VEER NARMAD SOUTH GUJARAT UNIVERSITY
M.Sc.-II (CHEMISTRY)
TO COME IN FORCE FROM JUNE-2008
PAPER-I (Inorganic)

Max. Marks: 70 **Total Periods: 120**

SECTION – I

UNIT-I : PHYSICAL METHODS IN INORGANIC CHEMISTRY (20 Periods)

Introduction, theory, instrumentation and application for structural illustration of compound, with reference to:

(i) Nuclear Magnetic Resonance Spectroscopy
(ii) Electron Spin Resonance Spectroscopy
(iii) Vibrational and Rotational Spectroscopy

UNIT-II : INORGANIC CHAINS, RINGS, CAGES & CLUSTERS: (20 Periods)

Chains:

Catenation, heterocatenation, isopolyanions, heteropolyanions.

Rings:

Borazines, phosphonitrilic compounds, heterocyclic inorganic rings, homocyclic inorganic rings.

Cages:

Non-metallic cage structures, phosphorous cage molecules, carboranes, metallocene carboranes.

Metal Clusters:

Metal-metal bonds, binuclear clusters, trinuclear clusters, octahedral clusters, octahedral clusters, metal sheets.

UNIT-III : CHEMISTRY OF NON-AQUEOUS SOLVENTS: (20 Periods)

Lewis Acid-base interaction in polar non-aqueous solvents:

(i) Introduction, characters, a coordination model, correlation of chemical reactions.

(ii) Liquid Ammonia:

Structure and physical properties, Solubility relationships, Reactions of elements of - (a) compounds of alkali and alkaline earth metals, (b) transition metal compounds.

(iii) Hydrogen fluoride:

Structure, physical properties, hydrogen fluoride as a protonating agents, hydrogen fluoride as a fluorinating agent, hydrogen fluoride as a medium for reactions.

(iv) Metal solutions in non-aqueous solvents:

Introduction, solubilities and phase diagram, dilute solutions, solutions of intermediate concentrations.

SECTION – II

UNIT-IV : CHEMISTRY OF NON-METALS: (20 Periods)

Compounds of Noble Gases:

Binary xenone fluorides, Xenone complexes, Oxyfluorides and Oxyacids, Krypton compounds.

(i) Pseudohalogens:

Cyanogen, Oxycyanogen, thiocyanogen, sellenocyanogen, azidocarbon disulphido, Azides, Polyhalogenoids.

(ii) Graphite and its compounds:

Crystal, graphite oxide, alkali metal compounds, graphite salts..

(iii) Synthetic reactions of high temperature.

UNIT-V : ORGANOMETALLIC COMPOUNDS AND HOMOGENEOUS CATALYSIS: (20 Periods)

(I) Organometallic Compounds:

Chemistry of transition metals, Synthesis, Structure and bonding, Reactions of Ferrocene like molecules, organometallic reagents in organic synthesis.

(ii) Catalysis:

Introduction, definition, classification, homogeneous catalysis by soluble metal complexes, hydrogenation of unsaturated compounds, hydroformylation, Wacker process, Zingler-Natta catalyst.

UNIT-VI : PHOTOCHEMISTRY (20 Periods)

(i) Introduction, photochemical laws and photochemical kinetics.
(ii) Photophysical processes.
(iii) Cis-trans isomerism.
(iv) Photochemical reactions: Transition metal complexes : Cr(III) and Co(III) complexes and selection rules.

REFERENCES:

1. Text-book of Quantitative Inorganic Analysis, ELBS.
2. Principles of Instrumental Analysis, Skoog and Hart, Holt, Rinehart and Winston.
3. Instrumental Methods of Analysis, Dean and Merit, Affiliated Press.
4. Inorganic Chemistry, I. S. Butler and J. F. Harrod, Benzamine-Cumming Corp.
5. Concepts and Models of Inorganic Chemistry, B. Douglas, D. H. McDonald, J. J. Alexander, John Wiley & Sons.
6. Advance Inorganic Chemistry, F. A. Cotton and C. Willkinson, John Wiley & Sons.
7. Modern Aspects of Inorganic Chemistry, H. J. Emeleus and G. Sharpe, Routledge and Kegan Paul, 1973.
8. Inorganic Chemistry, A. Sharpe, ELBS, 2nd Edition, 1986.
9. The Chemistry of Non-aqueous Solvents, Vol. 1, 2, 3, J. J. Lagowski, Academic Press, 1967.
10. Modern Inorganic Chemistry, W. L. Jolly, McGraw-Hill Publication.
11. Instrumental Methods of Chemical Analysis, G. Chatwal and S. Anand, Himalaya Publication.
12. Organometallic Compounds, P. L. Pausan.
13. Theoretical Approach to Inorganic Chemistry, A. F. Williams, Springer-Verlag, Berlin, N.Y.
14. Molecular Spectroscopy, J. D. Craybeal, McGraw-Hill.
15. Spectroscopy of Inorganic Compounds, C.N.R. Rao and Ferrare, Academic Press.

