



**HEMCHANDRACHARYA NORTH  
GUJARAT UNIVERSITY**

**NAAC A (3.02) State University**

**PATAN-384265**

Faculty of Science

M.Sc. Chemistry

Syllabus

Semester-IV

W.E.F June-2020 (and thereafter)

**CURRICULUM**

Hemchandracharya

North Gujarat University,

Patan.

M.Sc. (Chemistry)

(WEF June: 2020)

General Information of Semester III & IV  
Syllabus According To CBCS Pattern

1. The medium of instruction, question papers as well as answers in examinations will be English only.
2. Passing standard: 40% as per the revised rules and regulation of Hemchandracharya North Gujarat University, Patan (ACA/AXS/744/2018, Date 27/4/2018).
3. Viva voice will be pertaining to practicals.
4. The degree will be awarded in M.Sc. (Chemistry) in specialized branch. The curriculum will be common for semester-III & IV for all branches.
5. The result sheet of all semesters will contain the name of elective papers selected by the candidate. The grade and the credit secured.
6. A maximum of 10% students passing second semester may be allowed for dissertation at the 4<sup>th</sup> semester. Such students will be exempted from practical as well as via of forth semester. In lieu of that the dissertation of candidate will be assessed with 100 marks of dissertation and 50 marks of the viva of dissertation.  
If the number of students willing to opt dissertation exceeds 10% dissertation will be given on the basis of merit of combined marks of first and second semester. The dissertation will be allotted to the students in the beginning of third semester by head of the department / P.G. Center.
7. Intake of students every centre 40 (Organic branch) 25 for Inorganic & Physical branch, University Department.55 (Inorganic, Organic and Physical branches).
8. For semester III & IV  
(A) The internal evaluation for total 120 marks will be done as per the continuous evaluation process as under.

	Marks
a) Weekly test of theory (minimum8)	56
b) Internal Practical examination (once a semester)	20
c) Students seminar (once a semester)	14
d) Problem Solving / New Practical	06
e) Book review(In students own handwriting ,Separate book for all)	07
f) Project work assessment (separate for all)	07
g) Quiz/Questionnaire	<u>10</u>
	Total = 120
<b>(B) SE Paper Internal Evaluation</b>	<u>15</u>
	Total = 135

9. A batch of chemistry Practical will consist of 20 students per teacher.

10. For semester III the papers, CHNN-601-(I), CHNN-602-(I), CHNN-603-(I), CHNN-604-(I), are core compulsory. Furthermore, students will have to choice any one of CHNN-605A-(I), or CHNN-605B-(I), Practicals CHNN-606-(I), & CHNN-607-(I).

11. For semester IV, the papers, CHNN-701-(I), CHNN-702-(I), CHNN-703-(I), and CHNN-704-(I), are core compulsory. In addition, the students will have to choice any one of CHNN-705A-(I), or CHNN-705B-(I), Practicals CHNN-706-(I), & CHNN-707-(I).

12. For all the semesters, the total marks will be given out of 600. The cumulative grade will be per university rules.

Note: During the preparation of this curriculum, samples are taken for consideration of the followings:

- A. Model curriculum of U.G.C
- B. Concept of continuous evaluation
- C. CGPA(Cumulative Grade Point Average Credit)
- D. CBCS(Choice Based Credit System)
- E. Semester approach
- F. Revised rules and regulation of Hemchandracharya North Gujarat University, Patan.
- G. NET( NATIONAL ELIGIBILITY TEST) curriculum

13. As per recent directive from university, all the 4 credit as well as 2 credit courses will have internal marks as indicated in the table.

14. For university examination for each batch, maximum-30 students.

15. The mark distribution of 150 marks of practical will be as under from – (CHNN-606-(I), + CHNN-607-(I),M.Sc. SEM-III & CHNN-706-(I), + CHNN-707-(I),M.Sc. SEM- IV.

SECTION – I : 40 Marks

SECTION – II : 40 Marks

SECTION - III : 40 Marks

Viva : 30 Marks

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**Total: 150 Marks .....** (Two full days)

# **Inorganic Chemistry**

**Hemchandracharya**  
**North Gujarat University Patan**  
**M.Sc. (Inorganic Chemistry) (WEF June:2020)**  
**Semester-IV**

<b>Work Load</b>	<b>Paper No.</b>	<b>Subject</b>	<b>External Marks</b>	<b>Internal Marks</b>	<b>Credit</b>
60 Hrs.	CHNN-701-(I)	Inorganic Chemistry Paper-I	70	30	4
60 Hrs.	CHNN-702- (I)	Inorganic Chemistry Paper-II	70	30	4
60 Hrs.	CHNN-703- (I)	Corrosion Or Co-ordination Chemistry	70	30	4
60 Hrs.	CHNN-704- (I)	Applications of Inorganic Chemistry in Industries	70	30	4
30 Hrs.	CHNN-705A- (I)	Fundamentals and Safety in Chemistry Lab	35	15	2
30 Hrs.	CHNN-705B- (I)	Bioinorganic Chemistry	35	15	2
90 Hrs.	CHNN-706- (I)	Practical- I	75	-----	3
90 Hrs.	CHNN-707- (I)	Practical- II	75	-----	3
		<b>Total</b>	465	135	24

➤ **Working per semester minimum 90 days (15 weeks).**

**M.Sc. Semester-IV**  
**Inorganic Chemistry Paper-I**  
**(Spectroscopy)**  
**CHNN-701-(I)**

**Unit:-1 Mass Spectroscopy** **25% (15 Hrs)**  
Principles & Applications to Inorganic chemistry

**Unit:-2 Electron Spectroscopy** **25% (15 Hrs)**  
EXAFS, ESCA, Auger Electron Spectroscopy

**Unit:-3 Luminescence Spectroscopy** **25% (15 Hrs)**  
STM, AFM  
-Luminescence Spectroscopy  
Principles and Applications to Inorganic Chemistry.

**Unit:-4 Inorganic photo Chemistry:** **25% (15 Hrs)**

Introduction Photo Physical and Photochemical Laws & Kinetics, Photo Physical & Chemical Processes of Transition Metal Complexes. Photo isomerization of complexes.

**Reference Books:**

1. Spectroscopic Identification of Organic Compounds by R. M. Silverstein and F. X. Webster, 6<sup>th</sup> edition, John Wiley & Sons.
2. Introduction to Spectroscopy by D. L. Pavia, G. M. Lampman and G. S. Kriz, 3<sup>rd</sup> edition, Thomson Brooks/Cole.
3. Spectroscopic Methods in Organic Chemistry by D. H. Williams and I. Fleming, 4<sup>th</sup> edition, McGraw-Hill Book Company.
4. Organic Spectroscopy by William Kemp, 3<sup>rd</sup> edition, Palgrave.
5. Organic Spectroscopy-Principles and Applications by Jag Mohan, 2<sup>nd</sup> edition, Narosa Publishing House.

**M.Sc. Semester-IV**  
**Inorganic Chemistry Paper-II**  
**(Polymers)**  
**CHNN-702-(I)**

**Unit:- 1 Inorganic Polymers: 25% (15 Hrs)**

Borazine or Borazole, substituted Borazines, boron nitride, silicones, poly Phosphonitrilic Chloride, Poly ortho Phosphoric acids. Boro phosphate glasses, Nitride of sulphur, Thiazyl halides, imides of sulphur.

**Unit:-2 Co –ordination Polymers: 25% (15 Hrs)**

Nature & reactions yielding co-ordination polymers Various use of Inorganic Polymers.

**Unit:-3 Stereo chemistry of unusual co-ordination number. 25% (15 Hrs)**

Definition, stoichiometry, stereo chemistry, establishment of structure by IR Spectra, Bonding and electronic structure.

