।। सा विद्या या विमुक्तये ।।

# स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

"ज्ञानतीर्थ" परिसर, विष्णुपूरी, नांदेड - ४३१६०६ (महाराष्ट्र)

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED**

"Dnyanteerth", Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)

Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade

## ACADEMIC (1-BOARD OF STUDIES) SECTION

**Phone: (02462) 229542**
**Fax : (02462) 229574**

**Website: www.srtmun.ac.in**

**E-mail: bos.srtmun@gmail.com**

संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील **M. Sc. Inorganic Chemistry II Year** या विषयाचा अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्याबाबत.

# प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, प्रस्तुत विद्यापीठाशी **संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील M. Sc. Inorganic Chemistry II Year या विषयाच्या अभ्यासक्रमास विद्याशाखेने दिनांक १९/०१/२०२१ रोजीच्या बैठकीतील केलेल्या शिफारशीप्रमाणे व मा. विद्यापरिषदेच्या दिनांक २२ जानेवारी २०२१ रोजीच्या बैठकीतील ऐनवेळचा विषय क्र. ६/५०–२०२१ च्या** ठरावानुसार मान्यता देण्यात आली आहे.

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी.

**जा.क्र.:** शैक्षणिक–१/परिपत्रक/पदव्युत्तर–सीबीसीएस अभ्यासक्रम/
R-२०२०–२१/**२२३५**

**दिनांक :** ०२.०२.२०२१

स्वाक्षरित
**उपकुलसचिव**
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत माहिती व पुढील कार्यवाहीस्तव :

१) मा. कुलसचिव यांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED**
**M. Sc. INORGANIC CHEMISTRY Second Year**
**(SEMESTER III & IV)**
**CBCS Pattern Syllabus**
**June 2020**

| Semester | Paper | Course No | Course | Periods/ Week | Total Periods | Credits |
|---|---|---|---|---|---|---|
| Semester III | XV | CH-531 | Advanced Spectroscopic Methods | 4 | 60 | 4 |
| | XVI | CH-532/1 | Bio Inorganic and Supraolecular Chemistry | 4 | 60 | 4 |
| | XVII | CH-533/1 | Organo Metallic Chemistry | 4 | 60 | 4 |
| | XVIII | CH-534/1 | Analytical Chemistry | 4 | 60 | 4 |
| | XIX | | Seminar | | | 1 |
| Semester IV | XX | CH-541/1 | Organo Metallic catalysis and fluxanality | 4 | 60 | 4 |
| | XXI | CH-542/1 | Photoinorganic chemistry | 4 | 60 | 4 |
| | XXII | CH-543/1 | Chemistry of materials | 4 | 60 | 4 |
| | XXIII | CH-544/1 | Nuclear and Radiation chemistry | 4 | 60 | 4 |
| | XXIV | | Seminar | | | 1 |
| Practicals | XXV | CH-501 | Laboratory course V | 6 | 132 | 4 |
| | XXVI | CH-502 | Laboratory course VI | 6 | 132 | 4 |
| | XXVII | CH-503 | Laboratory course VII | 6 | 132 | 4 |
| | XXVIII | CH-504 | Laboratory course VIII | 6 | 132 | 4 |

**For each paper ESE-75 Marks (3 Credit), CA- 25 Marks (1 Credit)**

**M. Sc. Second Year, Semester-III**
**Paper–XV, [CH-531]**
**Advanced Spectroscopic Methods**

**Marks: 4 Credits** **Periods: 60**

SM-1: UV-Vis Spectroscopy:
SM-2: IR spectroscopy:
SM-3: NMR Spectroscopy (Organic):
SM-4: NMR Spectroscopy (Inorganic):
SM-5: Mass Spectroscopy:
SM-6: Moissabaur Spectroscopy:
SM-7: Structural problems:

**SM-1: UV-Vis Spectroscopy:** **06P**

Fieser-Woodward rules for conjugated dienes and carbonyl compounds, Fieser-Kuhn rules for polyenes. UV spectra of aromatic compounds and heteroaromatic compounds. Calculation of $\lambda_{max}$ for the benzene derivatives (R-$C_6H_4$-Co-G) by A. I. Scott emperical rules.

