

**North Maharashtra University, Jalgaon**

**SYLLABUS**

**T. Y. B. Sc.**

**Subject- Chemistry**

**(Semester 60-40 Pattern)**



**With Effect From- June 2017**

**Prepared By**

**Conveners of Syllabus designing workshop And**

**Experienced Teachers in Chemistry,**

**North Maharashtra University, Jalgaon.**

# North Maharashtra University, Jalgaon.

Class:- T.Y.B.Sc. (Semester 60-40 Pattern)

(with effect from June-2017)

CH-YSC [ Y for year, S for semester and C for course number].

The course structure and title of the courses for T.Y.B.Sc. (Chemistry) are as given below:

Course Number	Course Title	Periods	Marks	
			Internal	External
<b>Semester-V</b>				
CH -351	Physical Chemistry	60	40	60
CH -352	Inorganic Chemistry	60	40	60
CH -353	Organic Chemistry	60	40	60
CH- 354	Analytical Chemistry	60	40	60
CH -355	Industrial Chemistry	60	40	60
CH -356 (A) OR	Bio Chemistry	60	40	60
CH -356 (B)	Environment Chemistry	60	40	60
CH -357	Physical Chemistry Practical	60	40	60
CH -358	Inorganic Chemistry Practical	60	40	60
CH -359	Organic Chemistry Practical	60	40	60
<b>Semester- VI</b>				
CH -361	Physical Chemistry	60	40	60
CH -362	Inorganic Chemistry	60	40	60
CH -363	Organic Chemistry	60	40	60
CH- 364	Analytical Chemistry	60	40	60
CH -365	Industrial Chemistry	60	40	60
CH -366 (C) OR	Polymer Chemistry	60	40	60
CH -366 (D)	Chemistry In Every Day Life	60	40	60
CH -367	Physical Chemistry Practical	60	40	60
CH -368	Inorganic Chemistry Practical	60	40	60
CH -369	Organic Chemistry Practical	60	40	60

**Note:-**

1. Each period is of 50 minutes duration.
2. Each course is having weightage of four periods per week.
3. Each practical course is having weightage of four periods per week.
4. Examination of practical course shall be held at the end of the each semester.
5. An industrial study tour is compulsory for the T.Y.B.Sc. students. The students should submit their tour reports at the time of practical examination of VI Semester.
6. All units should be in SI unit.

## **NOTE:**

1. There are in all Six theory courses and Three practical courses for each semester.
2. Each theory paper carry 100 Marks out of which 40 Marks are allotted for internal assessment and 60 Marks for external assessment. As per the directions given by University, at the end of each semester internal examination will be conducted for 40 marks and University Examination will be conducted for 60 Marks.
3. The practical examination for courses CH-357, CH-358, CH-359 will be conducted at the end of V<sup>th</sup> Semester and that of CH-367, CH-368, CH-369 will be conducted at the end of VI<sup>th</sup> Semester Each practical course will carry 100 Marks out of which 40 Marks will be allotted for internal assessment and University Examination will be conducted for 60 Marks.
4. The students has a right to choose any one of the optional paper for Vth semester either CH-356(A) OR CH-356(B) Similarly The students has a right to choose any one of the optional paper for VI th semester either CH-366(C) OR CH-366(D)
5. A student is expected to submit a journal certified by the Head of the Department /Head of the Institution for each semester.
6. A student will not be permitted to appear at the practical examination unless he / she produces a certified journal. If the journal is lost ,the student should produce a certificate from Head of the department / Head of the Institution stating that he /she has satisfactorily completed the practical work.
7. Industrial tour is compulsory for all the students. The tour report will be evaluated in Organic Chemistry practical CH-369.