**Unit:-4 Molecular Polyhedra: 25% (15 Hrs)**

Boron Hydrides & Higher boranes, three center bonds, basic assumptions, three center orbitals in known structures the equation of balance, topological theory its applications.

**Books:**

1. Polymer chemistry: An introduction by Malcom P. Stevens, Indian edition, Oxford university press, London, 2011.
2. Introductory polymer chemistry, G.S. Mishra, New Age international LTD. Publishers, 2008.
3. Text book of polymers science, Fred W. Bill Meyer, a Wiley inter cience, Canada, New Delhi.1984.
4. Advanced polymer chemistry, manas Chandra, Marcell Dekker, New York,2000.
5. Speciality polymers, R.W. Dyson, Blackie Academic and professional, London1998.
6. Polymer science, V.R. Gawarikar, N.S. Viswanathan and J. Sreedhar, Wiley eastern.
7. Physical and Chemistry of Polymers J.M.G. Owe, Blackie Academic and professional.
8. Functional monomers and polymers, K. Takemotto, Ontabritte.

**M.Sc. Semester-IV**  
**Inorganic Chemistry Paper-III**  
**(Co-ordination Chemistry)**  
**CHNN-703-(I)**

**Unit:- 1 Methods of Coordination Compounds** **25% (15 Hrs)**

Methods of Studying Coordination Compounds:  
Molar Conductivities, Cyclic Voltammetry, X-ray Crystallography.

**Unit:-2 Magneto Chemistry:** **25% (15 Hrs)**

Introduction Origin of para-magnetism, Derivation o Van Vleck's equation, Calculation of magnetic susceptibility considering effect of spin-orbit coupling and magnetic fields as sequential perturbation. Ferromagnetism and Anti Ferromagnetism, Anti ferromagnetic exchange pathways, direct metal-metal interaction. Super Exchange Model, Magnetic susceptibility of binuclear Complexes.

**Unit:-3 Complex Equilibrium:** **25% (15 Hrs)**

Introduction, Computation of Stability constants from equilibrium data. Basic Principles, Mathematical functions and their relationships. Method of Computing stability constants. Half-integral n-values, correction term Method, Graphical methods. Numerical methods Experimental Determination of Composition and Stability, Solvent extraction. Ion exchange and Polarographic Methods.

**Unit:-4 Applications of Coordination Compounds** **25% (15 Hrs)**

Applications of coordination compounds in various fields.

**Reference Books:**

1. Advance Coordination Chemistry 1st Edition (English, Paperback, Shukla P R) Edition: 1st Edition, 2012 ISBN: 9789350515839, 9350515830
2. Inorganic Chemistry 3rd Edition 2008 by Donald A Tarr and Gary Miessler.
3. UGC Advanced Inorganic Chemistry (English, Paperback, Keemti lal, S.K. Agarwal) ISBN: 9789386306289, 938630628X



**M.Sc. Semester-IV**  
**Inorganic Chemistry Paper-III**  
**(Corrosion)**  
**CHNN-703-(I)**

**Unit:- 1 Factors affecting on the corrosion of Iron Steel: 25% (15 Hrs)**

Aqueous environment, Effect of dissolved oxygen, Temperature, pH, salts metallurgical factors, varieties of Iron Steel, composition, heat treatment.

**Unit:-2 Inhibitors and Passivators: 25% (15 Hrs)**

Theories of Passivity, Mechanism of Passivation, Application of Passivators. Packing inhibitors, Slushing compounds, vapor phase inhibitors.

**Unit:-3 Cathodic and Anodic protection: 25% (15 Hrs)**

Theory of Cathodic Protection, Methods of Cathodic and Anodic Protection.

**Unit:-4 Corrosion Resistance: 25% (15 Hrs)**

- a. Coatings for corrosion resistance:  
Methods of application, classification, Inorganic and Organic coatings.
- b. Alloying for corrosion resistance:  
Stainless steel, Monel metal, Incelel, Hastalloy.

**Reference Books:**

1. Handbook of Industrial Chemistry, Vol.1 by K.H.Davis, F.S.Berner, CBS Publishers, Bangalore.
2. Comprehensive Coordination Chemistry, Chapter 57, 58.
3. Insight into Speciality Inorganic Chemicals, Chapter 15, by David Thompson, The Royal Society of Chemistry, 1995.
5. New Trends in Green Chemistry, 2nd Edition by V.K.Ahluwalia and M.Kidwai, Anamaya Publishers, 2007.
7. Pietero Pedferri Corrosion Science and Engineering Springer ISBN: 9783030073800

**M.Sc. Semester-IV**  
**Inorganic Chemistry Paper-IV**  
**(Applications Of Inorganic Chemistry IN Industries)**  
**CHNN-704-(I)**

**Unit-1 :Pigments** **25% (15 Hrs.)**

Introduction; Pigments in Foods-Naturally Occurring Plant-and Animal-Pigments; Synthetic Food Pigments Such as Sunset Yellow, Allura Red, etc; Pigments in Plants-raw materials for paints; Physical Properties of the Pigments in paints; Brief descriptions of the manufacturing process and use of commonly used pigments such as White Lead, Zinc Oxide, Titanium dioxide, etc.

**Unit-2 Electrochemical Applications** **25% (15 Hrs.)**

Introduction; Brief discussion on classical electro deposition of metals; Advancement in the electrochemical industry-modification of electrode surface, Brief discussion with respect to preparations and properties of surface modified Electrodes such as nafion modified electrodes, pvp modified electrodes, etc; Applications of surface modified electrodes such as Electro catalysis, ion selective electrodes, etc.

**Unit-3 Corrosion Inhibitors** **25% (15 Hrs.)**

Introduction, Types of corrosion Principles of Corrosion Inhibitors, Corrosion as an Electrochemical Process, Practical aspects of Corrosion Inhibition Anion inhibitor properties in neutral electrolytes, some application of corrosion inhibitors (cooling water circulation-ince through and open systems, engine radiation & cooling systems, central heating system, refrigeration plants and high chloride systems, water for steam raising, corrosion inhibitors for paint coating)

**Unit-4 Waste and Waste Water Technology** **25% (15 Hrs.)**

Water processing, Operation of Waterworks, Wastewater flows and Characteristics, Wastewater Collection Systems, Wastewater processing, Operation of Wastewater Systems, Advanced wastewater treatment, Waste reuse

**Reference Books**

1. Handbook of Industrial Chemistry, Vol.1 by K.H.Davis, F.S.Berner, CBS Publishers, Bangalore.
2. Comprehensive Coordination Chemistry, Chapter 57, 58.

3. Insight into Speciality Inorganic Chemistry, Chapter 15, by David Thompson, The Royal Society of Chemistry, 1995.
4. New Trends in Green Chemistry, 2<sup>nd</sup> Edition by V.K. Ahluwalia and M. Kidwai, Anamaya Publishers, 2007.
5. Water and Wastewater Technology, 4<sup>th</sup> edition by Mark J. Hamer and Mark J. Hammer Jr., Eastern Economy Edition.
6. Wastewater engineering by Calf and Eddy.
7. Wastewater treatment for pollution control by Arceivala.
8. Manual on sewage & sewage treatment, Ministry of Works, Delhi.
9. Principles of water quality control by T.H.Y. Tebbut.

**M.Sc. Semester-IV**  
**Inorganic Chemistry Paper-V**  
**(Fundamentals & Safety In Chemistry Laboratory)**  
**CHNN-705(A)- (I)**

**Unit-1 Complex Equilibria**

**50% (15 Hrs.)**

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, Polarography Methods. Solubility methods and least square method for computing stability constant.