**SM-2: IR spectroscopy:** **10P**

a) Recapitulation, Characteristic vibration frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds Ketones, aldehydes, esters, amides, acids, anhydride, Lactose, lactams and conjugated carbonyl compounds. Factors affecting group frequencies: overtones, combination bands and Fermi-resonance. FITR and sampling technique.

b) Structural information from vibrational spectra: Group frequencies, Characteristic band stretching frequencies, Mode of vibrations of linear and non-linear molecules, deformation, frequencies of carbonyl metal complexes, pattern of group frequencies, mode of bonding of ambidentate ligands, Cynides, Ethylenediamine and Diketone complexes.

**SM-3: NMR Spectroscopy (Organic):** **12P**

**a) $_{1}$H NMR:** General introduction and definations, Chemical shift, Spin-spin interaction, shielding mechanism of measurement of chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehyde and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides and mercapto). Factors affecting chemical shift. Deuterium exchange. Spin-spin coupling, factors affecting coupling constant. Complex spin-spin interaction between two and three nuclei. Simplification of complex spectra, nuclear magnetic double resonance, contact shift reagents, solvent effects. Fourier transform technique. Nuclear Over-Hauser effect (NOE). Resonance of other nuclei; $_{19}$F and $_{31}$P.

**b) $_{13}$C NMR:** Resolution and multiplicity of $_{13}$C NMR, 1H-decoupling, noise decoupling, broad band decoupling; Deuterium, fluorine and phosphorus coupling; NOE signal enhancement, off-resonance, proton decoupling, Structural applications of CMR. DEPT; Introduction to 2D-NMR: COSY, NOESY, DEPT, INPET, APT, INADEQUATE.

3

**SM-4: NMR Spectroscopy (Inorganic):** **08P**

a) Basic principle of NMR spectroscopy and applications to Paramagnetic compounds and metal nuclei of Pt $_{195}$ and Sn $_{119}$.

b) Basic principle and applications of ESR spectroscopy to different free radical

molecules and transition metal ion complexes.

**SM-5: Mass Spectroscopy:** **06P**

Theory, instrumentation and modifications; Unit mass and molecular ions; Important terms- singly and doubly charged ions, metastable peak, base peak, isotropic mass peaks, relative intensity, FTMS, etc.; Recognition of M+ ion peak; General fragmentation rules: Fragmentation of various classes of organic molecules, including compounds containing oxygen, sulphur, nitrogen and halogens; α-, β-, allylic and benzylic cleavage; McLafferty rearrangement.

**SM-6: Moissabaur Spectroscopy:** **08P**

Basic priniciple of Moissabaur Spectroscopy, applications on the basis of isomer shifts, electric quadrupole interactions. Elucidation of structure of $I_2Br_2Cl_4$, $I_2Cl_6$, $Fe^{+2}$ and $Fe^{+3}$ complexes and $Sn^{+2}$ and $Sn^{+4}$ compounds

**SM-7: Structural problems:** **10P**

a) Combined problems on UV, IR, NMR and Mass spectral data for structure determination.

b) Elucidition of structure of organic molecules using spectra (IR & NMR).

**Reference Books:**

1. Spectroscopic identification of Organic Compounds, R. M. Silverstern, G.C. Bassler and T. C. Morril.
2. Introduction to NMR spectroscopy, R. J. Abraham, J. Fisher and P. Loftus.
3. Application of spectroscopy of organic compounds – J. R. Dyer.
4. Spectroscopy of organic compounds, P. S. Kalsi.
5. Organic Spectroscopy, William Kamp.
6. Organic Chemistry, R. T. Morrison and R. N. Boyd.
7. Practical NMR spectroscopy, M. L. Martin, J. J. Delpench and G. J. Martin.
8. Spectroscopic methods in organic Chemistry, D. H. William, I. Fleming.
9. Fundamentals of Molecular spectroscopy – C.N.Banwel

**M. Sc. Second Year, Semester-III**
**Paper–XVI, [CH-532/1]**
**Bioinorganic and Supramolecular Chemistry**

**Marks: 4 Credits** **Periods:60**

**Bioinorganic chemistry**

**1.** Introduction, Role of metals and non-metals in biological systems **05P**

**2. Metal storage and transport** **15P**

a. Alkali and Alkaline Earth metals: Na/K pump, Ca pump, transport of $Ca^{++}$ in microbes.
b. Supply and storage of iron: Ferittin, transferittin and Sidprophores
c. Storage and transport of copper and zinc
d. Transport and storage of other metals

