in process industries. S. P. Mahajan.
5. Introduction to air pollution. P. K. Trivedi.
6. Environmental pollution Analysis, S. M. Khopkar
7. A text book of Environmental pollution. D.D.Tyagi and M. Mehre.
8. Environmental pollution Engineering and control. C. S. Rao.

Unit-III: Separation and purification Techniques: Chromatography (15 periods)

(A) **General principles:** classification, partition Chromatography, Adsorption Chromatography, Techniques and application of paper, Thin Layer, column, HPLC, GC and electro Chromatography.

(B) **Solvent Extraction:** Basic Principle, significance of various term, classification, factors forming solvent extraction, extraction equilibria, synergetic effect,. Ion-pair extraction, salting out effect and stripping. Techniques of extraction by high molecular weight amines i.e. Crown ethers, cryptomers and calixarenes.

(C) **Ion-exchange separation:** Fundamental principles of ion-exchangers, theories of ion-exchange, exchange capacity, screening effect, penetration of electrolytes into the ions, ion exchange resins, sorption of complex ions, ion exchange equilibrium. Column operation, theory of break through curves, elution steps, use of non aqueous solvent in ion exchange separation, application of ion exchange separation in determination of total salt concentration, removal of interfering ions, separation of anions and methods.

(D) **Gas Chromatography:** principle of gas chromatography, plate theory of G.C, Instrumentation of G.C., working of G.C., Application of G.C.

Reference book:

1. Solvent extraction in analytical chemistry, G. H. Morrison and F. Friesen, John Wiley & sons, New York.
2. Ion exchange and solvent extraction of metal compounds. Y. Macros, A. S. Kertes, Wiley Interscience.
3. Ion exchange separation in analytical chemistry, O.Semalson, John Wiley & sons.
4. Fundamentals of Analytical chemistry. D.A. Skeog. Holy Rinchant.
5. Instrumental methods of chemical analysis, G. W. Eving, McGraw Hills.

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PAPER-II

Max. Marks: 70 **Total Periods: 45**

SEMESTER-III
(SPECTROSCOPY)

UNIT-I : IR AND RAMAN SPECTROSCOPY (15 Periods)

Theory of IR and Raman, selection rules, IR absorption, Raman scattering, Mutual exclusion rule, complimentary techniques, Instrumentation - FTIR and Raman, Cells and sampling techniques, Resonance Raman spectroscopy, Interpretation of IR spectra using correlation charts, Advantages of FTIR spectroscopy, Mid-IR Reflection – DRS, ATR, Data processing in Near IR, Applications in structure elucidation of inorganic and organic molecules.

UNIT-II : NMR SPECTROSCOPY (15 Periods)

Theory of NMR, Relaxation, population of energy levels, Larmor precession, chemical shift and factors affecting it, references and solvents, Spin-spin splitting, Coupling constant, Magnetic Anisotropy, Instrumentation, Shift Reagents, Interpretation of simple NMR spectra, Signal averaging, FT-NMR, Pulse FT-NMR spectroscopy, ^{13}C NMR spectra, NMR in medical diagnostics, Double resonance technique, Multi dimensional NMR, Problems to elucidate structure from NMR spectra.

UNIT-III : MOLECULAR MASS SPECTROSCOPY (15 Periods)

Instrumentation, Methods of ion production (EI, CI, FI, FD, Electro Spray, MALDI), Ion separators, Ion collection and recording, Double focusing, Time of flight analyser, Quadruple-mass spectrometer, Sample handling techniques, Resolution, Parent peak, Base peak, Metastable ions isotope effect, Molecular formula from mass spectra, Nitrogen rule, Ring rule, Fragmentation rules, Behavior of classes of compounds, Interpretation of mass spectra, Additional applications, Problems to elucidate structure from mass spectral data.

Books: On last page.

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PAPER-II

Max. Marks: 70 **Total Periods: 45**

SEMESTER-IV
(SPECTROSCOPY)

UNIT-I: ATOMIC X-RAY SPECTROSCOPY (15 Periods)

Emission of X-ray, continuum and line spectra, X-ray absorption, absorption spectra, Apparatus, Source (monochromatic X-ray), Sample handling, Wavelength and energy dispersive device, Detector, Chemical analysis by X-ray absorption, X-ray fluorescence: Theory, instrumentation and applications, X-ray diffraction: Theory, instrumentation and applications.