**Unit-2 Safety in chemistry laboratories**

**50% (15 Hrs)**

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 Chemical Laboratories, Environment Protection Act, 1986

**Reference Books:**

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

**M.Sc. Semester-IV**  
**Inorganic Chemistry Paper-V**  
**(Bioinorganic Chemistry)**  
**CHNN-705(B)- (I)**

**Unit-1 BIOINORGANIC CHEMISTRY-I**

**50% (15 Hrs.)**

The elements of living systems; The biological roles of metal ions. Calcium Biochemistry, Iron biochemistry, Nonmetals biochemistry Enzymes exploiting Acid Catalysis: Carbonic Anhydrase, Carboxy Peptidases.

**Unit-2 Bioinorganic Chemistry-II**

**50% (15 Hrs.)**

Redox Catalysis; Iron Sulphur Proteins and Non-Heme Iron, Cytochromes of the Electron transport chain, Cytochromes P-450 enzymes, Coenzyme B<sub>12</sub> Blue Copper proteins Metals in medicine: Antibiotic and related compounds, Chelate therapy, Inhibition and Poisoning, Metal Complexes as Probes of Nucleic Acids.

**Reference Books**

1. Elements of Bioinorganic Chemistry, G.N Mukherjee and Arbindas.
2. Bioinorganic Chemistry, G.R.Chatwal and A.K.Bhagi.
3. Principles of Bioinorganic Chemistry, S.J.Lippard and J.M.Berst
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. Ber 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 & Valentin Viva books pvt Ltd (1998)
12. BioInorganic Chemistry an introduction, J.A.Cowan, Wiley-VCH

**M.Sc. Semester-IV**  
**Inorganic Chemistry Paper-V**  
**(Practicals)**  
**CHNN-706-(I) & CHNN-706-(I)**

**1. Ore and Alloy analysis (at Least six)**

**2. Preparation of complexes and their analysis (any four)**

- a. Preparation of sodium cobaltinitrite and estimation of cobalt.
- b. Preparation of potassium trioxalato chromite and estimation of Chromium.
- c. Preparation of potassium tri-oxalato-aluminate and estimation of Aluminium.
- d. Preparation of N,N bis(salicylaldehyde) ethylene diamine and its Cu complex and estimation of Cu.
- e. Preparation of N,N bis(salicylaldehyde) ethylene diamine and its Co complex and estimation of Co.
- f. Preparation of N,N bis(salicylaldehyde) ethylene diamine and its Ni complex and estimation of Ni.

**3. Spectrophotometric Determination:**

- a. Determination of Iron spectrophotometrically by 1,10 phenanthroline method.  
To determine the amount of Ir

# Organic Chemistry

**Hemchandracharya  
North Gujarat University Patan  
M.Sc. (Organic Chemistry) (WEF June: 2020)  
M.Sc. Semester-IV**

<b>Work Load</b>	<b>Paper No Course Code</b>	<b>Subject Course Title</b>	<b>External Marks</b>	<b>Internal Marks</b>	<b>Credits</b>
60 Hrs.	CHNN-701-(O)	Natural & Stereo Chemistry	70	30	4
60 Hrs.	CHNN-702-(O)	Industrial Organic Chemistry	70	30	4
60 Hrs.	CHNN-703-(O)	Synthetic Drugs	70	30	4
60 Hrs.	CHNN-704-(O)	Selected Topic In Chemistry	70	30	4
30 Hrs.	CHNN-705A-(O)	Disconnection Approach	35	15	2
30 Hrs.	CHNN-705B-(O)	Chemical Toxicology & Solid Waste	35	15	2
90 Hrs.	CHNN-706(O) A Practicals	Organic Chemistry	75	-----	3
90 Hrs.	CHNN-706(O) B Practicals	Organic Chemistry	75	-----	3
		Total	465	135	24

➤ **Working per semester minimum 90 days (15 weeks).**



**M.Sc. Semester-IV**  
**Chemistry Paper-I**  
**Natural & Stereo Chemistry**  
**CHNN-701-(O)**

**Unit1: Purine & Nucleic Acid:** **25% (15 Hours)**

**Purine & Nucleic Acid:** Chemistry of Uric acid, Adenine, Caffeine, Structure of Nucleotides, Nucleosides, DNA, RNA and Conformations, Protein Synthesis, Prebiotic Chemistry.

**Unit 2: Carbohydrates:** **25% (15 Hours)**

Types of Naturally Occurring Sugars, Dexoy Sugars, Amino Sugar, General Method of Structure and Ring Size Determination with Reference to Starch and Cellulose, Photosynthesis of Carbohydrates.

**Unit 3: Steroids:** **25% (15 Hours)**

General Biosynthesis Studies of Steroids, Chemistry of Ergosterol and Lanosterol

Androgens: Oestrone, Oestriol and Oestradiol

Gestogens: Progesterone Adreno Cortical Hormones: Cortisone, Diosgenine and its Utility in Hormone Synthesis, Transformation in Steroids Molecules.

**Unit4: Conformational Analysis:** **25% (15 Hours)**

Conformation of Monocyclic System:

**Cyclo Propane:** Cyclopropane 1,2 Dicarboxylic Acid, 2-OH Methyl Cyclo Propane Dicarboxylic acid,

**Cyclo Hexane:** 1,3 Ditertiary Butyl Cyclohexane, 4-OH Cyclo Hexane Carboxylic Acid, Cyclohexane 1,2 di Carboxylic Acid.

**Cyclo Hexanone:** 2-Br Cyclo Hexanone, 2-Br 4,4-dimethyl Cyclo Hexanone, Cyclo Hexanol, Hexa-Chloro Cyclo Hexane, Conformation of Di substituted Cyclohexanones,

**Bridge ring system:** Bicyclic(1,1,1) pentane and Bicyclo (2,1,1) hexane, Bicyclo (2,2,1) Heptane and Bicyclo (2,2,2) Octane.

**Fused Ring System :** Per hydro Anthracene and Per Hydro Phenanthrene.

### **Basic Text & Reference Books:**

1. Natural Products by O.P. Agarwal, Vol. 1 & 2
2. Organic Chemistry of Natural Products by G.R. Chatwal, Vol. 1 & 2
3. NMR Spectroscopy : Basic Principles, Concepts and Applications in Chemistry , 3<sup>rd</sup> edition by Harald Gunther
4. Spectroscopic Identification of Organic Compounds, R. M. Silverstein and F. X. Webster, 6<sup>th</sup> edition (John Wiley & Sons)
5. Introduction to Spectroscopy, D. L. Pavia, G. M. Lampman and G. S. Kriz, 3<sup>rd</sup> edition (Thomson Brooks/Cole)
6. Spectroscopic Methods in Organic Chemistry, D. H. Williams and I. Fleming, 4<sup>th</sup> edition (Mcgraw – Hill Book Company)
7. Organic Spectroscopy, William Kemp, 3<sup>rd</sup> edition (Palgrave)
8. Organic Spectroscopy – Principles and Applications, Jag Mohan, 2<sup>nd</sup> edition (Narosa Publishing House)
9. Spectroscopy of Organic Compounds, P. S. Kalsi, 5<sup>th</sup> edition (New Age International Publishers)
10. Stereochemistry: Conformation and Mechanism, By P.S. Kalsi, 6<sup>th</sup> edition, New Age International (P) Ltd., Publishers (2005).
11. Stereochemistry and Mechanism through solved problems, By P.S. Kalsi, Wiley Eastern Ltd. (1994).
12. Stereochemistry of organic compounds, By D. Nasipuri, 2<sup>nd</sup> Edition, New Age International (P) ltd., Publishers (1994).
13. Stereochemistry of Carbon Compounds, By E.L. Eliel, Tata McGraw-Hill Pub. Co. Ltd. (1962).
14. Organic Chemistry, By J. Clayden, N. Greeves, S. Warren and P. Wothers, Oxford Uni. Press, N.Y. (2001).
15. Elementary Organic Spectroscopy: Principles and Chemical Applications (revised edition), Y. R. Sharma (S. Chand Publishing)

**M.Sc. Semester-IV**  
**Organic Chemistry Paper-II**  
**Industrial Organic Chemistry**  
**CHNN-702-(O)**

**Unit 1: Synthetic Industries Based On Petroleum: 25% (15 Hours)**

Coal, Petroleum, Natural Gas, Organic Chemicals from Coal Distillation, Refining of Crude Oil FCR Industrial Fuels, C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub> and Aromatic Chemicals. Textile Fibers Classification, Manufacture of Important Polyamide, Poly Ester Fibers.

