SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR

SYLLABUS EFFECTIVE FROM: 2018-19
M.Sc. CHEMISTRY
SEMESTER-IV
INORGANIC CHEMISTRY

(Total 650 marks)

Course Code	Course Title	Hours per week	Internal Marks	External Marks	Total Marks
PS04CINC21	Spectroscopy II	4 hrs	30	70	100
PS04CINC22	Solid State Chemistry and Supra Molecular Chemistry	-do-	30	70	100
PS04CINC23	Bioinorganic Chemistry	-do-	30	70	100
PS04CINC24	Practical OR	8 hrs.	30	70	100
PS04CINC25	Project	8 hrs.	30	70	100
PS04CINC26	Practical OR	8 hrs	30	70	100
PS04CINC27	Project	8 hrs.	30	70	100
PS04CINC28	General Viva-voce	1 hrs	-	50	50
PS04EINC21 **OR** PS04EINC22	ANY ONE	-do-	30	70	100
Total Marks					650

*** Project work** (as optional) in place of practicals; to be offered to some of the students, based on their merit, interest and placement with the teachers (Marks : 200). The project shall have to be carried out under the allotted teacher(s) and a dissertation shall be submitted and will be assessed for internal (60 marks) and external (140 marks), in the usual manner.

PS04CINC21: Spectroscopy-II

Unit-1	**Atomic Absorption/Atomic and Flame Emission Spectroscopy** Absorption of radiation by atoms; equipment: radiation sources (Hollow cathode lamps and electrode less discharge lamps); atomizers (Flame and carbon); wavelength selector and detectors; interferences in atomic absorption spectroscopy; applications and problems: qualitative and quantitative analysis. Introduction to plasma, arc and spark emission spectroscopy; equipment: inductively coupled plasma spectrometer and flame photometer; applications and problems	**25%**
Unit-2	**Mossbauer Spectroscopy:** Mossbauer effect, experimental methods, hyperfine interactions, molecular structure, electronic structure, applications of Mossbauer spectroscopy	**25%**
Unit-3	**Electron Spectroscopy:** Introduction, principle and theory of electron spectroscopy, Notations, X-ray Photoelectron Spectroscopy (XPS), Ultraviolet Photoelectron Spectroscopy (UPS), Auger Electron Spectroscopy (AES), Instrumentation of electron spectroscopy, Qualitative and Qualitative analysis by electron spectroscopy, Chemical shifts, Unwanted features in electron spectra, Applications of electron spectroscopy	**25%**
Unit-4	**Microscopic Techniques:** Introduction to scanning electron microscopy (SEM), Scanning tunneling microscopy (STM) and atomic force microscopy (AFM); basic principles and theory; instrumentation and operating parameters and applications	**25%**

Reference Books

1. Principles of Instrumental Analysis by Skoog, Holler and Neiman, Sunders College Publishers (USA).
2. Undergraduate Instrumental Analysis by James W. Robinson, Marcel Dekker, Inc. (Ny.) Introduction to Instrumental Analysis by Robert D. Braun, Pharme Med Press Hyderabad- India.
3. Instrumental Method of Analysis by Willard, Merritt, Jr., Dean and Settle Jr., CBS Publishers and distributors, New Delhi, India.
4. Microscopic and Spectroscopic Imaging of the Chemical State by Michael D. Morris, Marcel Dekker, Inc. (NY.).
5. Instrumental Methods of Chemical Analysis, 24th Edition 2005 by B. K. Sharma, Goel Publishing House, Meerut.

PS04CINC22: Solid State and Supramolecular Chemistry

Unit-1	**Crystal Structure :** Forms of solids, law of constancy of interfacial angles, crystal systems, crystal classes, lattice structure, unit cell, designation of crystal faces, law of rational indices, planes of cubic lattice, types of lattices, **Crystal Defects and Non-Stoichiometry:** Perfect and imperfect crystals, instrinsic and extrinsic defects – point defects, line and plane defects, Vacancies – Schottky defects and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, defects and nonstoichiometry	**25%**
Unit-2	**Optical Properties** : Optical reflectance, photoconduction and photoelectric effects, Lasers, Organic solids – electrically conducting solids, organic charge transfer complex, organic metals, new superconductors **Solid State Reactions :** General Principles, types of solid state reactions, experimental procedures, co-precipitation as a precursor to solid state reactions, Wagner mechanism of solid state reactions, sol-gel method, kinetics of solid state reactions	**25%**
Unit-3	**Basics of Supramolecular Chemistry** Definition and development of supramolecular chemistry, Classification of supramolecular Host-Guest compounds, Receptors, coordination and lock and key analogy, Binding constants, Cooperativity and the chelate effect, Preorganisation and complementarity, Thermodynamic and kinetic selectivity and discrimination, Nature of supramolecular interactions, Solvation and hydrophobic effects, Supramolecular concepts and design	**25%**
Unit-4	**Cation binding hosts** Selectivity of cation complexation, Soft ligands for soft metals, Different cation binding hosts **Anion binding hosts** Introduction, From cation hosts to anion hosts- a simple change in pH, Some anion hosts **Binding of neutral molecules** Interactivity complexes of neutral molecules: solution and solid state binding, Some neutral binding hosts	**25%**