## **Rules for personal safety in Chemistry Laboratory:**

- 1) For eye protection, safety goggles must be worn in the laboratory at all times. If the student wears contact lenses, full protection goggles, which provide total seal around eyes, must be worn. All students are expected to wear safety goggles.
- 2) A long sleeved, knee length laboratory coat/ apron is recommended. Long pants and closed toed shoes must be worn for individual safety. Loose clothing, open style shoes and sandals are prohibited. Long hair must be tied up. Each student will have to get his / her own necessary protection items.
- 3) Prior to the practical examination, the teacher-in-charge will check all protective equipment to ensure that they are in order.
- 4) Pipetting by mouth should be avoided. Use of pro-pipette bulbs is recommended.
- 5) All laboratories should be equipped with safety chart, adequate first aid requirements and fire extinguishers.

**T.Y.B.Sc. Chemistry**

**Sem. -V**

**Course No:- CH-351**

**Subject: Physical Chemistry.**

**Chapter-1:-Electrochemical Cell and its Applications. (L-18)(M-18)**

Introduction, Classification of electrochemical cell, Liquid junction potential, Chemical cell with and without transference, concentration cell, electrode concentration cell without transference, electrolyte concentration cell with transference, electrolyte concentration cell with and without transference Determination of junction potential of concentration cell with transference. Reversible with cation and reversible with anion.

Application of emf measurement, Determination of solubility product, Determination of pH using Hydrogen gas electrode, Quinhydrone electrode and Glass electrode, Potentiometric titrations, Related numerical.

**Ref.-1:-Page Nos. 497-519**

**Chapter-2:-Photochemistry (L-12)(M-12)**

Introduction, Difference between photochemical and thermo chemical reactions, Laws of Photochemistry, Grotthus-Drapper Law, Einstein's Law of Photochemical equivalence, Quantum yield, Causes for high and low quantum yield, primary and secondary process, Consequence of light absorption by atoms and molecules, Jablonski diagram, Fluorescence, phosphorescence, Quenching of fluorescence. Experimental Study of Photochemical reactions, Photochemical gas reactions, Photolysis of ammonia, Combination of H<sub>2</sub> and Cl<sub>2</sub> reaction, Photosensitized gas reaction H<sub>2</sub> and O<sub>2</sub>, H<sub>2</sub> and CO, Chemiluminescence, related numerical.

**Ref.1:-Page Nos.:- 775-781,784-790,796-797.**

**Ref.2:-Page Nos.:-1154-1172.**

**Chapter-3:- Phase Rule :****(L-12)(M-12)**

Definitions, Gibb's phase rule, derivation of phase rule , Terms involved in the phase rule- the phase, Degree of Freedom, Number of Components, one component system for sulphur and water system, two component system for silver-lead, Three Component system.

**Ref. 1 : Pages 344-355. 773-791**

**Ref. 3. Pages 244-246.**

**Chapter-4:- Radioactivity and its Applications****(L-18) (M-18)**

Introduction, Radioactive elements, types of radioactive decay, decay schemes , General characteristic of radioactive decay, Decay kinetics-Decay constant, half life period ,mean life, Units of radioactivity,  $\alpha$  decay-The range and ionizing power of  $\alpha$  decay, The  $\alpha$  particle energy spectrum, Geiger-Nuttals law,  $\beta$  decay-Types of  $\beta$  decay. Detection and measurement of nuclear radiation, G. M. Counter. End Window and Liquid counter, Related numerical.

Application of radioactivity – Radiochemical principle of tracer technique; application of tracer technique – Chemical investigation reaction mechanism- esterification, hydrolysis, Oxidation - decomposition of  $H_2O_2$  and Oxidation of CO , structure determination -  $PCl_5$  molecules, Thiosulphate ion, C-14 dating and Age determination of the Earth, Medical applications- Thyroiditis, Bone fracture Healing, Brain tumor location, Defects in Blood Circulation.