**Unit 2: Paints & Varnish, Explosive 25% (15 Hours)**

**Paint:** Industries Paint and Varnish Classification of Paints, Manufacture of Paints. Methods of Applying Paints.

**Varnish:** Raw Materials Manufacture of Varnishes, Types of Varnishes.

**Explosives:** Propellants and Toxic Chemical Agents.

Types of Explosives, Characteristics of Explosive, Industrial Explosives, propellants, Rocket and Missiles, Propellants for Rocket, Miscellaneous Industrial Explosives Uses, Pyrotechnics, Military Explosives, Incendiaries, Toxic Chemical Agents (Weapons).

**Unit 3: Industrial Polymers 25% (15 Hours)**

Introduction of Polyethylene's, Manufacture of Polyethylene, Low and High Density Polyethylene co-polymers of Ethylene and Application.

Monomers, Dacron, Orlon, Bakelite, Nylone 6,6 Teflon Polymer Reactions, Hydrogenation, Addition and Substitution Aldehyde and ketonic Group Reactions. Cyclisation, Cross linkage Reaction.

**Resins:** Introduction & Preparation of Resins, Mechanism Type of Resin, Application

**Acrylic Polymer**

- 1) Poly acrylate and Poly methylated acrylate,
- 2) Poly Methyl Methacrylate
- 3) Poly Acrylonitrile

**Unit 4: Selected Small Scale Industries:****25% (15 Hours)**

Safety Matches, Agarbatties, Naphthalene balls, Candles, Shoe Polish, Gum paste, Pen Ink, Removal of Stains, Phenol disinfectant Soaps, Detergents.

**Basic Text & Reference Books:**

1. Industrial Chemistry by B.K. Sharma
2. Shereve's Chemical Process Industries by George T. Austin
3. Industrial Organic Chemistry by Klaus Weissemann

**M.Sc. Semester-IV**  
**Organic Chemistry Paper-III**  
**Synthetic Drugs**  
**CHNN-703(O)**

**Unit 1: Chemotherapeutic Drugs** **25% (15 Hours)**

Antimalarial Agents: Chemotherapy of Malaria, Malaria Parasite and its cycle, 4-aminoquinolines, 8-aminoquinolines, 9-aminoacridines, Di-amino pyrimidine's, Antimoebic Drugs, Anti-viral drugs and Anti-Cancer drugs

**Unit 2: CNS Drugs or Psychopharmacological Agents:** **25% (15 Hours)**

Antipsychotics, Antidepressant, Antianxiety, Hallucinogenic Drugs, Anti Convulsants, Hypnotics & Sedative, Anti Parkinsonism Drugs,

**Unit 3: Cardiac & Diuretics Drugs:** **25% (15 Hours)**

Drugs acting on the Cardiovascular, Hypertensive Drugs, Haematopoeic and Renal Systems Cardiac drugs, diuretics.

**Unit 4: Miscellaneous Drugs:** **25% (15 Hours)**

Anti-diabetic Dugs (Hypoglycemic Drugs) & Anti-Bacterial, Antitubercular and Antileprotic Drugs, Antifungal Drugs

**Basic Text & Reference Books:**

1. Medicinal Chemistry by Ashutosh Kar
2. Medicinal Chemistry by G. R. Chatwal
3. Medicinal Chemistry by D. Shriram
4. Synthetic Organic Chemistry O P Agarwal
5. Synthetic Drug J J Trivedi & K A Thakar
6. Synthetic Drug by Anamik Shah
7. Medicinal Chemistry by

**M.Sc. Semester-IV**  
**Organic Chemistry Paper IV**  
**Selected Topic In Chemistry**  
**CHNN-704**

**Unit-1: Molecular Rearrangements-1**

**25% (15 Hours)**

Rearrangement to electron deficient atoms,

**(A) Rearrangement to electron deficient carbon**

- (1) Pinacol Pinacol rearrangement
- (2) Wangermeerwin rearrangement
- (3) Wolf rearrangement

**(B) Rearrange to Electron Deficient Nitrogen**

- (4) Hofmann rearrangement
- (5) Curtius rearrangement
- (6) Beckmann rearrangement

**(C) Rearrangement to Electron Deficient Oxygen**

- (7) Baeyervilliger Reaction,
- (8) Dakin Reaction

**Unit-2 Molecular Rearrangements-2**

**25% (15 Hours)**

**(A) Rearrangement to electron deficient carbon**

Stevens rearrangement, Wittig rearrangement, Favorskii rearrangement

**(B) Aromatic Rearrangement**

Hofmann Martius rearrangement, Claisen rearrangement, Cope rearrangement  
Benzidine rearrangement, Fries rearrangement

**Unit-3 Organo Metallic Compounds**

**25% (15 Hours)**

Organo Magnesium Compounds, Organo Aluminum Compounds, Organo Cadmium Compounds, Organo Silicon Compounds, Organo Lithium Compounds,

**Unit-4 Name Reactions**

**25% (15 Hours)**

Cannizaro Reaction, Dieckman Reaction, Fischer Indole Reaction, Leuckart Reaction, Reformastky Reaction, Wittig reaction, Pechmann Reaction, Dilesalder Reaction, Wolfkishner Reduction, Friedel-Crafts Reaction, Reimertiemann Reaction,

**Basic Text & Reference Books:**

1. Organic Chemistry Reaction and Reagents O. P. Agarwal
2. Organic Chemistry by J. Clayden, N. Greeves and S. Warren, 2<sup>nd</sup> edition, Oxford University Press, UK.
3. Modern Methods of Organic Synthesis; W. Carruthers and I. Coldham, 4<sup>th</sup> edition, Cambridge University Press, UK.
4. Name Reaction for Functional Group Transformation, E. J. Corey and Jie Jack Lie, John Wiley and Sons, New Jersey.
5. Name Reactions, Jie Jack Lie, 4<sup>th</sup> edition, Springer, New York.
6. Selected Organic Synthesis, Ian Fleming, John Wiley & Sons, New Jersey.

**M.Sc. Semester-IV**  
**Organic Chemistry Paper-V**  
**Disconnection Approach**  
**CHNN-705 (A)**  
**Subject Elective**

**Unit-1: Disconnection Approach** **50% (15 Hours)**

Introduction and definition of disconnection, Synthons, Synthetic equivalents, Disconnection Approach, Functional Group Inter Conversion, used in disconnection. The importance of order of events in organic synthesis, One and two C-X group disconnection, and Synthesis of Amine, Reversal of Polarity.

**Unit-2: Protecting Groups & Reactions:** **50% (15 Hours)**

Protection of organic functional groups, Protecting Reagents and Removal of Protecting. Protection of Amine, Alcohol, Carbonyl and Carboxylic Acid Groups. Suzuki Reaction, Smith Reaction, Sharpless Epoxidation Reaction, Heck Reaction Michael addition and Robinson Annulation.