Reference Books

1. Introduction to Solids by L. V. Azaroff, Mc.Graw Hill Co., New York
2. Principles of the Solid State by H. V. Kheer, Wiley Eastern
3. Solid State Chemistry by D. K. Chakrabarthy by New Age International
4. Solid State Chemistry and Its Applications by Anthony R. West, John Willey & Sons
5. Crystal – Structural Analysis by M. J. Buerger, John Wiley and Sons, New York
6. Elements of X-ray Diffraction by B. D. Cullity Addision – Wesley Publ. Co., London
7. Supramolecular Chemistry by Jonathan W. Steed, Jerry L. Atwood, John Wiley & Sons, Ltd.

8. Supramolecular Chemistry- Fundamentals and Applications by Katsuhiko Ariga, Toyoki Kunitake Springer

PS04CINC23: Bioinorganic Chemistry

Unit-1	**Bioinorganic Chemistry-1** The elements of living system: The biological roles of metal ions, Calcium biochemistry, Iron biochemistry, Nonmetals biochemistry Enzymes exploiting acid catalysis: Carbonic anhydrase, Carboxy peptidases.	**25%**
Unit-2	**Bioinorganic Chemistry-II** Redox catalysis: Iron sulphur proteins and non-heme iron, Cytochromes of the electron transport chain, Cytochrome P-450 enzymes, Coenzyme B_{12}, Blue copper proteins Metals in medicine: Antibiotic and related compounds, Chelate therapy, Inhibition and poisoning, Metal complexes as probes of nucleic acids	**25%**
Unit-3	**Metal ions and complexes in Medicine – I** Metal deficiency and diseases, chelation therapy for metal ion detoxification, Lithium drugs in neurological disorders, gold antiarthritis drugs, pharmacology of auranofin, Role of metal ions in the action of antibiotics, Metal ions in clinical diagnosis: MRI agents Radiopharmaceuticals: Use of Tc, Re, Sm, Sr, Ga, Co, and I isotopes	**25%**
Unit-4	**Metal ions and complexes in Medicine – II** Metal- nucleic acid interactions: Coordination, Non-covalent interactions - intercalation and hydrogen bonding, hydrophobic interactions, DNA strand cleavage, Biological fluorophores, Application of fluorescence quenching in drug-DNA binding studies. DNA binding and mechanistic possibility, Platinum anticancer drugs, structure activity relationship, mechanism of action, aspects of Pt binding to DNA – kinetics, crosslinking, physical effects and biological consequences, Nonplatinum antitumor metal complexes: Ru(III) ammine complexes, Antitumor activity, structure activity relationship, DNA binding and cleavage Anticancer activity of metallocenes, Structure and chemical properties of streptonigrin and its metal complexes, evidence for formation of ternary complexes involving DNA, antitumor activity and mechanism	**25%**

Reference Books:

1. Elements of Bioinorganic Chemistry, G.N. Mukerjee and Arabinda Das
2. Bioinorganic Chemistry, G. R. Chatwal and A. K. Bhagi
3. Principles of Bioinorganic Chemistry, S.J. Lippard and J. M. Bersa
4. Bioinorganic Chemistry, Bertini, H. B. Gray and S. J. Lippard
5. Inorganic Chemistry, Shriver and Atkins
6. Inorganic Chemistry, James E. huheey, Ellen A. Keiter and Richard L. Keiter
7. Bio-inorganic Chemistry, R.W. Hay – R.W. Hay, Ellis Horwood Limited Publishers chichester 1984
8. Metal ions in Biological Systems Ed by H. Sigel Vol I to XIX, Marcel Dekker, Basel
9. Principles of Bio Inorganic Chemistry, S. J. Lippard and J. M. Berg, University Science Books 1994

10. Facets of coordination chemistry Ed by B.V. Agarwala & K.N. Munshi, World Scientific, Singapore, NJ, London.
11. Bioinorganic Chemistry , Bertini, Gray, Lippard, & Valentine Viva books pvt ltd (1998)
12. BioInorganic Chemistry an introduction, J.A. Cowan, Wiley-VCH