**3. Transport and storage proteins** **10P**

**Oxygen transport and storage:** Oxygen carrier, myoglobin and haemoglobin, Hemerythrin and Hemocyanine

**4. Metals in medicines** **08P**

**Metals and its complexes as a therapeutic agents**

i. Anti cancer drugs ( Platinum and other metal complexes) ,
ii. Antiartharthritis Drugs ( Gold and copper complexes )
iii. Metal deficiency : Iron, Copper, Zinc, Cobalt, and other metal toxicity
iv. Vitamin $B_{12}$.

**Supramolecular chemistry**

**1. Concept and language :** **08P**

Molecular recognition : Molecular receptors for different types of molecules including anionic substrates, design and synthesis of coreceptor molecules and multiple recognition.

**2. Supra molecular reactivity and catalysis** **08P**

Anion receptor molecules, metallo receptor molecules and co-catalysis

**3. Supra molecular assemblies** **06P**

Molecular and supramolecular photonic/ electronic/ionic devices

**Books Suggested**

1. Principles of bioinorganic chemistry, S. J. Lipard and J. M. Berg University science book
2. Bioinorganic Chemistry , I.Bertine, H.B.Grey, S.J.Lipard, University Science book
3. Progress inm Inorganic Chemistry – Vol. 18 & 38 Edn J.J.Lipard Wiley
4. Supra molecular chemistry, J.M.Lehn, VCH
5. Bioionorganic and supramolecular chemistry, Ajay kumar Bhagi and G.R.Chatwal, Himalaya Publication.

**M. Sc. Second Year, Semester-III**

**per–XVII, [CH-533/1]**

**Organo-metallic Chemistry**

**Marks: 4 Credits** **Periods: 60**

**1. Organometallic Chemistry** **12P**

a. Introduction, Classification, Nomenculture, 18 electron rule and their stability.

b. Synthesis and properties of organometallic compounds with i. carbonyl,

ii. Phosphine, iii. Nitrosyl ligand

**2. Compound of transition metal carbon multiple bonds** **16P**

Introduction, Synthesis, Nature of bonds, structural characteristic, Nucleophillic and Electrophillic reactions on the ligands, Role in organic synthesis of i. Transition metal Fischcr and Schrock carbene complexes. ii. Transition metel alkylidyne complexes.

**3. Transition metal π complexes** **20P**

a. Introduction , Transition metal π complexes with unsaturated organic molecules,

b. Preparations, properties, nature of bonding and structural features. Important reaction relating to nucleophillic and electrophillic attack on ligand and to organic synthesis.

i. Transition metal Alkenes complexes,

ii. Transition metal Alkynes complexes,

iii. Transition metal Allyl complexes ,

iv. Butadiene Transition metal cylcobutadiene complexes,

v. Transition metal cylcopenta dienyl complexes,

vi. Transition metal Arene complexes,

vii. Transition metal trienyl complexes,

**4. Reactions of Organometallic compounds** **12P**

a. Oxidative - addition reactions,

b. Reductive elimination reactions,

c. Insertion reactions

d. Deinsertion reactions,

e. Nucleophillic and Electophillic attack on coordinated ligand

**Books Suggested**

1. Principles and Applications of organotransitions metal chemistry
J.P.Collman, L.S.Hagsdus J.R.Norton & R.G.Finke – University science book.

2. Organometallic chemistry of transition metal – R.H.Carbetre , John Wiley

3. Metalloorganic chemistrty – A.J.Pearson – Wiley

4. Organmometallic Chemistry – R.C.Mehrotra A.Singhj –age International

5. Inorganic Chemistry by Butler, Harrod,1989, Benjamin/Cummins Pub.Co.

**M. Sc. Second Year, Semester-III**
**Paper–XVIII, [CH-534/1]**
**Analytical Chemistry**

**Marks: 4 Credits** **Periods: 60**

**1. Thermal methods of analysis** **15P**

Introduction of different thermal methods, Thermogravimetry TG, and DTG, Static thermogravimety, quasistatic, Thermogravimetry and dynamic thermogravimetry, Instrumentationl Factors affecting thermograms, Applications of thermogravimetry, Differential thermal analysis (DTA),DTA curves, Factors affecting DTA curves, instrumentation, applications of DTA. Simple numerical problems.