**Basic Text & Reference Books:-**

1. Designing Organic Synthesis – A Programmed Introduction to the Synthons Approach, Stuart Warren, John Wiley & Sons (1994).
2. Organic Synthesis: The disconnection approach, Stuart Warren, John Wiley & Sons (1994).
3. Selected Organic Synthesis, Ian Fleming, John Wiley & Sons (1977).
4. Organic Chemistry, 2<sup>nd</sup> edition by Jonathan Clayden, Nick Greeves & Stuart Warren, Oxford University Press.
5. Modern Methods of Organic Synthesis, 4<sup>th</sup> edition by W. Carruthers & Iain Coldham, Cambridge University Press.
6. Modern Organic Synthesis: An introduction by George S. Zweifel & Michael H. Nantz, W. H. Freeman & Company.
7. Greene's Protective Groups in Organic Synthesis, 4th edition, by P. G. M. Wuts and T.W. Greene, Wiley Interscience.
8. Organic Chemistry by J. Clayden, N. Greeves and S. Warren, 2<sup>nd</sup> edition, Oxford University Press, UK.
9. Modern Methods of Organic Synthesis; W. Carruthers and I. Coldham, 4<sup>th</sup> edition, Cambridge University Press, UK.
10. Name Reactions, Jie Jack Lie, 4<sup>th</sup> edition, Springer, New York.



**M.Sc. Semester-IV**  
**Organic Chemistry Paper-VI**  
**Organic Chemical Toxicity & Solid Waste Management**  
**CHNN-705 (B)**  
**(Subject Elective)**

**Unit-1: Chemical Toxicology**

**50% (15 Hours)**

Toxic Chemicals in the Environment, Impact of Toxic Chemical on Enzymes, Biochemical Effects of Cadmium, Lead, Arsenic and Mercury, Minamata Epidemic in Japan, Biological Methylation, Amplification of Mercury in food Chain, Biochemical Effects of Ozone, PAN, Cyanide and Methyl Isocyanate, Biochemical Effects of Pesticides and Carcinogens, Solution to Environmental Problems, Preventive Environmental Managements, Industrial Ecosystem and Better Industrial Process, Kalundborg Industrial Ecosystem.

**Unit-2: Solid Waste Management, Treatment & Recycle 50% (15 Hours)**

Classification of Solid Waste, Objective of Solid Waste Management, Characteristics of Solid Waste, Municipal Solid Waste Treatment, Automatic System of Composting, Vermi Composting, Sanitary Land Fill, Incineration, Auto Thermal Incineration of dewatered sludge, industrial solid waste treatment, High Temperature Incineration, Pyrolysis and Vitrification, Solid waste management by biotechnology, Biomedical Waste and its treatment, Recycling, Recovery, and Reuse of Paper, Glass and Plastics, Recovery of Metal Ions, and Waste Oil.

**Basic Text & Reference Books:**

1. Environmental Chemistry H Kaur Pragati 8<sup>st</sup> Edition 2014 ISBN:978-93-5140-060-8

**M.Sc. Semester-IV**  
**Organic Chemistry Practicals**  
**CHNN-706 (O) & CHNN-707 (O)**

**1) Organic Separation:**

Separation, purification and Identification of three compounds (Ternary Mixture) 10 grams organic mixture by semi micro method- preparation of derivative. (Minimum Five mixtures should be done).

**2) Organic Estimation (Semi micro Methods):**

1. Estimation of Isoniazid
2. Estimation of Ibuprofen
3. Estimation of Paracetamol by hydrolysis
4. Estimation of Diazepam by non aqueous titration
5. TLC of Drugs

**3) Organic Preparation:**

Two & Three stage preparation from 4 & 5 grams starting materials semi micro method (Minimum five should be done) including name reactions.

Spectroscopic Problems: Identification of Organic Compound by either spectral data or actual spectra (Combined UV-Visible, Mass, IR,  $^1\text{H}$  NMR,  $^{13}\text{C}$  NMR).

**Basic Text & Reference Books:**

1. Vogel's Textbook of Practical Organic Chemistry, 5<sup>th</sup> edition, B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchell (Pearson Education)
2. Comprehensive practical organic chemistry: Qualitative analysis, V. K. Ahluwalia, Sunita Dhingra (Universities Press)
3. Organic Structures from Spectra, 5<sup>th</sup> edition, L. D. Field, S. Sternhell, J. R. Kalman (Wiley: A John Wiley & Sons Ltd publication)
4. Elementary Organic Spectroscopy: Principles and Chemical Applications (revised edition), Y. R. Sharma (S. Chand Publishing)

# Physical Chemistry

**Hemchandracharya**  
**North Gujarat University Patan**  
**M.Sc. (Physical Chemistry) (New Syllabus WEF June: 2020)**  
**M.Sc Semester-IV**

<b>Work Load</b>	<b>Paper No</b>	<b>Subject</b>	<b>External Marks</b>	<b>Internal Marks</b>	<b>Credits</b>
60 Hrs.	CHNN-701-(P)	Physical Chemistry	70	30	4
60 Hrs.	CHNN-702-(P)	Physical Chemistry	70	30	4
60 Hrs.	CHNN-703-(P)	Physical Chemistry	70	30	4
60 Hrs.	CHNN-704-(P)	Physical Chemistry	70	30	4
30 Hrs.	CHNN-705A-(P)	Physical Chemistry	35	15	2
30 Hrs.	CHNN-705B-(P)	Physical Chemistry	35	15	2
90 Hrs.	CHNN-706-(P) Practicals	Physical Chemistry	75	-----	3
90 Hrs.	CHNN-707-(P) Practicals	Physical Chemistry	75	-----	3
		Total	465	135	24

➤ **Working per semester minimum 90 days (15 weeks).**

**M.Sc. Semester -IV**  
**Physical Chemistry**  
**CHNN-701(P)**  
**Paper-1**

**Unit:-1 Photo Chemistry-2** **25% (15 Hours)**

Basics: Nature and importance of singlet and triplet oxygen, Photochemical equivalence and photo stationary states (with examples), consequence of light absorption (Jablonski diagram, radiative, non-radiative and chemical reactions, Frank codon principle, Anti stroke behaviour.

Florescence: Theory of Florescence, Relation between Florescence intensity and concentration,

Quenching of Florescence, Kinetics of Quenching of Florescence (Photo peroxidation reaction),

Factors affecting Quenching of florescence, Difference between fluorescence, Phosphorescence and Chemiluminescence.

Mechanism of Reaction: Ene reactions, Cycloaddition reactions, Reduction reaction, Radiolysis of water photo conductivity, CO<sub>2</sub> reduction

Energy conversion and storage: Photo sensitizers, Transition metal complex, Metal complex sensitizers, reaction sensitized by Mercury, Chlorine, Excimers and Exciplexes.

**Unit:-2 The Colloidal State** **25% (15 Hours)**

Colloidal systems:

Classification of colloids: Liophobic and Liophilic sols.

Preparation of hydrophobic colloidal solutions: despartion methods and condensation methods

Purification of colloidal solutions:

Properties of colloidal systems: (1) Electrical properties: Charge on colloidal particles, the electrical double layer, DLVO theory of the stability of liophobic colloids, coagulation of colloidal solutions

(2) Electro kinetic properties: Electrophoresis and electroosmosis

Determination of size of colloidal particles

Surfactants (Surface-active agents)

Hydrophile- Lipophile balance (HLB): (1) Micelle formation: The mass action model and the phase separation model, shape and structure of micelles, micellar

aggregation numbers, the critical micelle concentration (CLC), factors affecting CMC in aqueous media, thermodynamic approach to CMC, thermodynamics of Micellization, Micelle concentration range (MTR) or Kraft point

Solubilisation: Location of solubilizates in micelles, the phase rule of solubilisation, Emulsification by surfactants: Macro emulsions, factors determining stability of emulsions, microemulsions

Theories of Emulsions: (1) Qualitative theories Bancroft rule (2) Quantitative theories, The selections of surfactants as emulsifying agents, Gels and their preparations, Importance and applications of colloids.