VEER NARMAD SOUTH GUJARAT UNIVERSITY
M.Sc.-II (CHEMISTRY)
TO COME IN FORCE FROM JUNE-2008
PAPER-II (Inorganic)

Max. Marks:70 **Total Periods: 120**

SECTION – I

UNIT-I : **(20 Periods)**
Environmental Chemistry:

Pollution : Introduction, definition, classification.

Air Pollution:

Primary pollutants, sources, concentrations effects and control, with reference to:

(i) Carbon monoxide, (ii) Nitrogen oxides, (iii) Hydrocarbons, (iv) Sulfur oxides, (v) Particulate matter.

Water Pollution:

Types of water pollutions – physical, chemical, biological.

(i) Industrial waste waters, their pollutants, and removal of (a) ammonia, (b) iron, (c) manganese, (d) soluble organic materials.
(ii) Characteristics and treatment to waste water effluents from (a) textile, (b) petroleum refineries.
(iii) Toxid metals in industrial waste waters: (a) Lead, (b) Mercury, (c) Arsenic, (d) Cadmizem, (e) Chromium.

UNIT-II : BIOINORGANIC CHEMISTRY: **(20 Periods)**

(i) Biochemistry of – (a) Zinc, (b) Copper, (c) Cobalt, (d) Molybdenum.
(ii) Iron storage and transport compounds: Ferritm transferrin.
(iii) Electron transport proteins: Rubredoxin – isolation, structure, substitution of metal.
(iv) Bacterial iron transport.
(v) Nature of Heme-dioxygen binding.

UNIT-III : CERAMICS, REFRACTORIES GLASS: **(20 Periods)**

(i) Ceramics:

Introduction, defination, sub-division, properties, basic row materials, clays, properties of clays structural, clay products.

(ii) Refractories:

Introduction, classification properties – (a) Fire bricks: Manufacture, properties and uses, (b) High arumina: Properties and uses, (c) Super refractories: Manufacture properties and uses of carborudum and graphite.

(iii) Glass:

Introduction properties, characteristics, raw materials and some special glasses.

SECTION – II

UNIT-IV : INSTRUMENTAL TECHNIQUES: **(20 Periods)**

(I) Thermal Methods:

(a) Thermogravimetry: Introduction, types, factors influencing, instrumentation, applications.
(b) Thermometric titrations: Introduction, theory instrumentation, applications.

(II) Atomic Absorption:

Introduction, principle, instrumentation, evaluation and application.

(III) Solvent Extraction:

Introduction, principles, extraction techniques factors, synergistic extraction and applications.

(iv) Chromatographic Techniqus:

Introduction, classification paper chromatography, Thin-layer chromatography, column chromatography, Gas chromatography, ion-exchange chromatography with reference to theory, evaluation and applications only.

UNIT-V : FERTILIZERS: (20 Periods)

(I) Soil fertility fertilizer grades, fillers complete fertilizers, elements required in plant nutrition.
(II) Mixed fertilizers: Higher analysis fertilizers, manufacture, chemical reactions involved, Ammoniation.
(III) Micronutrients: Introduction, defination functions, sources, deficiency symptoms, application methods with special reference to – (a) copper, (b) iron, (c) boron, (d) molybdenum, (e) zinc.
(IV) Hydroponics: Introduction, defination, techniques, nutrient solutions, water physical conditions, economic possibilities.
(V) Potassic fertilizers: Sources, production, two component fertilizers, Role of fertilizers in photosynthesis and respiration.

UNIT-VI : METALLIC CORROSION AND PREVENTION: (20 Periods)

(I) Introduction, definations, corrosion damages, corrosion rate expressions.
(II) Electrochemical aspects: Electrochemical reactions, polarization, passivity.
(II) Forms of corrosion: Uniform, galvanic, pitting, selective leaching, intergranular.
(IV) Prevention: Material selection, alteration of envirionment, coatings, metallic, organic, inorganic, cathodic protection, anodic protection.