PRACTICALS: PS04CINC24

Ores analysis (7 hrs)

1. Analysis of Hematite
    1) Acid insoluble residue
    2) Iron as Fe_2O_3
    3) Iron by redox method (volumetrically)
2. Determine the amount of Ca(II), Mg(II), Fe(III) and Carbonate in the given sample of Dolomite ore.
3. Determine the amount of Ca(II), Mg(II), Fe(III) and Carbonate in the given sample of Calcite ore.
4. To analyze the given sample of Pyrolusite
    1) Acid insoluble residue
    2) Iron as Iron oxide
    3) Mn by using EDTA
    4) MnO_2 oxalic acid method/Iodometric method
5. To analyze the given sample of Galena ore.
    1) Determine the amount of Pb as $PbSO_4$
    2) Determine the amount of Sulphur as $BaSO_4$
    3) Insoluble mass Si as SiO_2
6. To determine the amount of Al and Fe in the given sample of Bauxite ore
    1) Al as Al_2O_3
    2) Fe as Fe_2O_3
7. Analysis of Industrial waste
   Determination of Calcium fluoride, Calcium and Carbonate from Industrial waste
8. Analysis of Cement: (White/Black Cement)
   Determination of SiO_2, Fe^{+3}, Al^{+3}, Ca^{+2}, Mg^{+2} in a given sample.
9. Determine percentage of metal ions in given mixtures by gravimetric/volumetric/spectrophotometric.
10. Miscellaneous

Reference book

1. Qualitative Chemical semimicroanalysis by V. N. Alexeyev, Mir Publishers Moscow.
2. Vogel's Qualitative Inorganic Analysis by G. Svehla, Orent Longman, New Delhi.
3. Vogel's Textbook of Quantitative Chemical Analysis, 5th edition by G. H. Jeffery, J. Bassett, J. Mendham and R. C. Denney, ELBS Publication, 1996, Chapter 2, 3, 11.

PRACTICALS: PS04CINC26

Alloys analysis (7 hrs)

1. Analysis of German silver
2. Analysis of BRONZE
3. Analysis of Solder
4. Analysis of Brass
5. Analysis of Steel
6. Analysis Aluminum alloy
7. Percentage of metal ions in given mixtures
8. Miscellaneous

Reference book

1. Modern Analytical Chemistry, 1st Edition by D. Harvey, The McGraw-Hill Pub, 2000.
2. Instrumental Methods of Analysis, 4th edition by G.W. Ewing, McFraw Hill Ltd., 1970.
3. Physical Methods in Inorganic Chemistry by R. S. Drago, John-Wiley Pub., 1975.

VIVA VOCE: PS04CINC28

PS04EINC21: Selected Topics in Advanced Inorganic Chemistry-II

Unit-1	**Molecular Polyhedra** Boron hydrides and related structures, Three centre bonds: basic assumptions, Three center orbital in known structures, Equation of balance, Topological theory and its applications	**25%**
Unit-2	**Photo-inorganic Chemistry** Basics of photochemistry, quantum efficiencies and quantum yield, consequences of light absorption, luminescence, mutagenic effect of radiation, properties of the excited states, excited states of metal complexes, ligand field photochemistry	**25%**
Unit-3	**Complex Equilibria** Types of Complex Equilibria in Solution and Equilibrium Constants: Basic principles, Mathematical functions and their interrelationship. Statistical considerations. Factors affecting the stability constants of Metal complexes. Mixed-ligand complexes. Experimental Methods for the Determination of Stability Constants Ion exchange methods, Polarographic methods. Solubility methods and Least square method for computing stability constant	**25%**
Unit-4	**Safety in Chemistry Laboratories** Good Laboratory Practices: Elements of Good Laboratory Practices; Standard Operating Procedures; Quality Assurance, Handling of Hazardous Materials, Toxic Materials (Various types of toxins and their effects on humans), Explosives and Inflammable Materials, Types of fire extinguishers, Bioactive materials, Recycling and Waste Disposal, Management in Chemical Laboratories. Legal provisions regarding ChemicalLaboratories, Environment Protection Act, 1986.	**25%**

Reference Books

1. Structure and Bonding,Vols. 1& 6, Springer-Verlag.
2. Inorganic Chemistry byPhillips and Williams, Oxford.
3. Non-stoichiometric Compounds by L. Mandelcorn, Academic Press.
4. Inorganic Chemistry byK.F. Purcell and J.C.Kotz,Half-Saunders International Edtions.
5. Boron Hydrides byWilliam N. Lipscomb, Benjamin.Inc.