UNIT-II: ATOMIC SPECTROSCOPY (15 Periods)

(a) Atomic Absorption Spectroscopy (AAS)

Principle of AAS, Instrument, Continuous sources and line sources, Flames, Flame atomizers, Non flame atomizers (furnaces), Monochromator and Detector, Interference with AAS Quantitative Analysis with AAS, Applications, Numerical.

(b) Flame Emission Spectroscopy (FES)

Flame as a source of atomic vapour, Flame atomization, Flame photometer, Applications and limitations comparison with AAS, Interference.

(c) Plasma and Electrical Discharge Emission

Emission spectroscopy with plasma sources, Instrument, AES with electrical discharge, Electrodes of AES, DC- arc, spark, Laser microprobe, Salient features of the emission spectrograph, Qualitative and Quantitative analysis applications.

UNIT-III: ESR & APPLICATION OF UV- VISIBLE (15 Periods)

(a) Theory of ESR, Population of E levels, relaxation time, Larmor precession, Instrumentation of ESR, Analytical applications of ESR spectroscopy, Hyperfine coupling mechanism, Super hyperfine splitting, g factor, Fine structure in ESR spectra hyperfine splitting constant, applications of ESR in study of metal complexes.

(b) Application of UV- Visible, Photometric accuracy, Simultaneous determinations of two components in a mixture, pK_{In} of indicator, Photometric titrations, Determination of metal to ligand ratio, analysis of drugs by UV-VIS spectrophotometry, Quantitative analysis, Numericals.

Books: On last page.

REFERENCE BOOKS:

(1) Instrumental Analysis: G. D. Caristian and J. E. O'Reilly (Allyn & Bacon Inc., New York, 2nd edition.

(2) Instrumental Methods of Chemical Analysis: G. W. Ewing (McGraw-Hill, New York), 5th edition.

(3) Instrumental Methods of Analysis: H. R. Willard, L. L. Merrit, J. A. Dean, F. A. Settle (Van Nostrand Reinhold Co., New York), 6th edition.

(4) Modern Methods of Chemical Analysis: Pecsok, Shield & Cairns (John Wiley), 2nd edition.

(5) Introduction to Instrumental Analysis (1987), R. D. Braun (McGraw-Hill Book Company), New Delhi.

(6) Analytical Chemistry: Principles and Techniques: Larry G. Hargis (Prentice-Hall International edition).

(7) Introduction to Modern Liquid Chromatography: L. R. Shyder & J. J. Kirkland (John Wiley & Sons, New York).

(8) Treatise on Analytical Chemistry: I. M. Kohthoff & P. J. Elving (John Wiley & Sons, New York).

(9) Handbook of Analytical Chemistry: L. Meites (McGraw-Hill, New York).

(10) Photometric and Fluorometric Methods of Analysis: F. D. Snell (John Wiley & Sons Inc., New York).

(11) Standard Methods of Chemical Analysis: Vol. I & II (6th edition), D. Van Nostrand Co. Inc. (London).

(12) Official Methods of Analysis: Published by Association of Official Analytical Chemists, Washington.

(13) Instrumental Methods of Chemical Analysis: B. R. Sharma (Goel Publishing House, Meerut).

(14) Environmental Chemistry: B. R. Sharma, H. Kaur (Goel Publishing House, Meerut).

(15) Inorganic Quantitative Analysis: A. I. Vogel (Orient Longman).

(16) "Polarography", J. D. Talati (In Gujarati), University Granth Nirman Board.

(17) "Polarography": Kolthoff I. M. and Lingane J. J. (Vol. I & II) (Interscience Publishers, New York).

(18) "Polarographic Techniques": L. Meites (Interscience Publishers, New York).

(19) Principles of Instrumental Analysis (5th ed.) by Skoog, Holler and Nieman (Saunders College Publishings).

(20) Undergraduate Instrumental Analysis (5th ed.), J. W. Robinson (Marcel Dekker Inc.).

(21) Fundamentals of Molecular Spectroscopy, by Banwell.

(22) Electronic Absorption Spectroscopy and related techniques, D.N. Sathyanarayan, (New Age International ND. 1996) Uni. Press, Hyderabad.

(23) Introduction to Spectroscopy (3rd ed.) by Pavia Lampman Kriz, Cengage Learning Harcourt College Publishers.