REFERENCES:

1. Water Pollution, J. E. Jajic, Marcel-Dekker.
2. Air Pollution, H. W. Parker, Prentice-Hall.
3. Environmental Chemistry, A. K. De, Wiley Eastern Ltd.
4. Environmental Pollution, Indrajeet Sethi, M.S. Sothi, Commonwealth Publication, New Delhi.
5. Industrial Chemistry, B. K. Sharma, Goel Publication, Meerut.
6. Bioinorganic Chemistry, EI-ICHIRO OCHAI, Allyn & Bacon Inco.
7. Concepts and Models of Inorganic Chemistry, B. Douglas, D. H. McDaniel, J. J. Alexander, John Wiley & Sons.
8. Advanced Inorganic Chemistry, F. A. Cotton and G. Willkinson, John Wiley & Sons.
9. Inorganic Biochemistry Vol. 2, H.Q.O. Hill Royal Society of Chem., London.
10. Text-book of Inorganic Chemistry, P. L. Sen, S. Chand Company.
11. Advanced Inorg. Chemistry, Gurudeep Raj Chatwal & Mehra, Goel Publishing House.
12. Modern Inorganic Chemistry, J. J. Lagowski, Marcel & Dekker.
13. Instrumental Methods of Chemical Analysis, G. Chatwal, S. Anand, Himalaya Publishing House, Delhi.
14. Soil Fertility and Fertilizers, S. L. Tisdale, W. L. Nelson.
15. Soils and Fertilizers, F. E. Bear, John Wiley & Sons, 1952.
16. Soiless gardening, W. F. Gericke, Prentice Hall Inc.
17. Role of Potassium in Agriculture, V. J. Kllmer, S. E. Younts & N. C. Bredy, ASA Publication, USA, 1968.

VEER NARMAD SOUTH GUJARAT UNIVERSITY
M.Sc.-II (CHEMISTRY)
TO COME IN FORCE FROM JUNE-2008
PAPER-III (Inorganic)
CO-ORDINATION CHEMISTRY

Max. Marks:70 **Total Periods: 120**

SECTION – I

UNIT-I : (20 Periods)

(A) Theory of Metal Ligand Bonding:

- Theoretical principles of crystal field theory.
- Crystal field theory of weak and strong field – (I) octahedral, (ii) tetrahedral, (iii) tetragonal, (iv) square-planar, and (v) penta-coordinated (trigonal bipyramidal and square pyramidal) complexes.
- Drawback of crystal field theory.
- Experimental evidences in support of metal-ligand overlap.
- Adjusted Crystal Field Theory (ACFT).

(B) Molecular Orbital Theory For Complex Ions:

- Introduction
- Construction of group or symmetry orbitals of the ligands in octahedral (with and without π-bond), tetrahedral and square planar complexes.
- Molecular orbital energy level diagrams and electronic configuration of M.O.'s.

UNIT-II : ELECTRONIC SPECTRAL PROPERTIES OF COMPLEXES:

(20 Periods)

- Introduction
- Theoretical aspects of spectra of complexes.
- Crystal field strength.
- Crystal Field Terminology (R.S. coupling Hund's rule and ground level).
- Determination of function (n, l, ml, S, ms) corresponding to the terms 3F, 3P, 1G, 1D and 1S obtained from d^2 system in R.S. coupling.
- Strong and weak field approximations.
- Crystal field diagram for d^1 to d^n configuration.
- Orgel and Tanabe Suzano diagrams.
- Electronic transition selection rules.
- Selection rules and d-d transition in metal complexes.
- Charge transfer transitions (spectra).
- Intensities of spectral peak.
- Oscillator strength and band width.
- Spectrochemical and Naphelauretic series.
- Crystal field and related parameter of transition metal complexes.
- Electronic spectra of lanthanides and actinides (F-electron transition).
- Correlation diagram for d^2 and d^3 configurations.

UNIT-III : MAGNETIC PROPERTIES OF COMPLESES: (20 Periods)

- Introduction
- Types of magnetic bodies
- Source of paramagnetism
- Diamagnetism and Pascal's constants
- Experimental techniques
- Magnetic susceptibility measurements experiments by Gouy and Faraday methods.

- Calculation of magnetic moment from experimental data.
- Thermal energh and magnetic property.
- Magnetic moments with different multiplate width.
- Magnetic properties of free ions.
- Ligand field, orbital contributions.
- Orbital contribution in complexes of stereochemistry other than octahedral.
- Van Vleck equation.
- Spin orbit coupling on A, E and T terms.
- Spin pairing, some aspects of spin pairing and cross over region.
- Variation of susceptibility with temperature.
- Antiferromagnetism and ferromagnetism.
- Types of antiferromagnetism.
- Exchange pathways.
- Quantitative treatment of antiferromagnetism.
- Examples of antiferromagnetic binuclear complexes.