**2. Electroanalytical Techniques** **12P**

**Voltametry and Amperometry :**

Linear and cyclic sweep voltametry, Randle's Sevcik equation, Tests for electrode reactions coupled with chemical reactions coupled , EC and ECE reactions, Application of voltametry in the study of unstable reaction intermediate, Enzyme catalysed reaction.

**Stripping technique :**

Anodic and cathodic stripping voltametry and their application in the trace determination metal ions and biologically important compounds.
Principal,methodology and applications of amperometric titrations, Chromopotentiometry.

**3. Analysis of water pollution** **15P**

Origin of waste water, Types of water pollutant and their effects. Sources of water pollution – Domestic, Industrial, Agricultural soil and Radioactive waste as a source of pollution. Objective of analysis parameter for analysis colour, Tubidity, total solid, conductivity, acidity, Alkalinity, hardness, chloride, sulphate, fluoride, silica, phosphates and different forms of nitrogen. General survey of instrumental technique for the analysis of heavy metal in aqueous systems. Measurements of DO, BOD and COD. Pesticides as water pollutant and analysis. Water pollution laws and standards

**4. Analysis of soils, fuel, Body fluids and Drugs** **12P**

a. Analysis of soil :Moisture, Ph, total nitrogen, phosphorous, silica, lime, magnesia, mangnese, sulphur and alkali salts

b. Fuel analysis : solid, liquid and gas altimate and proximate analysis – heating values, grinding of coal, liquid fuels – flash points, aniline point, octane number and carbon residue. Gaseous fuels – producer gas and water gas, calirific values

c. Clinical chemistry : Compositions of blood – collection and preservation of samples, clinical analysis, serum electrolysis, blood glucose, blood urea nitrogen, uric acid, albumin, globulins, barbiturates, acid and alkaline phosphates

d. Drug analysis : Narcotics and Dangerous drugs. Classification of drugs, screening by gas and by TLC and spectrophotometric measurements.

**5. Food Analysis** **06P**

a. Introduction, food safety and reasons
b. Analysis of food materials: Moisture, ash, crude fibers, fats, proteins, carbohydrates, total sugars, starch, Ca, Na, adulterants.
c. Microscopic examinations of foods

**Books Suggested:**

1. Analytical Chemistry – G. D. Christians, J. Wiley
2. Fundamentals of analytical Chemistry – D. a. Smog,C. n. west and F. J. Holler, W. B. Saunders
3. Analytical Chemistry, principles, J. H. Kenedy, W. B, Saunders
4. Principles of Instrumental Analysis, D. A. Skoog, W. B. Saunders
5. Basic concepts of analytical. Chemistry – S. M. Khoppkar, wiley Eastern
6. Quantitative analysis – R. A. Day, Jr and A. L. Underwood, Prentice Hall
7. Analytical Chemistry – Alka Gupta, Pragati prakashan.

**M. Sc. Second Year, Semester-IV**

**Paper–XX, [CH-541/1]**

**Organometallic Catalysis and fluxanality**

**Marks: 4 Credits** **Periods: 60**

**1. Catalysis** **03P**

**G**eneral principles .description and property of catalysts.

Types of catalysts catalytic steps involved in homogenous catalysis and heterogenous catalysis

**2. Homogenous catalysis – I** **15P**

a. General features, types of catalysts

b. Study of

**i.** Hydrogenation of catalysis **(Wilkinson's catalyst)**

**ii.** Tolmen catalytic cycle

**iii.** Monsoanto acetic acid synthesis

**iv.** Wacker process

**v.** Ziegler-Natta polymerisation of alkens

**vi.** Hydrocarbonylation / Hydroformulation of Olefins

**3. Homogenous catalysis – II** **15P**

Study of

i. Water gas shift reactions

ii. Fishcher-Tropsch synthesis

iii. Hydrosilation

iv. Activation of C-H bond

v. Reppe's catalysis

vi. Heck reactions, Suzuki coupling

vii.Epoxidation

**4. Heterogenous catalysis** **15P**

a**.** General features, types of catalysts.