**Ref.-4:-Page Nos. 117-125, 140-142, 148-150, 299-305,402-404, 407-410,**

### Reference Books:-

1. Fundamental of Physical Chemistry - Moron and Prutton, 4<sup>th</sup> edition, Oxford and IBH Publishing Co. Pvt. Ltd.
2. Essential of Physical Chemistry – Arun Bahl, B. S. Bahl, G.D. Tuli, S., Chand Publication, revised edition-2012.
3. Advance Physical Chemistry - Gurtu and Gurtu, 18<sup>th</sup> Edition, Pragati Prakashan
4. Essentials of Nuclear Chemistry – H.J. Arnikar, 4<sup>th</sup> Edition. New Edge International Publication.
5. Principles of Physical Chemistry- Puri, Sharma and Pathaniy-46<sup>th</sup>Edd<sup>n</sup>.
6. Electrochemistry - C.H.Hanman, John Wiley (1998)
7. An Introduction to Electrochemistry - Samuel Glasstone, Affiliated to East-west press.

**Chapter-1:-Investigation of Molecular Structure.**

**(L-18)(M-18)**

Introduction, Molar refraction, Dipole Moment, induced dipole moment, Electrical polarization of molecules. Orientation of dipole in an electric field, Debye equation. Method of determination of dipole moment, vapour-temperature method, Dilute solution method, molecular structure and dipole moment.

Molecular Spectroscopy – Introduction, Electromagnetic radiation, types of spectra, Rotational, Vibration and Electronic energy levels; Region of Spectra, Fluctuation in dipole moment due to rotational, Vibration and electronic excitation. Rotational Spectra of a rigid diatomic molecule, non rigid diatomic molecule-Moment of inertia, Energy Levels, Selection Rules, Nature of Spectrum, Determination of Bond Length, Isotopic Substitution, effect on rotational Spectra. Mathematical interpretation of rotational spectra in terms of bond length, reduced mass and moment of inertia of HCl and CO molecule and related numerical.

**Ref.-1:-Page Nos.:-691-697**

**Ref.-3.:-Page Nos.:-5-9,34-41.**

**Chapter-2:-Chemical kinetics**

**(L-18)(M-18)**

Introduction, Rate laws, Measurement of reaction rate, Order and molecularity, Distinction between order and Molecularity, First order reaction , Derivation of integrated rate law for first order reaction, characteristics and example Thermal decomposition of azo-isopropane,

Second order reaction, Derivation of integrated rate law for Second Order reaction with equal and unequal initial concentration. Characteristics of Second

order reaction, example of second order reaction, Decomposition of acetaldehyde.

Third order reaction, Derivation of integrated rate law for with equal initial concentration, characteristics of third order reaction, examples of third order reaction, Pseudo molecular reaction, Hydrolysis of Methyl acetate, Inversion of cane sugar, Methods to determine order of reaction using Integrated rate equation method, Graphical method, Half life method, Differential method. Effect of temperature on reaction rate, Arrhenius equation, related numerical.

**Ref.-1:-Page Nos.-548-565,571-574.**

**Ref.-2:-Page Nos.-731-755.**

**Chapter-3:-Solid State:**

**(L-12)(M-12)**

Introduction, Unit Cell, Weiss and Miller indices, Inter planar distance in cubic crystals, Properties of crystal, anisotropic, isotropic, etch figure, polymorphism, X rays, Use of X-ray in determination of crystal structure, Bragg's Equation, Braggs of X ray spectrometer, Powder method of crystal



analysis, x-ray analysis of NaCl, Position of Na<sup>+</sup> and Cl<sup>-</sup> ions in lattice, Calculation of inter-planer distance (d) and wavelength ( $\lambda$ ) of X rays, Number of molecules in unit cell, Determination of Avogadro's number, related numerical.

Liquid Crystals, and applications of liquid crystal.