SECTION – II

UNIT-IV : COMPLEX EQUILIBRIA: (20 Periods)

Introduction

- Stability of complexion solution, stepwise stability constants.
- Computation of stability constants from equilibria data.
- Basic principles.
- Mathematic functions and their interrelationship.
- Determination of stability constants of complex by experimental methods such as – (I) Spectroscopic method, (ii) Potentiometric method (pH-meter Irving-Rossotti method), (iii) Polarographic method.
- Factors affecting stability of complexes.
- Determination of thermodynamics functions e.g. ΔG, ΔH and ΔS.

UNIT-V : REACTION MECHANISM IN METAL COMPLEXES: (20 Periods)

- Octahedral substitution: The nature of substitution reaction, theoretical approach to substitution mechanism nucleophilic -–reactivity, nature of central atom, kinetic application of crystal field theory, substitution of Co(III) complexes, replacement of coordinated water, acid catalysis.

- Stereochemical changes in octahedral complex: molecular rearrangement in complexes – Reaction of geometrical and optical isomers – isomerization and recemization of octahedral complex – Ligand stereospecificity.

- Substitution reaction of square planar complexes:

  - Trans effect and its theories.
  - Mechanism of substitution of platinum(II) complexes.

- Electron transfer reactions (oxidation-reduction reaction) : Outer sphere and inner sphere electron transfer reaction mechanism.

- Experimental technique and interpretation of data.

UNIT-VI : STEREOCHEMISTRY OF COORDINATION COMPOUNDS (20 Periods)

Stereochemistry of unusual co-ordination number.

REFERENCE BOOKS:

Unit-I:

1. Inorganic Chemistry (Principles of Structure and Coordination Compounds), J. E. Hathecy, Harper and Row International Series, New York (1983).
2. Coordination Compounds, S.F.A. Kettles, Nelson.
3. Advanced Inorganic Chemistry (V Edition), F. A. Cotton and G. Wilkinson, Interscience, New York (1988).
4. Theoretical Inorganic Chemistry (New Edition), M. C. Day and J. Selbin, East-West Press.
5. A Modern Inorganic Chemistry, Moeller, Wiley-Interscience.

Unit-II:

1. Inorganic Electronic Spectroscopy (2^{nd} edition), A.B.P. Lever, Elsevier, Amsterdam (1984).
2. Introduction to Ligand Field, B.N. Figgis, 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).

Unit-III:

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. Earnshaw, Academic Press, New York (1968).
4. Magnetism and Transition Metal Complexes, F. E. Mabbs & D. J. Machin, Chapman and Hall, London (1973).

Unit-IV:

1. Determination of Stability Constants, Rossotti and Rossotti, McGraw-Hill.
2. Chemistry of Complex Equilibria, M. T. Beek.
3. Instability Constants of Complexes Compounds, Yatisimiraskii and Vasile, Consult and Bul.
4. Chemistry of Metal Chelate Compounds, Martell and Calvin, Prentice-Hall, Inc., Eaglewood Cliffs, N. J.

Unit-V:

1. Inorganic Reaction Mechanism, Basellow and Pearson, Wiley Eastern Ltd., New Delhi (1977).
2. Kinetics and Mechanism, A. A. Frost and R. G. Pearson, Wiley, New York, 1953, 1961.
3. Inorganic Reaction Mechanism, S. K. Skyes.
4. Electron Transfer Reaction, H. Taube, Academic Press.
5. Modern Inorganic Chemistry, J. Lewis and R. G. Wilkinson, Interscience, New York.

Unit-VI:

1. Inorganic Chemistry, J. E. Huheey, Harper and Raw, New Delhi (1983).
2. A Modern Inorganic Chemistry, Moeller, Wiley Interscience.
3. Stereochemistry of Coordination Compounds.

VEER NARMAD SOUTH GUJARAT UNIVERSITY
M.Sc.-II (CHEMISTRY)
TO COME IN FORCE FROM JUNE-2008
PAPER-III (Inorganic)
(CORROSION CHEMISTRY)

Max. Marks:70 **Total Periods: 120**

SECTION – I

UNIT-I : THEORIES OF CORROSION: (20 Periods)

Definitions, Acid, Colloidal and Peroxide theories, Thermodynamics of Corrosion reactions, Electrochemical theory, Electrode kinetics, Exchange current density, Activation, Concentration and combined polarisation, mixed electrodes – A metal in contact with a single redox system, a metal in acid solutions containing oxidizers.