b The nature of heterogenous catalysis

i] surface area and porosity

ii]surface acidic and basic sites

iii]surface metal sites

c. Catalytic steps

I]Chemisorption and desorption,

ii]surface migration

d]catalytic reactions

i]hydrogenation of alkenes

ii]Birch clemmensons reactions

iii]Wolf-kishner reactions

iv]sodium borohydride

v]lithium aluminium hydride

vii]ammonia synthesis

viii]$SO_2$ oxidation

ix]. Zeolites Synthesis of different zeolites, charatirisation ,synthetic and selective

applications. interconvertion of aromatics by zeolites e]Electrocatalysis

**5. Fluxional organometallic compounds** **12P**

i. Introduction, Detection of sterochemical non-rigidity, Rate of fluxionality

ii. Fluxionality in triogonal bipyramidal complexex.

iii. Fluxionality in $n_3$ allyl complexex

iv. Fluxionality in cyclopentadienyl complexex

**Books Suggested**

1. Principles and Applications of organotransitions metal chemistry
J.P.Collman, L.S.Hagsdus J.R.Norton & R.G.Finke – University science book.
2. Organometallic chemistry of transition metal – R.H.Carbetre , John Wiley
3. Metalloorganic chemistrty – A.J.Pearson – Wiley
4. Organmometallic Chemistry – R.C.Mehrotra A.Singhj –age International
5. Inorganic Chemistry by Butler, Harrod,1989, Benjamin/Cummins Pub.Co.

**Paper–XXI, [CH-542/1]**
**Photo Inorganic Chemistry**

**Marks: 4 Credits** **Periods: 60**

**1. Basic Photochemistry** **15P**

a. Absorption, excitation, photochemical laws, quantum yield.
b. Readeation, Absorption and emission for complexes with different ground state/ excited state for $ML_6$ complexes.
c. Potential energy function and energy levels for electronically transition of $ML_6$ complexes.
d. Flash photolysis, stopped flow techniques. Energy dissipation by radiative and non-radiative processes, absorption spectra.
e. Frank-Codon principle, photochemical stages – primary and secondary processes.
f. Jablonski diagram for photochemical process

**2. Photochemical properties of transition metal complexes** **15P**

a. Photophysical process
b. Photochemical process : Photo substitution reactions ,photoredox reactions, Photorearrangement reaction,
c. Prompt and Delayed Photochemical reactions
d. Photolysis rules and ligand field theory

**3. Photochemical reaction of coordination compounds** **15P**

**a.** Ligand field excited states i) $Cr^{+++}$ ion complexes ,$Co^{+++}$ ion complexes, $Rh^{+++}$ ion complexes and $Ir^{+++}$ ion complexes.
**b.** charge transfer excited states i) LMCT ii) MLCT iii) Charge transfer to solvent state.
**c.** Integrated excited state

**4. Photoreactions** **15P**

i) In solar energy conversion
ii) Photographic systems
iii) photosynthesis

**Boks Suggested**

1. Progress in Inorganic Chemistry – Vol. 18 & 38 Edn J.J.Lipard Wiley
2. Supra molecular chemistry, J.M.Lehn, VCH
3. Concepts of Inorganic Photochemistry, A.W.Adamson, & T.D.Flkeischaue, Wiley
4. Elements of Inorganic photochemistry – G.J.Ferraudi

**Paper–XXII, [CH-543/1]**
**Chemistry of Materials**

**Marks: 4 Credits** **Periods: 60**

**1. The structure of crystalline solids** **10P**

a. Crystal structure: Fundamentals concepts, Unit cells,Metallic structure, Cystallographic points, Directions and planes.

b. Crystalline and noncrystalline materials: single crystal, poly crystalline materials, and non crystalline solids

c. Imperfections and related phenomenon in solids

**2. Mechanical properties of metals** **07P**

a. Elastic deformation and Elastic properties of materials

b. Plastic deformation and their tensile properties

**3. Multiphase materials** **12P**

**Types of metal alloys**

a. Ferrous alloys, Fe-C phase transformation in ferrous alloys, stainless steel, properties of ferrous alloys and their application.

b. Non-ferrous alloys ( compositions and applications of alloys of copper and Aluminum)

c. Fabrication of metals

d. Thermal processing of metals

**4. Structure, properties and applications of ceramics** **10P**

a. **C**eramics structures, mechanical properties,

b. Types and applications of ceramics : Glasses and Glass ceramics , clay products. Refractories, abrasives, cements and advanced ceramics.

c. Fabrication and processing of glasses and clay products.