**Ref 1:-Page Nos.:-**70-73, 76-87.

**Ref.2:-Page Nos.:-**450-451, 471-473.

#### **Chapter-4:- Elementary Quantum Mechanics**

**(L-12)(M-12)**

Black body radiation Planks radiation law, Photoelectric effect, Compton effect, Debroglies hypothesis, Heisnbergs uncertainty principals, Interpretation of wave function, Operators in quantum mechanics, Postulate of Quantum mechanics,

**Ref 4. :-Page No :-.** 24,33-35, 38, 43-45.

**Ref 5. :-Page No :-.** 3-8, 16,20,36-39,43-49.

#### **Reference Books:-**

1. Fundamental of Physical Chemistry - Moron and Prutton-4<sup>th</sup> edition,Oxford and IBH Publishing Co.Pvt.Ltd.
2. Essential of Physical Chemistry – Arun Bahl, B. S. Bahl, G. D. Tuli, S. Chand Publication revised edition-2008.
3. Fundamental of Molecular Spectroscopy by C.N. Banwell and McCash, 4th edition/5th edition,Tata McGraw Hill Publishing Co.Ltd.
4. Principles of Physical Chemistry, Puri, Sharma and Phthania, Vishal Publishing Co.
5. Quantum Chemistry - R. K. Prasad, New Edge Publication, 4<sup>th</sup> Edittion.
6. Chemical Kinetics-K.J.Laidler
7. Basic Chemical Kinetics - G.L.Agrawal (1990),Tata McGraw Hill Publishing Co.Ltd., NewDelhi.

**Sem. -V**

**T.Y.B.Sc. Chemistry**

**Course No:- CH-352**

**Subject: Inorganic Chemistry.**

**Chapter - 1: Basic concepts of coordination Chemistry.**

**(L-12, M-12)**

Double salts and coordination compounds, co-ordination complexes and complex ions, coordination number, Unidentate, bidentate and polydentate ligands, chelating ligand and chelates, physical methods used in study of complex, Nomenclature of coordination compounds.

**Ref. - 1: Page Nos. 729-735, 738-741.**

**Ref. - 2: Relevent Pages.**

**Chapter - 2: Werner's coordination theory.**

**(L-12, M-12)**

Assumptions, Werner theory and isomerism, EAN, Stability of complex ion, Factors affecting stability of complex ion, stereochemistry of coordination compound with C.N. 4 and 6, isomerism in coordination compounds.

**Ref. - 1: Page Nos. 735-737, 742-745, 750, 751, 752-757.**

**Ref. - 2: Relevent Pages.**

**Chapter - 3: Modern Theories of M-L Bonds: V.B.T.**

**(L-10, M-10)**

The main points of V.B.T., Examples of square planar, tetrahedral and octahedral complexes, short coming of V.B.T.

**Ref. 1: Page Nos. 760 - 779.**

**Chapter - 4: Modern Theories of M-L Bonds: C.F.T.**

**(L-14, M-14)**

Assumptions, Degeneracy of 'd' orbitals, Application of CFT to square planer, tetrahedral and octahedral complexes. C.F.S.E., Calculation of C.F.S.E. in weak field and strong field complexes, Evidences of C.F.S.E., Factor's affecting  $10 Dq$ , CFT and magnetic properties, spin only magnetic moments, equation, Electron occupancy in CFT, Problems related to calculation of spin only magnetic moment for square planer, tetrahedral and octahedral complexes, ( $\Delta$  for high spin and low spin complexes) spectrochemical series, John Teller distortion, limitations.

**Ref.1: Page Nos. 760 - 779.**

**Ref.2: Page Nos. 194-236.**

**Chapter - 5: Modern Theories of M-L Bond - M.O.T.**

**(L-12, M-12)**

Introduction, Assumptions, Molecular orbital treatment of octahedral complexes, effect of bonding, charge transfer spectra, comparison of VBT, CFT and MOT. pi

**Ref. 1: Page no. 878- 880.**

**Ref. 2: Page Nos. 227-230.**

**References:**

1. Principle of Inorganic Chemistry by B.R. Puri, L.R. Sharma, K.C. Kalia, Milestone Publisher and distributor.
2. Concise Inorganic Chemistry, 5th Edition - J.D. Lee.