VEER NARMAD SOUTH GUJARAT UNIVERSITY
M.Sc. Part-II INORGANIC CHEMISTRY
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PAPER-III

Max. Marks: 70 **Total Periods: 45**

SEMESTER-III
(ELECTROANALYTICAL TECHNIQUES)

UNIT-I: DC-POLAROGRAPHY (15 Periods)

Principle, Types of currents, Electro capillary maxima, Maxima suppressors, Interference of oxygen DME as electrode, Wave equation, Ilkovic equation (derivation), half wave potential, Applications, Determination of stability constants of complexes. Quantitative analysis, Numerically, Applications of DC polarography, limitations, **Amperometric titrations:** Principle, DME & RPE, curves, Biamperometric titration.

UNIT-II: MODERN POLAROGRAPHIC METHODS (15 Periods)

Electrochemical Definitions and Terminology, Faradic and Non-Faradic processes, Concentration profiles at microelectrode surface during electrolysis:

A.C. Polarography: Principle of Sinusoidal alternating applied potential, A.C. peak polarogram, Peak current equation, Characteristic of AC polarographic peak, Importance of signal to noise ratio for the sensitivity, Comparison with DC polarography.

Square-wave Polarography: Principle of alternating rectangular wave voltage applied, Frequency of square wave applied, Problems of large condenser currents in A.C., Peak polarogram, Peak current equation, Limitations of techniques.

Pulse Polarography: Effect of capillary response with frequency of applied square wave potential, Principles and difference between Normal Pulse Polarography and Differential Pulse Polarography, Importance of charging and Faradaic currents.

UNIT-III: POTENTIOMETRIC METHODS OF ANALYSIS (15 Periods)

Membrane potential, Principles of selectivity, Methods of evaluating selectivities separate and mixed solution method. Classification of ion selective electrodes, Solid state electrodes – Glass electrode effect of glass structure on selectivity function of the glass electrode. Acid error, Alkali error, Silver halide, Sulphide, Lanthanum fluoride ion selective electrodes. Liquid ion exchange electrode – Calcium selective ion electrodes. Gas electrodes, ammonia, sulphur dioxide, oxygen and CO2 sensing electrode, Micro ion selective electrode, enzyme electrodes. Quantitative determination – known addition method – known subtraction method.

Books: On last page.

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PAPER-III

Max. Marks: 70 **Total Periods: 45**

SEMESTER-IV
(SEPARATION TECHNIQUES)

UNIT-I: SOLVENT EXTRACTION (15 Periods)

Review of distribution law, Distribution coefficient, Distribution ratio, Equations for the solute dissociating or associating in one phase, Successive extractions, Extraction of metal ion with chelating agent with necessary equation, Multiple extractions, Craig pseudo counter current extractions, Apparatus for Craig extractions, Continuous counter current extractions, Extraction involving association of ion pairs, Elementary idea of extraction with crown ethers, Cryptans, Use of organic reagents, Numericals.

UNIT-II: THEORY OF CHROMATOGRAPHY: PROCESS ANALYSERS

(15 Periods)

Theory of Chromatography: Methods of elution, Ideal and non-ideal chromatography, Plate theory, Rate theory, Reasons for broadening of lands, Van Deemter equation and significance of terms involved, Optimum velocity, Resolution, Methods to improve resolution, GLC, Supports for liquid stationary phases, Selection of columns, FSOT, Selective Detectors- FPB, TID, Temperature programming in GC, Derivatisation in GC, Qualitative analysis from retention parameters, Quantitative analysis, Headspace Analysis, Thermal Desorption.

UNIT-III: LIQUID CHROMATOGRAPHY: (15 Periods)

(a) Liquid Chromatography:
Principle of HPLC, Instrument and significance of each component, Pumps, Guard column, Stationary phases (solid, liquid), Bonded phase supports, Detectors UV absorption, Fluorescence detector, RI detectors, electrochemical detectors, Normal phase and Reversed phase.

(b) Ion-exchange Chromatography:
Resins used, Principle of exchange, Factors affecting the exchange, Capacity of resin and its determination, Techniques, IEC with eluent suppressor columns, Applications.

(c) Gel-permeation Chromatography:
Principle, Types of gels, Theoretical principles, Techniques and applications.

(d) Plane Chromatography: Paper and TLC: Two dimensional, solvent systems, Location, HPTLC and applications.