**5. Composites** **06P**

a. Introduction , Scheme for the various composites types

b. Particle Reinforced composites : concrete

c. Fibre Reinforced composites , Elestic behaviors

d. Ceramic matrix composites.

**6. Nanomaterials** **15P**

a. Introduction

b. Basic aspects, properties and application with respect to

i. Electronic and optical materials

ii. Magnetic properties

iii. Superconducting materials

iv. Biomaterials

c. Thin films and Langmuir-Blodgett films

Preparation technique, evaporation /sputtering chemical processes, MOCVD, solgel etc. Langmuir-Blodgett, film growth technique photolithography

**Books Suggested**

1. Solid state Physics – N.W.Aschroff G.N.D.Merimin – Saunders college
2. Material science of Engineering, an Introduction – W.D.Callister, Wiley
3. Material science – J.C.Anderson, K.R.laever, J.M.Alexander- ELBS
4. Hand book of liquid crystals – Kaelkar & Haatz, Chemie Verlag
5. Thermotropic liquid crystals, Ed.G.W.Cray, John Wiley
6. Solid state chemistry , N.B. Hannay
7. Principals of Solid state, H.V. Keer.
8. Electronic structures and chemicals solids, P.A. Cox.

**M. Sc. Second Year, Semester-IV**

**Paper–XXIII, [CH-544/1]**
**Nuclear and Radiochemistry**

**Marks: 4 Credits** **Periods: 60**

**1. Radioactivity** **12P**

a. Radioactive elements , Characteristics of Radioactive decay
b. Systematic alpha, Beta, Gamma decays
i. Alpha decays, energy curves, Alfa particle energy spectrum, GN law, Theory of alpha decays
ii. Types of Beta decays, Electron capture reaction, Range of energy relation ship of beta particle, beta positive decays, Dirac's theory of positron.
iii. Gamma emission, gamma decays constant, internal conversions, Auger effect.

**2. Nuclear reactions :** **10P**

a. Types and conservation of nuclear reactions,
b. Reaction cross sections, Energetic, cross sections
c. Compound nucleus theory of nuclear reactions
d. Nuclear fission **:** Mass, energy and charge distribution of fission products,
Decay chains,
f. Fusion reactors

**3. Nuclear models** **10P**

**a.** Nuclear stability ,Shell model, Fermi gas model, collective nuclear model and optical model
**b.** Nuclear fission : liquid drop model, fission barrier, fission cross section, Mass energy, Symmetric and asymmetric fission

**4. Nuclear reactors** **10P**

Nuclear fission as a source of energy and chain reacting system
Natural uranium reactors
classification of reactors
Critical size of the thermal reactors and its controls
Breeder reactor
Enriched aqueous homogeneous reactors
Reactors in India: Uranium and Thorium recourses,
Reprocessing of spent fuels.

**5. Chemicals Effects of Nuclear Transformation** **08P**

Szillard-Chalmer's reaction and recoil chemistry, retention
Chemical affects accompanying the other nuclear reactions

**6. Radiolysis:** **10P**

a. Radiation chemistry
b. Interaction of radiation with matter
c. Radiation Dosimetry
d. Radiolysis of water
e. Radiolysis of aqueous solutions containing organic and inorganic species
f. Hydrated electron

Books Suggested:

1. Essentials of Nuclear Chemistry by H.J.Amikar, Wiley Eastern Pvt. Ltd,News Delhi (1990)
2. Source of Book of Atomic Energy, by S.Glasstone, Affiliated East We3st Pressltd., New Delhi (1967)
3. Nuclear chemistry by U.N.Dash, Sultan Chand and soins, Nes Delhiu (1991)
4. Introduction to Radiation chemistry, by J.W.t.Spinks, anmd R.j.Woods,John-Wiley and Sons, New York (1964)
5. Nuclear and radiation Chemistry by B.K.Sharma. GoelPublishing House, Meerut (1997)