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**Sem. -VI**

**T.Y.B.Sc. Chemistry**

**Course No:- CH-362**

**Subject: Inorganic Chemistry.**

**Chapter - 1: The Copper group Coinage Metals**

**(L-08, M-08)**

Introduction, Electronic structure, Extraction and uses of Cu, Ag and Au, Oxidation states, Biological role of Cu.

**Ref. - 1 : Page Nos. 816-820, 832, 833.**

**Chapter - 2: Solvents, Solutions, Acids and Bases.**

**(L-14, M-14)**

Donor and Acceptor properties, molten salts, solvents for electrochemical reactions, purity of solvents. Definition and approaches, solvent system concept, Lux-flood concept, Lewis concept, Generalized Acid-base concepts. Differentiating and leveling solvents. Co-solvating agents. Hard and soft acids and bases: definitions, Pearson HSAB concept, theories of Hardness and softness, application and limitation of HSAB concepts.

**Ref. - 2 : Page Nos. 220, 221, 223-229, 234-236.**

**Ref. - 3 : Page Nos. 238-245, 255-258, 263, 266, 269, 270.**

**Ref. - 4 : Page Nos. 374-386.**

**Chapter -3: Corrosion and passivity**

**(L-12, M-12)** Types of

corrosion - Atmospheric corrosion, Immersed corrosion, microbiological corrosion, Theories of corrosion, Protection of metals from corrosion. Passivity: Definition, types, causes.

**Ref. - 5 : Page Nos. 609 to 619.**

**Chapter – 4: Structure and Reactivity of Molecules.**

**(L-14, M-14)**

VSEPR theory, Structure of molecules containing lone pair of electrons- Sulphur tetrafluoride , Bromine trifluoride, Dichloroiodate(I)anion, Pentafluorotellurate(IV) anion, Tetrachloroiodate(III) anion, Nitrogen dioxide, Phosphorus trihalides, Carbonyl fluoride, Summary of VSEPR rules.

**Ref. 6: Relavant pages.**

**Chapter - 5: Some Transition and Inner Transition Elements.**

**(L-12, M-12)**

Occurrence, Extraction, properties and uses of Transition elements Ti and Cr.

Occurrence, Extraction of thorium, properties and uses of Th and U.

**Ref. 7: Page Nos. 305-312, 466-472.**

**References :**

1. Concise Inorganic Chemistry 5th edition by J.D. Lee.
2. Basic Inorganic chemistry 3rd edition by F.A. Cotton, G. Wilkinson, Paul Guss John Wiley and Sons.
3. Theoretical principals of Inorganic chemistry by G.S. Manku, Tata Mc. Graw Hill edition.
4. Advanced Inorganic chemistry by Gurudeep Raj., Vol. I, 23rd Edition, Goel publishing House Meerut.
5. Advanced Inorganic Chemistry, Fifth Aug. edition by Dr. S.K. Agrawal and Dr. Keemtila Pragati Prakashan.
6. Inorganic Chemistry Principles of Structure and Reactivity, 4<sup>th</sup> Edition; James E. Huheey, Ellen A. Keiter. Richard L. Keitler.
7. Advanced Inorganic Chemistry, Vol - II, Satya Prakash, G.D. Tuli, S.K. Basu, R.D. Madan.

Sem. -V

T.Y.B.Sc. Chemistry

Course No:- CH-353

Subject: Organic Chemistry.

**Chapter 1: Structural Effects (10 L, 10 M)**

Inductive effect, resonance effect, steric effect, hyper conjugation.

Application of all these effects in deciding the strength of acids and bases with examples.

Ref.2-Relevant Pages.

Ref.3-Pages 21-28.

**Chapter 2: Nucleophilic Substitution at Saturated Carbon (10 L, 10 M)**

Introduction, relation between kinetics and mechanism.

$SN^1$ ,  $SN^2$  and  $SN^i$  mechanisms.