### **Unit:-3 Chemical Kinematics**

**25% (15 Hours)**

Theories of reaction rates: Kinetic theory of collision, Rate theory of based on statistical mechanics, early dynamical theories and CTST

Unimolecular reactions: Perrin, Lindmann-Christiansen, Hisnhel wood, RRR, RRRM and Slater,

Conventional transition state theory

Chain reactions: Features and kinetics of chain reaction, autooxidation, kinetics of branched chain

reactions, explosion limits, a kinetic isotope effect (primary and secondary)

Reactions in solutions: Theory of absolute reaction rate, applicable to reaction in solution (Ideal and real solution), Linear free energy relationship and Hammett equation, Deviation from Hammett equation. Significance of  $\rho$  and  $\rho^\ddagger$

Examples: kinetics of organic decomposition of  $\text{CH}_3\text{CHO}$ , butane, reaction between  $\text{H}_2$  and  $\text{O}_2$ .

### **Unit 4:- Spectroscopy**

**25% (15 Hours)**

UV-visible: principle, instrumentation, determination of  $\text{pK}$  value of indicator, and instability constant, qualitative and quantitative analysis.

Raman Spectroscopy: Raman effect, difference from IR and fluorescence, nature of spectra, selection rule, basic instrumentation and applications.

Atomic absorption spectroscopy: Basic principle, advantages over flame emission spectroscopy, basic instrumentation and applications

Emission spectroscopy: Basic principle, radiative and non-radiative decay, internal conversion, basic instrumentation and applications.

### **Books:-**

(1) Fundamentals of photochemistry, R.K. Rohatgi and Mukherji, Tata McGraw Hall

- (2) Essentials of photochemistry, A. Gilbert and J. Baggott, Black well scientific publishers
- (3) Introductory Photochemistry, A. Cox and T camp, McGraw Hall
- (4) Organic photochemistry, J. Coxon and B. Hilton, Cambridge university press
- (5) Essentials of nuclear chemistry, Hari Jeevan Arnikar, New Age international (1995)
- (6) Nuclear and radiochemistry (3<sup>rd</sup> edition), Gerhart Friedlander, Joseph W. Kennedy, Edward S. Macias and Julian Malcolm Miller, John Willey and Sons publications
- (7) Modern Nuclear Chemistry, Walter D. Loveland, David J. Morrissey and Glenn T. Seaborg, John Willey and sons publications
- (8) Handbook of nuclear chemistry (2<sup>nd</sup> edition): VOL.1: Basics of nuclear science; VOL.2: elements and isotopes formation, transformation, distribution, edited by Attila Vertis, Sandor Nagy, Zoltan Klencsar, Rezso Gyorgy Lovas, Frank Rosch, Springer publications.
- (9) Principle of Physical Chemistry by Puri Sharma Pathania
- (10) Chemical Kinetics, Keith J. Laidler, McGraw Hill
- (11) Modern spectroscopy, J.M. Hollas, McGraw Hill
- (12) Basic principles of spectroscopy, H. Chang, McGraw Hill
- (13) Spectroscopy methods of organic chemistry, D.H. Williams and I. Fleming, tata McGraw Hill
- (14) Spectroscopy, P.S. Kalsi, Pragati Prakashan, 1998.
- (15) Advanced physical Chemistry By Gurdeep Raj.

**M.Sc. Semester -IV**  
**Physical Chemistry**  
**CHNN-702(P)**

**Paper-II**

**Unit:-1 Solvation and Solvent Effects: 25% (15 Hours)**

Qualitative understanding of solvent-solute effects on reactivity. Thermodynamic measure of solvation. Effects of solvation on reaction rates and equilibria.

Various empirical indexes of solvation based on physical properties, solvent sensitive reaction rates, spectroscopic properties and scales of specific solvation, use of solvation scales in mechanistic studies. Solvent effects from the curve crossing model.

Electrochemistry of material science: Corrosion of ultrapure material, cathodic reaction in corrosion, thermodynamics and stability of metals, uses and abuses of Pourbaix diagram, corrosion and Evans diagram, methods of studying corrosion, types of corrosion, inhibition of corrosion, passivation and depassivation. Corrosion of iron in presence and absence of oxygen.

**Unit:-2 Ionic liquids: 25% (15 Hours)**

Definition, features of ionic liquids, models of ionic liquids (lattice-oriented models and gas-oriented models), solvent properties of fused nonmetallic oxides, fused oxide system in metallurgy.

Protons in solution: conditions of proton solvation, heat of hydration of proton, proton transport (abnormal mobility of proton, conduction by chain reaction, quantum mechanical proton jumps), proton mobility in ice.

Electrochemical energy conversion and storage: Electrochemical generator (Hydrogen oxygen cell, hydrocarbon air cells, natural gas co air cells, dissolved fuel air cells), quantities of electricity storage (storage density, energy density and power), electricity storage using alkali metals and non-aqueous solutions.

**Unit:-3 Electro Kinetic Phenomena: 25% (15 Hours)**

Electroosmosis, streaming potential, electrophoresis, determination of Zeta potentials, Zeta potentials, influence of ions on electro kinetic phenomena, electrophoretic mobility and bound hydrogen ion.



Quantum aspects of charge transfer: quantum aspects of charge transfer reaction or electrode solution interface, mechanics of electron, penetration of electrons in to classically forbidden regions, probability of electron tunneling through barriers, tunneling condition and proton transfer curve, de-electrons, reaction. A symmetry factor B.

Bio electro chemistry: electrical conduction in biological cells (electronic, protonic), electrochemical mechanism in neurons, interfacial electron transport in biological systems, conduction and electron transport in biological systems.

**Unit:-4 Solutions of Non-Electrolytes: 25% (15 Hours)**

Solutions of liquids in liquids, Raoult's law, Vapor pressures of ideal solutions

Activity of component in an ideal solution, Chemical potentials of ideal and non-ideal solutions, Gibbs-Duhem-Margules equation, Temperature dependence of vapor pressure of solution, Thermodynamics of ideal solutions, Free energy change of mixing for an ideal solution, Volume change and enthalpy change of mixing for an ideal solution, Entropy change of mixing for an ideal solution

Pressures of non-ideal solutions, Pressure composition and boiling point

Composition curves of completely miscible binary solutions, Fractional distillation of binary liquid solutions, Azeotropic mixtures, Lever rule and fractional distillation, Distillation of immiscible liquids, Solubility of partially miscible liquids, UCST and LCST, Phenol-water system, Aniline-hexane system

Triethylamine-water system, Nicotine-water system, Solutions of gases in liquids, Factors influencing solubility of a gas, Henry's law, Henry's law and Raoult's law Questions and problems

**Books:**

- (1) Modern Electrochemistry, J OM Bockeris / A.K.N. Reddy, vol. 1 and 2, third edition, plenum press, 1977
- (2) Modern Electrochemistry, J OM Bockeris / A.K.N. Reddy, vol. 1, 2 and 3, second edition, springer, 2008
- (3) An introduction to electrochemistry, Samuel Glasstone, 10<sup>th</sup> edition, D. van Nostrand company, INC 1962
- (4) Evings analytical instrumentation handbook, edited by Jack Cazes, third edition, Instrumental methods of chemical analysis, Galen W. Ewing, fourth edition, Mac Graw hill 1975

**M.Sc. Semester -IV**  
**Physical Chemistry**  
**CHNN-703(P)**

**Paper-III**

**Unit:-1; Structure of Polymers**

**25% (15 Hours)**

**Chemical structure and properties of polymers:** Mechanical properties, Thermal stability, flammability and flame resistance, chemical resistance, degradability, electrical conductivity, Optical properties.