**M. Sc. Second Year**

**Laboratory Course-V, Paper– XXV, CH-501/1**

**Marks: 4 Credits** **Periods: 132**

**Preparations and Characterisation (Any Six)**

**(Conductance, Magnetic succeptibility, moisture)**

1. Metal oxalate hydrate ($Mg^{+2}$)
2. Sodium tetrationate $Na_2S_4O_6$
3. Metal complexes of $CuCl_2$.2DMSO
4. Ni $(acac)_2$
5. Bromination of $Ni(acac)_3$
6. Cis/trans $[Co(en)2Cl_2]^+$
7. [Co(phenanthroline)-5,6 quinone]
8. Ferrocene
9. Copper glycine complex (Cis/trans)
10. Hexa ammine Cobaltic complex

**Estimations**

**A. volumetric / gravimetric**

1. Estimation of $Mg^{++}$ from metal oxalate hydrate complex by volumetric methods
2. Estimation of Tin from Tin halide by Gravimetric methods
3. Estimations of copper from copper DMSO complex by volumetric
4. Estimation of Nickel from $Ni(acac)_2$ by Gravimetric
5. Estimation of chromium from $cr(acac)_3$ by volumetric methods
6. Estimation of cobalt from $[Co(en)_2Cl_2]^+$
7. Estimation of Iron from Fe(II) chloride by volumetric methods

**Laboratory Course-VI, Paper– XXVI, CH-502/1**

**Marks: 4 Credits** **Periods: 132**

**Instrumentation**

**A. Spectrophotometry ( Any five )**

1. Simultaneous determination

i] Manganese / Chromium in steel

ii] Vanadium and titanium

iii] Chromium and cobalt

2. Determination of Nickel by spectrophotometric methods
3. Determination of Tungstan by Spectrophotometric method
4. Determination of Fluoride by Spectrophotometer
5. Job-method Zirconium Alizarin red – 5-complex (mole-ratio method)
6. Stoichiometry and stability of $Fe^{+3}$ salicylate complex by jobs and mode ratio method
7. Stoichiometry and stability of $Fe^{+3}$ thiocynate complex by jobs and mode ratio method

**B. Flame photometry ( Any Two )**

1. Estimation of sodium
2. Estimation of potassium
3. Estimation of calcium
4. Estimation of Lithium
5. Estimation of $Cd^{++}$ and $Mg^{++}$ in tap water

**C. Chromatography ( any one )**

1. Separation of $Cd^{++}$ and $Zn^{++}$ by paper chromatography. Determine its RF value.
2. Separation of $Ni^{++}$ and, Co by paper chromatography. Determine their Rf value.
3. Separation of $Cd^{++}$ and $Zn^{++}$ by TLC. Determine their Rf value.

**Books Suggested:**

1) Structural methods in Inorganic Chemistry by E.A.V. Ebsworth.
2) Physico chemical methods in Inorganic Chemistry by Drago
3) Inorganic Experiments – J. Derek, woo

**M. Sc. Second Year**

**Laboratory Course-VII, Paper– XXVII, CH-503**

**Marks: 4 Credits** **Periods: 132**

**A] Metal estimations: Volumetric / gravimetric ( Any Six )**

**Alloys/ores/drugs/paints/edibles**

1. Estimation of metal ions in coins
2. Estimation of metal ions in Bauxite ore
3. Estimation of metal ions in Pyrolusite ore.
4. Estimation of Lead in red paints (Lead borate)
5. Estimation of calcium and magnesium in talcum powder
6. Estimation of Aluminium from its ore.
7. Estimation of calcium from drug sample .
8. Estimation of metal ions in cement
9. Estimation of metal ions in fruits

**B] Structural interpretation (Any one from each section)**

**1. LFT**

1. Indicate the splitting of the d-levels and the number of electrons in each level foreach of the following complexes.

a) Ni $(NH_3)_6^{+2}$ (Paramagnetic)

b) Trans-Ni$(CH_3)_4Cl_2$ (Paramagnetic, tetragonal, $\Delta$ for $NH_3 > C1^-$)

c) Cu $(NH_3)_4^{+2}$

d) Trans-Ni $(CN)_4$ $(H_2O)_2^{-2}$

e) Ni $Cl_4^{-2}$ (tetrahedral)

f) Mn $(acac)_3$ (acac = acetylacetonate)

g) Cr $(CN)_6^{-3}$

h) $FeO_4^{-2}$ (tetrahedral)

i) Cu $Cl_4^{-2}$ (tetrahedral)

j) Co $(NH_3)_6^{+2}$

2. Of the complexes in a, e, f, g, h, i and j above, which would you expect to be distorted?

3. Compare the CFSE in $Co(NH_3)_6^{+2}$ and $Co(NH_3)_6^{+3}$

4. **A.** Calculate the relative energies as a function of Dq and P for both the high spin (HS) and low spin (LS) octahedral and HS tetrahedral aquo complexes of Co(II) and Fe(II). On the basis of these calculations state which configuration is the most energetically favorable for each of these ions.