Stereo chemical implications of mechanisms:  $SN^2$  mechanism-Inversion of configuration,  $SN^1$  mechanism-Racemisation,  $SN^i$  mechanism-Retention of configuration

Effect of structure, nucleophile, leaving group and solvent on  $SN^1$  and  $SN^2$  mechanism.

Ref.3- Pages 77-92 and 95-99.

Ref.2- Relevant Pages.

**Chapter 3: Electrophilic Addition to C=C (10 L, 10 M)**

Introduction, addition of halogens, addition of HX to C=C with mechanism and its stereochemistry.

Other addition reactions (with mechanism): hydration, hydroxylation, hydrogenation, ozonolysis.

Ref.3 -Pages 175-190.

Ref.1,2- Relevant Pages.

**Chapter 4: Nucleophilic Addition to C=O (10 L, 10 M)**

Structure and Reactivity, Addition of water, alcohol, thiol, hydride ion, derivatives of ammonia, semicarbazide. Addition of nucleophile to C=O examples like -Aldol Condensation, Cannizzaro reaction, Perkin reaction, Claisen ester condensation.

Ref.3 - Pages 202-226.

Ref.2,4,5- Relevant Pages.

### **Chapter 5: Aromatic Substitution (12 L, 12 M)**

Electrophilic Aromatic Substitution- Introduction, general mechanism, orientation of substitution in monosubstituted benzene.

Mechanism of nitration, sulphonation, halogenation, Friedal Craft alkylation and its Limitations, Friedal Craft acylation, Diazo coupling reactions.

Nucleophilic Aromatic Substitution- Introduction,

Mechanisms: Addition – Elimination mechanism,

Elimination-Addition mechanism (Benzyne intermediate)

Ref. 2,3,4-Relevant Pages.

### **Chapter 6: Rearrangement reactions (08 L, 08 M)**

Introduction, classification, 1) migration to carbon : Pinacol- pinacolone

rearrangement 2) migration to nitrogen : Beckmann rearrangement

3) migration to oxygen :Baeyer Villiger rearrangement.

### **Reference Books:**

- 1) Organic Chemistry by F.A. Carey (III<sup>rd</sup> Edn).
- 2) Organic Chemistry by Morrison and Boyd, VI<sup>th</sup>Edn.
- 3) A guide book to Mechanism in Organic Chemistry by Peter Sykes
- 4) Organic Chemistry by S. H.Pine, V<sup>th</sup>Edn.
- 5) Organic Chemistry by Jerry March.
- 6) Reactions and rearrangements by S N Sanyal

Sem. -VI

T.Y.B.Sc. Chemistry

Course No:- CH-363

Subject: Organic Chemistry.

## Chapter-1: Spectroscopy

### Introduction

(2 L, 2 M)

Meaning of spectroscopy, nature of electromagnetic radiations, wavelength, frequency, energy, amplitude, wave number, units of measurement. Different regions of electromagnetic radiations.

Interaction of radiation with matter, excitation of molecules to different energy levels i.e. rotational, vibrational and electronic.

Ref.-1,2,3-Relevant pages.

### Ultraviolet spectroscopy

(08 L, 08 M)

Introduction, nature of UV curve, electronic excitations and their types, effect of solvent on electronic transition.

Terms used in UV spectroscopy: chromophore, auxochrome, bathochromic shift and hypsochromic shift, hyperchromic shift, hypochromic shift.

Effect of conjugation on UV bands, calculation of  $\lambda_{\text{max}}$  by using Woodward Fieser rules: for diene system and enone system.

Applications of UV spectroscopy.

Ref.-1,2,3-Relevant pages.

### Infrared Spectroscopy

(10 L, 10 M)

Introduction, principles of IR spectroscopy, fundamental modes of vibrations, types of vibrations, fundamental group regions.

Characteristic IR absorption of following groups-

Alkanes, alkenes, alkynes, alcohols, ethers, alkyl halides, amines, aldehydes, ketones, acids, esters, amides, aromatic compounds and their substitution pattern.