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PAPER-IV

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SEMESTER – III
Coordination Chemistry (Special Paper)-I

Unit – I: Theories of Metal Ligand Bonding (15 periods)

(i) Crystal Field Theory(CFT)

Theoretical principles of CFT

CFT of weak and strong field compounds: Splitting pattern in

(i) Octahedral (O_h), (ii) Tetragonal, (iii) Tetrahedral (T_d), (iv) Square planar (D_4h) and (v) Penta coordination (TBP & Sp) Complexes.

Limitation of crystal field theory.

Structural effects of orbital splitting, Jahn Teller effects and distortions in on Complexes.

Ligand Field Theory (LFT). Experimental evidences in support of metal ligand orbital overlap.

Adjusted crystal field theory (ACFT).

(ii) Molecular Orbital Theory for complex Ions.

Determination of Ligand group of orbitals, σ and π Molecular Orbitals, Qualitative treatment of MOT of Octahedral Complexes with σ bonding and π bonding, Qualitative Molecular Orbital angry level diagrams and their interpretation of O_h. T_d and square plannar complexes with examples.

Reference Books:

1. Inorganic Chemistry (Principles of structure and coordination compounds) J. E. Huhhe Harper and Row International series, New York (1983).
2. Studies in Modern chemistry coordination complexes S.F.A. Kettle Nelson, London (1969).
3. Advanced Inorganic Chemistry (V Edition) F.A. Cotton and G. Wildinson, Interscience, New York (1988).
4. Theoretical Inorganic Chemistry (New Edition) M. C. Day and J. Selbin East-West Press Pvt. Ltd. (New Delhi) 1971.
5. A modern Introduction Inorganic Chemistry T. Moeller John Wiley and Sons, New York, (1982).

Unit – II: Electronic Spectral Properties of Transition metal and metal Complexes (15 periods)

Theoretical aspects of spectra of complexes.

Spectroscopic Terms, microstates for the p, d and f configurations. Hund's rules for ground state term, the correlation of spectroscopic terms in to Mulliken symbols, Electronic transition selection rules, vibronic coupling, spin- orbit coupling. Strong field and Weak field approximation. Crystal field diagram for d^1 and d^{10}configuration. Orgel and Tanalu sujano energy level diagrams for O_h and T_d complexes (d^1- d^9 states). Charge transfer spectra and interligand spectra.

Calculation of Dq, B^1 and β parameters for Cu (III), Co(II) and Ni(II) complexes using electronic spectral data under different geometries.
Spectrochemical series and Nephelauxatic series, Intensity of spectral peak: Oscillator strength and bond width, Electronic spectra of Lanthanide and actinide (f- electron transition), d^2 & d^3configuration correlation diagram.

Reference Books:

1. Inorganic Electronic Spectroscopy (II Edition), A.B.P. Lever, Elsevier, Amsterdam (1984).
2. Introduction to Ligand Field, B. N. Feggis, Interscience, New York (1966).
3. Physical Methods in Inorganic Chemistry (Both Edition), R.S. Drago, W. B. Saunders, Philadelphia (1977).
4. Introduction to Ligand Field Theory, C.G. Ballhenson, McGraw-Hill, New York (1962).
5. Electron Absorption Spectroscopy and Related Techniques, D.N. Sathyanarayana Universities Press (India) Ltd. Hyderabad (2001).

Unit – III: Magnetic Properties of complexes: (15 periods)

Introduction, Concept of magnetic susceptibility. Types of magnetic bodies. Source of paramagnetism, Diamagnetism and Pascal's constants. Experimental techniques for measurements susceptibility.Temperature dependence paramagnetism.
Magnetic moments with different multiplate width. Magnetic properties of free ions. Orbital contribution. Van Vleck equation spin orbit coupling on A, E and T ground terms. Spin pairing, High spin Lows spin crossover region. Temperature inpendent paramagnetism (TIP), Variation of susceptibility with temperature. Antiferromagnetism. Magnetic exchange coupling (Exchange pathways) Quantitative treatment of antiferromagnetism and Examples of antiferromagnetism binuclear complexes.