**B.** On the basis of the CFSE's alone, predict which ion should show the greater tendency form tetrahedral complexes.

**C.** Is this prediction upheld by the calculations made above and if not, why?

**II MAGNETIC CHEMISTRY**

**1. a.** Co $(N_2H_4)_2Cl_2$ has a magnetic moment of 3.9 BM. Is hydrazine bidentate? Propose a structure.

**b.** How could electronic spectroscopy be employed to support the conclusion in **a.**

**2.** In which of the following tetrahedral complexes would you expectcontributions from spin orbit coupling? $V^{+3}$ , $Cr^{+3}$ , $Cu^{+3}$, $Co^{+2}$ , $Fe^{+2}$ , $Mn^{+2}$

**3.** In which of the following spin-paired square planar complexes would you expect contributions? $d^2$, $d^3$, $d^4$. $d^5$, $d^6$

**4.** Why is $Fe_2(CO)_9$ with three bridging and six terminal carbonyl is diamagnetic?
**5.** Explain why mixing of a $D_{4th}$, component in with $T_d$ ground state lowers the moment nickel (II) complexes.
**6.** What is expected magnetic moment for $Er^{+3}$ ?

## III INTERPRETATION EXERCISES

1. X-ray powder diffraction analysis of cubic compound
a. Determination of lattice constants and geometry
b. Partical Size
c. Density
2. Interpretation of Mossbaur spectrum with reference to determination of a) isomer shift b) quadruple splitting c) Internal magnetic field d) general comment (Problems 7.1 to 7.6.)
3. Interpretation of IR / Raman spectrum with reference to stretching vibration 0-2 C=N, C=O, N-, M-O Problems 5.9 to 5.15
(The spectrum of $Co(NH_3)_6(ClO_4)_3$ has absorption bands at 3320 $cm^{-1}$, 3240 $cm^{-1}$, 1630 $cm^{-1}$, 1352 $cm^{-1}$, and 803 $cm^{-1}$. For purposes of assignment the molecule can be treated as a $C_{3v}$ molecule. Use the Vn, symbolism to label the bands and also describe them as bends, stretches etc.
4. Interpretation of NMR spectrum with reference to calculation of chemical shifts and general comments.
5. Interpretation of absorption spectra for
a. Verification of position of ligands in spectrochemical series.
b. Determination of geometry (Octahedral, square planer, tetrahedral) of a given compound.
c. Calculation of spectral splitting parameters.
6. Interpretation of polar gram for determination of half wave potentials and unknown Concentration.

BOOKS SUGGESTED:

1. Analytical Chemistry – G. D. Christians, J. Wiley
2. Fundamentals of analytical Chemistry – D. A. Smog, C. N. West and F. J. Holler, W. B. Saunders
3. Analytical Chemistry, principles, J. H. Kenedy, W. B, Saunders
4. Principles of Instrumental Analysis, D. A. Skoog, W. B. Saunders
5. Basic concepts of analytical. Chemistry – S. M. Khoppkar, Wiley Eastern
6. Quantitative analysis – R. A. Day, Jr and A. L. Underwood, Prentice Hall

**M. Sc. Second Year**
**Laboratory Course-VIII, Paper– XXVIII, CH-504**

**Project**

**Marks: (3+1) Credits** **Periods: 132**

The students will develop utilities such as analytical spectra, simulation programmes that will supplement laboratory exercises in their subject of specialization. For this, variety of small research project designed by the teacher based on the interest of the student and capabilities should be worked out.

The students will have to give at least one seminar in each semester in their subject of specialization. For this, submission of synopsis of seminar delivered by every student is compulsory which is to be produced before examiner of practical examination.