Factors affecting IR spectroscopy : inductive effect, resonance effect, hydrogen bonding.

Applications of IR spectroscopy : Structure determination, Study of chemical reactions, hydrogen bonding.



Ref.-1,2,3-Relevant pages.

**NMR Spectroscopy (10 L, 10M)**

Introduction, principles of NMR spectroscopy, magnetic and nonmagnetic nuclei, nuclear resonance, chemical shift, molecular structure, shielding and deshielding, measurement of chemical shift,  $\delta$  scale and  $\tau$  scale, TMS as reference and its advantages. Peak area, spin-spin coupling, coupling constant, J values (only first order coupling).

Applications of NMR spectroscopy.

Ref.-1,2,3-Relevant pages.

**Problems based on UV, IR and NMR Spectroscopy (10 L, 10 M)**

Spectral data such as  $\lambda$  max values, IR frequencies, chemical shift ( $\delta$  values) and coupling constant should be provided to students.

Ref.-1,2,3-Relevant pages.

**Chapter 2: Designing Organic Synthesis (10 L, 10 M)**

Introduction, different terms used: disconnection, synthon, synthetic equivalence, FGI, TM.

One group disconnection: disconnection of simple alcohols

Ref-4. Relevant pages

**Chapter 3: Natural products (10 L, 10M)**

a) Terpenoids

Introduction, occurrence, isolation, classification, isoprene rule, general methods of structure determination of terpenoids.

Citral: structure determination, Barbier- Bouvealt synthesis

b) Alkaloids

Introduction, occurrence, isolation, general properties, general methods of structure determination.

Atropine: structure determination, synthesis of tropine, synthesis of atropine (Fischer Speier esterification)

**Reference Books:**

1. Spectroscopic Methods in Organic Chemistry by Willams Fleming, 4<sup>th</sup>Edn.
2. Spectroscopy of Organic Compounds by P.S.Kalsi, WileyEastern Publication.
3. Spectrometric Identification of Organic Compound by Silverstein, Bassler and Morrill 4<sup>th</sup>Edn.
4. Designing Organic Synthesis by Stuart Warren, 1983.
5. Organic Chemistry by Jerry March.
6. Stereochemistry of Organic Compounds by P.S.Kalsi, WileyEastern Publication.
7. Stereochemistry of Organic Compounds by E.L.Eliel.
8. Organic chemistry By finar vol.II, Vth ed.
9. Spectroscopy by Y R Sharma
10. Chemistry of natural products by G R Chtwal

**T.Y.B.Sc. Chemistry**

**Sem. -V**

**Course No:- CH-354**

**Subject: Analytical Chemistry.**

**Chapter-1 :-Solvent Extraction (14L, 14M)**

The Distribution Co-efficient, The Distribution Ratio, Percent Extracted, Solvent Extraction of Metals - Ion Association Complex and Metal Chelates, The Extraction Process, The Separation Efficiency of Metal Chelates, Analytical Separations, Multiple Batch Extractions, Countercurrent Distribution, Simple numerical problems on Percent Extracted and Multiple Extraction

**Ref.1:-Pages 484 to 498.**

**Ref. 2-6:- Relevant Pages**

**Chapter-2:- Ion Exchange Chromatography (12L, 12M)**

Introduction, Cation Exchange Resins, Anion Exchange Resins, Cross-linkage, Effect of pH-Separation of Amino Acids, Effect of Complexing Agents-Separation of Metal ions on Anion Exchange Columns, Applications of Ion Exchange Chromatography

**Ref.1:-Pages 517 to 522**

**Ref. 2-6:- Relevant Pages**

**Chapter-3:- Size Exclusion Chromatography (6L, 06M)**

Introduction, Principles, Exclusion Limit, Types of Gels, Applications

**Ref.1:-Pages 515 to 517**

**Ref. 2-6:- Relevant Pages**

**Chapter-4:-Gas chromatography (12L, 12M)**

Introduction, Principles, Gas chromatography Columns, Gas Chromatography Detectors, Column Efficiency in Chromatography- Theoretical Plates, 1) Van Deemter Equation, 2) Capacity Factor and 3) Resolution