6. Chemistry of The Metal Chelate Compounds byA.E. Martell and M. Calvin,Prentice-Hall Inc., Englewood Cliffs, New Jersey.
7. Chelates in Analytical Chemistry, Vol. 1 by H.A. Flaschka and A. J .Barnard,Marcel Dekker Inc., N.Y.
8. Co-ordination Chemistry Reviews, Vo1.7(l) by A.B.P. Lever, Elsevier Publishing Company, Amsterdam.
9. New Pathways in Inorganic Chemistry byE.A.V. Ebsworth, University Press, Cambridge.
10. Chemistry of Complex Equilibria by M.T. Beck, Van Nostrand Reinhold Company, London.
11. Determination of Stability Constants by F.J.C. Rossotti and H.Rossotti.
12. Progress in Inorganic Chemistry, Vol. 1 by F.A.Cotton, IntersciencePub.Inc., New York.
13. Vogel's Textbook of Quantitative Chemical Analysis, 5th edition by G. H. Jeffery, J. Bassett, J. Mendham and R. C. Denney, ELBS Publication, 1996, Chapter 2, 3, 11.
14. Modern Analytical Chemistry, 1st Edition by D.Harvey, The McGraw-Hill Pub, 2000.
15. Instrumental Methodsof Analysis,4th edition by G.W. Ewing, McFraw Hill Ltd., 1970.
16. Inorganic Medicinal and Pharmaceutical Chemistry by Lea and Febiger, John H. Block, E.B. Roche, T.P.Soine and Charles O.Wilson, 1974.
17. Physical Methods in Inorganic Chemistry byR. S. Drago, John-Wiley Pub.,1975.

PS04EINC22: Inorganic Polymers and Inorganic Materials

Unit-1	**Inorganic Polymers** Introduction, Classification of inorganic polymers, General properties of inorganic polymers, Characterization of inorganic polymers, Crystalline and amorphous polymers, Solubility parameter, Glass-transition temperature, Modulus-temperature curves, Important inorganic polymers: phosphorus-based polymers, Sulphur-based polymers, Boron-based polymers, Silicon-based polymers, Pre-ceramic Inorganic polymers	**25%**
Unit-2	**Co-ordination Polymers** Introduction to Co-ordination Polymers, Classification of coordination polymers, Organometallic polymers, Metal organic frameworks (MOFs), General method of preparation of MOFs, Ferrocene-Based Polymers, Synthesis and properties, Application of coordination and organometallic polymers	**25%**
Unit-3	**Aluminosilicates** Introduction, Classifications, Clays, Talc, Zeolites and related silica based materials, Phosphate-based Zeolites, Synthesis and Characterization of Aluminosilicates, Modification of Zeolites, Applications of aluminosilicates in heterogeneous catalysis	**25%**
Unit-4	**Metal Clusters** Introduction, Cluster Compounds of the Main Group Elements-Alkali Metals, Boron Hydrides, Carboranes and Metallocarboranes, Cage Compounds of Non-Metal Elements, Transition Metal Clusters, Metal carbonyl and halide clusters	**25%**

Reference Books

1. Inorganic Polymers, 2nd Edition byJ.E. Mark, H.R. Allcock, R. West, Oxford University Press, Inc., New York.
2. Inorganic and Organometallic Polymers by R.D. Archer,Wiley-VCH, Inc.
3. Inorganic Polymers by D.N. Hunter.
4. Modern Aspects of Inorganic Chemistry by H.Emeleus and A.G.Sharpe, Universal Books Stall, NewDelhi Routledge& Kegan paul, London.
5. Inorganic Polymers by G.R.Chatwal, Himalaya Publishing House.
6. Advanced Inorganic Chemistry by F.A. Cotton and G. Wilkinson, John-Wiley & Sons, New York.
7. Catalysis and Zeolites: Fundamentals and Applications byJ.-L. Guth, H. Kessler, J. Weitkamp, L. Puppe (Eds.), Springer-Verlag Berlin Heidelberg GmbH.
8. Zeolites and Catalysis: Synthesis, Reactions and Applications, Edited byJ.Cejka, A.Corma, and S. Zones, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim.
9. Introduction to Zeolite Science and Practice byH. van Bekkum, E.M. Flanigen, P.A. Jacobs and J.C. Jansen (Eds.), Elsevier Publications, Amsterdam.
10. Cluster Chemistry byGuillermo Gonzalez-Moraga, Springer- Verlag Berlin Heidelberg GmbH.
11. Metal clusters in chemistry by P. Braunstein, L.A. Oro, P.R. Raithby, Wiley-VCH Verlag GmbH, Weinheim.