UNIT-II : COMMON TYPES OF CORROSION: (20 Periods)

Localized Corrosion:

Pitting, Crevice Corrosion, Filiform Corrosion, Impingement attack, Fretting stress corrosion.

Bimetallic Corrosion:

General theory, in aqueous solution in corrosive atmospheres, protective measures.

Atmospheric Corrosion:

Classification, Composition of atmosphere, atmospheric contaminents other atmospheric variables, Electrochemistry of atmosheric corrosion, Corrosion of plastics and elastomers.

UNIT-III : PASSIVITY: (20 Periods)

Introduction, definations, theories of passivity, characteristics of passivation Flade potential, behaviour of passivators, passivation of iron by nitric acid, Anodic protection, trans passivity, passivity in alloys.

SECTION – II

UNIT-IV : OXIDATION AND TARNISH: (20 Periods)

Protective and non-protective scales, Equations of oxidation, Wagner theory of oxidation, Galvanic effects, Oxidation of – (I) Copper, (ii) Iron and Iron alloys, (iii) Oxidation resistant alloys, Catastronic oxidation.

UNIT-V : CORROSION TESTING: (20 Periods)

Classification, purposes, specimens, surface preparation, conventional methods, Electro-chemical techniques, Optical and radioactive techniques.

UNIT-VI : CORROSION PREVENTION: (20 Periods)

Material selection, Metal and alloys, metal purification, non-metallics, Alteration of Encirenment – Inhibitors, Protective coatings : Metallic coatings, Protection : Organic and inorganic cathodic and anodic protection.

REFERENCES:

1. Corrosion and Corrosion Control, H. H. Uhlig, John Wiley.
2. Corrosion Engineering, M. G. Fontana and N. D. Green, McGraw-Hill.
3. Basic Corrosion Course, NACE, NACE Publication.
4. Corrosion, Vol. 1 and 2, L. L. Sheier, Newens Butterworths.
5. Corrosion Testing Procedures, F. A. Champion.
6. Corrosion Testing Procedures, J. H. Ailor, Electrochem. Soc., Inc., Princetion.
7. Dhatvik Ksharan, Vo. 1 and 2, M. N. Desai, Univ. Granth Nirman Board, Gujarat.
8. Metallic Corrosion Passivity and Prevention, U. R. Evans, Longmans and Green.
9. Corrosion Hand-Book, H. H. Uhlig, John Wiley.
10. Corrosion Inhibitors, R. H. Hausler, NACE Publication.

VEER NARMAD SOUTH GUJARAT UNIVERSITY
M.Sc.-II (CHEMISTRY)
TO COME IN FORCE FROM JUNE-2008

Inorganic Chemistry
Practicals

(I) Analysis of Alloys: **Constituents and methods**

(1) Stainless Steels:
(1) Cr: Gravimetrically
Colorimetrically
Complexometrically

(2) Ni: Gravimetrically
Colorimetrically

(3) Fe: Gravimetrically
Volumetrically

(2) German Silver:
(1) Cu: Gravimetrically
Volumetrically

(2) Zn: Complexometrically

(3) Ni: Gravimetrically

(II) Analysis of Ores:

(1) Dolomite:
(i) Loss on ignition.
(ii) SiO_2 % Colorimetrically
(iii) Ca % by EDTA
(iv) Mg % by EDTA.
(v) Fe % Colorimetrically

(2) Bauxite:
(i) SiO_2 % Gravimetrically
(iii) R_2O_3 % Gravimetrically
(iv) Al_2O_3 % Gravimetrically
(v) Fe_2O_3 % Colorimetrically

(III)

(1) Determination of Composition of Complexes:
(i) Job's Method (ii) Slope ration methods
(iii) Molar rato method.

(2) Synthesis minimum eight complexes and characterization of them by
(i) M.P. (ii) Metal content (iii) Magnetic Properting
(iv) Spectral Characteristics

(3) Use of
(i) Ion –Exchange
(ii) Column chromatography
(iii) Paper chromatography for inorganic metals ion separation
(iv) Solvent extraction
(v) Thin Layer Chromatography in inorganic analysis.

(IV) Analysis of Commercial Products Such as

(i) Portland Cement (ii) Nitrogeneous / Phosphatic fertilizer
(iii) Ultramarines (iv) Phosphoric acid etc.

(V) Determination of proton ligand and metal ligand stability constant by conventional techniques.