**Copolymerization:** Nomenclature of Co-Polymers with examples (Unspecified, Statistical, Alternate, Ideal, Random, Block and Graft) Kinetics of free Radical copolymerization, Binary co-polymerization equation, Composition of copolymers, Reactivity Ratios, Q-e scheme. Polymer blends, some common copolymers (Ethylene copolymers, styrene copolymers, vinyl chloride copolymers)

**Unit:-2: Synthesis of Polymers and Molecular Weight determination**

**25% (15 Hours)**

**Methods of Synthesis:** Bulk polymerization, precipitation, Emulsion polymerization, Suspension polymerization, Interfacial polymerization,

-Methods for determination of average molecular weight of polymer: Colligative Property measurement, Light scattering methods, dilute solution viscometry, ultra-centrifugation, mass spectrometry, refractive index measurements.

-Weight Distribution Methods: Gel permeation chromatography, fractional solution, fractional precipitation, gradient elution, TLC.

**Unit :- 3; Polymer Morphology and Processing**

**25% (15 Hours)**

Crystallinity in polymer: Degree of crystallinity, determination of crystallinity, morphology of crystalline polymer (Lamellae, Spherulites, Helix)

-Rheology of polymers: Hook's equation, Newton equation, Maxwell, Voigt model, Burger Model, Deformation behaviour of materials, relaxation and retardation.

-Polymer processing: Compounding, Casting, Moulding, Foaming, Reinforcing, Fibre spinning,

#### **Unit :- 4; Characterisation, Analysis and Testing of Polymers**

**25% (15 Hours)**

Chemical Analysis, -Spectroscopic Analysis (IR, Raman, NMR, ESR, UV visible, fluorescence), -X-Ray Diffraction Analysis, -Thermal Analysis (TGA, TMA, DSC, DTA), -Physical Testing (Mechanical Properties, Thermal Properties, Optical properties, Electrical Properties)

#### **Books:**

1. Polymer chemistry: An introduction By Malcom P. Stevens, Indian edition, 3<sup>rd</sup> edition, oxford university press, London, 2011
2. Introductory polymer chemistry, G.S. Mishra, New age international LTD. Publishers, 2008
3. Textbook of polymer science, Fred W. Bill Meyer, a Wiley inter science, Canada, New Delhi, 1984
4. Advanced polymer chemistry, Manas Chandra, Marcell Dekker, New York, 2000
5. Speciality polymers, R.W. Dyson, Blackie Academic and professional, London, 1998
6. Polymer science, V.R. Gawarikar, N.S. Viswanathan and J. Sreedhar, Wiley Eastern
7. Physics and chemistry of polymers, J.M.G. Cowe, Blackie Academic and professional
8. Functional monomers and polymers, K. Takemotto, Ontabritte, Introduction Of polymers, R.J. Yuan and P.A .Lovell, 2<sup>nd</sup> edition, nelso thrones LTD, 2002.

**M.Sc. Semester -IV**  
**Physical Chemistry**  
**CHNN-704(P)**

**Paper-IV**

**Unit 1: Chemistry of Nanomaterial's**

**25% (15 Hours)**

Classification and nomenclature of nanomaterials: Nanosized metals and alloys, semiconductors, Organic semiconductors, Carbon materials; Zero-, One, Two and Three dimensional nanostructures-Quantum dots, Quantum wells, Quantum rods, Quantum wires, Quantum rings; Synthesis of nanomaterials (Nucleation and growth of nano systems; self-assembly, mechanical Milling, Chemical reduction and oxidation, Hydrothermal, Micelles, Sol-Gel processes, photolysis, radiolysis) Designing of advanced integrated nano-composites, fundamental properties (Size effects on structure and morphology of free or supported nano particles, size and confinement effects), applications of nano materials.

**Unit 2: Green Chemistry**

**25% (15 Hours)**

Need for Green Chemistry, Goals of green chemistry, Limitations/obstacles in pursuit of the goals of green chemistry, green chemistry in sustainable development. Twelve principles of green chemistry with their explanation and examples; designing a green synthesis using these principles, immobilized solvents and ionic liquids; energy requirements for reactions like use of microwaves, ultrasonic energy; green synthesis of adipic acid, catechol, ibuprofen, paracetamol, BHT. Microwave assisted reactions in water (Hofmann elimination, Hydrolysis of benzyl chloride, Benzamide), Ultrasound assisted reactions in water (Esterification, saponification, substitution reactions, alkylation, oxidation, reduction)

**Unit 3: Nuclear Chemistry-1**

**25% (15 Hours)**

Introduction. Atomic structure, Isotopes, Isomers, Isobars, Isotones.

Nuclear reaction, Nuclear stability, Mass spectrograph, Thomson's parabola method, Aston's Dempster's, Bainbridge Neir's Nuclear reactions classifications, Q-values equation and calculations, Cross-sections and its determination, High energy reactions, Direct nuclear reactions, Photo nuclear reactions, Thermo nuclear reactions, Nuclear radio activity:  $\alpha$ ,  $\beta$ ,  $\gamma$  rays, Decay schemes, Group displacement rules, Mechanism of radioactive decay, GEIGER-

NUTTALS RULE, Rate of nuclear disintegration, Radioactive equilibrium and its types, Cyclotron, Synchrotron, Linear accelerator.

**Unit 4: Nuclear Chemistry-2**

**25% (15 Hours)**

Methods of artificial disintegration, Nuclear fission and nuclear fusion, Atomic bomb, Hydrogen bomb, Nuclear Models: Shell Model (periodicity, properties, magic number nuclear configuration), liquid drop model and semi empirical equation, fermi gas model, collective model.

Synthesis of radio isotopes of Na and C

Application of Radio isotopes: Chemical investigations, age determination, Medicinal applications, analytical applications and industrial applications.

**Books:**

1. Klabunde K.J.(Ed.), "Nanoscale materials in chemistry ", John Wiley &sons Inc. 2001
2. Nalwa, H.S.(Ed.), "Encyclopedia of nanoscience and nanotechnology" 2004
3. Sergeev, G.B. Nano chemistry, Elsevier, B.V. 2010
4. Schmid, G. (Ed.) "Nanoparticles", Wiley-VCH Verlag GmbH & co. KgaA. 2004
5. Rao, C.N.R., Muller, A. and Cheentham, A.K(Eds), "Chemistry of nanomaterials" , Wiley-VCH, 2005 NSC
6. V.K. Ahluwalia & M.R. Kidwai: New trends in Green chemistry, Anamalaya publications (2005)
7. Advanced physical Chemistry By Gurdeep Raj.
8. Principle of Physical Chemistry by Puri Sharma Pathania
9. Nuclear Chemistry By C .V Shekar

**M.Sc. Semester -IV**  
**Physical Chemistry (S.E)**  
**CHN-705(A)-P**  
**Paper-V**

**Unit: 1:** **50% (15 Hours)**

**(A) High performance (Pressure) liquid Chromatography**

Introduction, Principle, Instrumentation, Apparatus and Materials, Column efficiency and selectivity, Comparison of High-performance liquid chromatography and Gas Liquid chromatography, Applications, HPLC adsorption Chromatography, HPLC partition chromatography