Reference Books:

1. Elements of Magnetochemistry, R.L. Datta & A. Syamal, Affiliated East- West Press Pvt. Ltd., New Delhi (1993).
2. Magnetochemistry, R.L. Karlin, Springer-Verlag, New York (1993).
3. Introduction to Magnetochemistry, A.Earnashaw, Academic Press, New York (1968).
4. Magnetism and Transition metal Complexes, F. E. Mabbs & D. J. Machin, Chapman and Hall, London (1973).

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PAPER-IV

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SEMESTER – IV
Coordination Chemistry (Special Paper)-I

Unit-I: **(15 periods)**

Kinetics and Reaction Mechanism of Transition Metal Complexes: Reactivity of metal complexes, ligand replacement reactions, classification of mechanism and energy profile of a reaction. Inert and labile complexes, Interpretation of lability and internees of transition metal complexes on the basis of VBT and CFT.

Kinetics of octahedral substitution reaction: Acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugates base mechanism, direct and indirect evidences in favor of conjugate mechanism. Anation reaction, reactions without metal-ligand bond cleavage.

Stereo chemical changes in octahedral complexes: Molecular rearrangement in complexes, reaction of geometrical and optical isomers. Isomerization and racemization of octahedral complex, Ligand stereo specificity.

Redox reaction: Electron transfer reactions, mechanism of one electron transfer reactions, outersphere of one electron transfer reactions, outersphere electron transfer reactions, tannelling effect, cross reaction, Marker-Hush theory, inner sphere electron transfer reactions, bridged activated mechanism. Experimental Techniques.

Reference Books:

1. Inorganic reaction mechanism, Basello and Pearson, Wiley Eastern Ltd. New Delhi-1977.
2. Kinetics and mechanism of Inorganic reactions: A study of metal complexes in solution, A. A. Frost and R. G. Pearson, Wiley, New York-(1953, 1961).
3. Inorganic reaction mechanism, S. K. Skyes.
4. Electron Transfer reaction of metal complex ions in solution, H. Taube, Academic press, London-1970.
5. Modern Inorganic Chemistry, J. Lewis and R. G. Wilkinson, Interscience, New York.
6. Inorganic Reaction Mechanism, M. L. Obe, Nelson, London-1972.
7. Mechanism of Inorganic Reactions in Solutions: An Introduction, D. Benson, Mc GrowHill, Chapter-15, P-455, 1968.
8. “Comprehensive coordination Chemistry” G. Wilkinson, R. D. Gillard and J. A. Mccleverty pergamon, London, Vol-1. P-281-322, 331-374, 385-411, 415-458 (Chapter-7-4) and P-463-471 -1987.

Unit-II: **(15 periods)**

Metal-ligand complex equilibria in Solution: Stability of complex ions in solution, Basic principles, mathematical function and their interrelationship. Trends in stepwise constants.

Determination of stability constants of binary complex by experimental methods:

(i) Spectrophotometric methods
(ii) Potentiometric method (pH–metric Titration Technique, i.e. Irving-Rossotti methods)
(iii) Polarographic method

Factors affecting the stability of metal complexes with reverence to the nature of metal ion and ligand. Statistical, electrostatics, chelate effect and its thermodynamics functions (ΔG, ΔH and ΔS).

Reference Books:

1. Instability constants of complex compounds, K. B. Yatsimirskii and V. P. Vasilen (Translated from Russian), D. Van Mostrand Co. Inc. Princeton, New Jersey-1966.
2. Chemistry of Complex Equilibria, M. T. Beck (Hungary), translated by R.A. Chalmers, van Nostrand Co., London, 1970.
3. Rossotti F.J.C. and Rossotti H.S., The determination of stability constants, McGrow Hill, New York, P-108, 1961.
4. Irving H. and Rossotti H.S. J. Chem. Soc, 3397, 1953.

Unit-III: Selected topic in inorganic chemistry **(15 periods)**

1. Stereochemistry of unusual coordination number
2. Metal clusters: synthesis, bonding and structure
3. Coordination model for non-aqueous solvent behavior
4. Molecular polyhydra
5. Metal sequestration and its industrial application

Reference Books:

1. Stereo chemistry and bonding in Inorganic chemistry, J. E. Fergusion. Prentice Hall, Inc. Eryleword Cliffs, N.J., 1974.
2. Inorganic chemistry (Principles of structure and coordination compounds), J. E. Huhee Harper and Row Intermediated series, N.Y., 1963.
3. Organic sequestering Agents, Chaberck S. and Martell, John-Wiley and Sons, Inc, New York (1959).