**(B) Adsorption Chromatography**

Introduction, Theory, Adsorbents, Solvents, Procedure, Differences between Adsorption and gas liquid chromatography, Limitations, Applications of Adsorption chromatography

**Unit:2** **50% (15 Hours)**

**(A) Column Chromatography**

Introduction, Principle, Experimental details, Theory of development Column efficiency, Factors affecting column efficiency, Applications of Column chromatography

**(B) Gel Chromatography or Gel Permeation Chromatography**

Introduction, Principle, Materials, Gel preparation, Column packing and detectors, Applications, Advantage of Gel chromatography

**(C) Ion Exchange Chromatography**

Introduction, Definition, Principle, Cation exchangers, Anion exchangers, Regeneration, Ion exchange Column used in chromatographic separations, Selections of suitable systems, Ion exchange capacity, Ion exchange techniques, Application of ion exchangers

**Book:**

1. Instrumental Methods of Chemical Analysis by Gurdeep R Chatwal, Sham K Anand Himalaya Publishing House.

**M.Sc. Semester -IV**  
**Physical Chemistry (S.E)**  
**CHNN-705(B)**  
**Paper-V**

**Unit:1 Infrared Absorption Spectroscopy**

**50% (15 Hours)**

Introduction, The range of infrared radiation, Nomenclature of infrared spectra, Theory of Infrared Absorption spectroscopy or requirements for infrared radiation absorption, Mathematical theory of IR Absorption spectroscopy, Linear molecules, Symmetric top molecules, Asymmetric Molecules, Instrumentation, Single beam and double beam spectrophotometers, Modes of vibrations of atoms in polyatomic molecule, Factors which influence Vibrational Frequencies, Selection rules, Positions and intensity of bands, Intensity of Absorption bands, Units of measurements, Applications of infrared spectroscopy to organic compounds, Applications of infrared spectroscopy to inorganic complexes, Miscellaneous Examples, Attenuated total reflectance, Nondispersive infrared, Photothermal beam deflection spectroscopy (PBDS), Application of Infrared spectroscopy to quantitative analysis, Limitations of Infrared spectroscopy

**Unit:2**

**50% (15 Hours)**

**(A) Raman spectroscopy**

Introduction, Principle, Characteristic properties of Raman lines, Differences between Raman spectra and Infrared spectra, Mechanism of Raman effect, Instrumentation, Intensity of Raman peaks, Applications of Raman spectroscopy, Short type questions

**(B) Visible Spectrophotometry and colorimetry**

Introduction, Theory of Spectrophotometry and colorimetry, Deviations from Beer's law, Instrumentation, Obtaining and Interpreting data, Applications of colorimetry and spectrophotometry, Molar compositions of complexes, Spectrophotometric titrations

**(C) Ultraviolet spectroscopy**

Introduction, Origin and theory of ultraviolet spectra, Types of transitions of Inorganic molecules, Types of transitions of organic molecules, The shape of UV absorption curves, Transition probability

**Books:**

1. Principle of Physical Chemistry by Puri Sharma Pathania.
2. Advanced physical Chemistry By Gurdeep Raj.
3. Atomic and Molecular spectra by Raj Kumar.

**M.Sc. Semester -IV**  
**Physical Chemistry Practicals**  
**CHNN-706-(P) & CHNN-707-(P)**

**Section-1 Minimum 04**

1. Determine effect of  $\text{Cl}^-$ ,  $\text{Br}^-$  or  $\text{I}^-$  ions on alkaline hydrolytic constant of n-butyl acetate conductometrically
2. Determination of mixture of acids and relative strength of weak acids in mixture conductometrically
3. Determination of CMC and  $\Delta G$  of sodium dodecyl sulphate conductometrically
4. Investigate effect of substitution of chloride ions on rate constant of inversion of cane sugar by using mono, di and trichloro acetic acid as catalyst (Polarimetry)
5. Study the adsorption of acetic acid or oxalic acid from aqueous solution by activated charcoal. Examine validity of Freundlich and Langmuir's adsorption isotherm
6. Verify law of refraction of mixtures (Glycerol and water) using Abbe's refractometer.
7. Determine the heat capacity of the calorimeter and concentration of unknown solution of benzoic acid by measuring heat changes during dilution.
8. Gas chromatographic analysis of tertiary mixture of Pentane, Hexane and Heptane
9. Estimation of insecticides in water using HPLC.
10. To determine the amount of riboflavin in given B-complex tablet by Fluorimetry.
11. To study the complexation of  $\text{Ni}^{+2}$  with EDTA by conductometrically.
12. To determine the Amount of aspirin content in a given Tablet by conductometrically.
13. To determine the dissociation constant ( $K_a$ ) of weak organic acid [Benzoic Acid] by conductometrically.

**Section-2 Minimum 05**

1. Determine mol. Wt. of polymer by viscosity measurement/turbidity measurement.
2. Investigate autocatalytic reaction between oxalic acid and potassium permanganate.
3. Separation by TLC.



Phenyl butazene

Aspirin

Phenazone

Glycine

Caffeine

Phenacetin

Paracetamol

Glutamic Acid

4. Determination of  $\Delta G$ ,  $\Delta H$  and  $\Delta S$  of silver benzoate by solubility product method.
5. Determine partial molar volume by intercept using density measurement.
6. Study the variation solubility of calcium hydroxide in presence of sodium hydroxide and hence determine the solubility product of calcium hydroxide at room temperature.
7. Determine adiabatic compressibility and intermolecular free length for interaction between DMSO and acetone for binary mixtures.
8. Determine ultrasound velocity for addition of  $\text{NH}_4\text{Cl}$  solution in water and acetone binary mixture at room temperature.
9. Study the kinetics of oxidation of propanol using an oxidant.
10. To determine the capacity of anions/cation exchange resin by column method.
11. To determine the standard electrode potential of silver/ copper/ lead electrode.
12. Potentiometric titration of halide-mixture of  $\text{KCl}+\text{KBr}+\text{KI}$  against given std.  $\text{AgNO}_3$  Solution
13. To determine rate constant and order of reaction between acetone and iodine catalysed by mineral acid.

### Section-3 Minimum 05

1. Study effect of ionic strength on activity coefficient and mean activity coefficient of silver ion in 0.01M silver nitrate solution by potentiometer.
2. Determine solubility of  $\text{Ag}_2\text{CrO}_4$  potentiometer.
3. Discuss the primary salt effect in a reaction between  $\text{K}_2\text{S}_2\text{O}_8$  and  $\text{KI}$ .
4. To study the complex formation between Fe (III) and salicylic acid and find instability constant and free energy change by spectrophotometer.
5. Determine partial molar volume by intercept using density measurement.
6. To estimate the amount of D-glucose in given solution calorimetrically.
7. Determine the dissociation constant of indicator (Methyl red/O-nitrophenol/Phenolphthalein) by spectrophotometer.
8. Simultaneous spectrophotometric determination of  $\text{Cr}^{+6}$ ,  $\text{Mn}^{+7}$ .
9. Ultraviolet spectrophotometric determination of Aspirin, Phenacetin & in APC table using solvent extraction.

10. Determine the heat of solution of a solid compound ( $\text{CaCl}_2$ ,  $\text{MgCl}_2$  or synthesized/ Schiff's base) and also lattice energy of  $\text{CaCl}_2$  using Bron-Haber cycle.
11. To study the effect of electrolytes on water structure by viscosity method.
12. To determine the molar refraction and refractive index of a given salt.
13. To study the variation of refractive index with composition of mixture of carbon tetra chloride and ethyl acetate.
14. To determine parachor/density/ refractive index of binary solutions.