**Ref.1:-Pages 522 to 528, 511 to 515**

**Ref.2-6:- Relevant Pages**

**Chapter-5:-High-performance Liquid Chromatography (08L, 08M)**

Introduction, Principles, Equipment for HPLC, Choice of Column Materials for HPLC

**Ref.1:-Pages 537 to 545**

**Ref.2-6:-Relevant Pages**

**Chapter-6 :-Electrophoresis (08L, 08M)**

Introduction, Principles of Electrophoresis, Properties of Charged Molecule, Theory of Electric Double layer, Classification of Electrophoresis Methods, Techniques of electrophoresis, Applications in Inorganic chemistry

**Ref. 3:- 223 to 230, 232 to 233**

**Ref :- 1-2, 4-6 Relevant Pages**

**Reference Books:-**

1. Analytical chemistry, by G.D. Christian, 5<sup>th</sup> Edition
2. Instrumental Methods of chemical analysis- Chatwal and Anand
3. Basic Concept of Analytical Chemistry-2nd edition S.M. Khopkar
4. Chemical analysis by A. K. Shrivastawa, P. C.Jain, S. Chand and company.
5. Quantitative analytical chemistry, 5<sup>th</sup> Edition, by James S. Fritz, George H.Schenk
6. Vogel's Text Book of Quantitative Chemical Analysis by J. Mandham, R.C.Denney, J. D. Barnes, M. Thomas, B. Shivashankar 6<sup>th</sup> Edition

**T.Y.B.Sc. Chemistry**

**Sem. -VI**

**Course No:- CH-364**

**Subject: Analytical Chemistry.**

**Chapter-1:-Spectrometry**

**(20L, 20M )**

Interaction of electro-magnetic radiation with matter, Electro-magnetic Spectrum, The Absorption of Radiation, Absorption by Inorganic Compounds, Solvents for Spectrometry, Quantitative Calculations, Beer's Law, Principles of instruments - Sources, Monochromators (prism, diffraction gratings, Optical filters), Cells, detectors, Slits Width, Single Beam Spectrometer, Spectrometric Errors, Deviation from Beer's Law - Chemical deviation, Instrumental deviation.

**Ref.-1:-Pages 398-401, 410-411, 413--435, 439-443.**

**Ref. 2 -6:-Relevant Pages**

**Chapter-2: Emission Spectrometry**

**(08L, 08M)**

Flame Emission Spectroscopy, Plasma Emission Spectrometry, Distribution between Ground and Excited States,

**Ref.-1:-Pages 462 - 467**

**Ref. 2-6:-Relevant Pages**

**Chapter-3:-Atomic Absorption Spectrophotometry**

**(10L, 10M)**

Principles, Instrumentation – Sources, Burners, Flames, Interferences – Spectral Interferences, Ionization Interferences, Refractory Compound Formation, Physical Interferences, Use of Organic Solvents, Sample Preparation, Applications of AAS.

**Ref.-1:-Pages 467 - 475**

**Ref. 2-6:-Relevant Pages**

**Chapter-4:-Nephelometry and Turbidimetry**

**(10L, 10M )**

Introduction, Turbidimetry and Colorimetry, Nephelometry and Fluorimetry, Choice between Nephelometry and Turbidimetry, Theory, Instrumentation, Comparison of spectrometry, Turbidimetry and Nephelometry, Applications of Turbidimetry and Nephelometry

**Ref.-3:-Pages 2.389 - 2.397.**

**Ref. 1,2,4,5,6,-Relevant Pages**

**Chapter-5:-Thermal Methods**

**(12L, 12M )**

General Discussion,

**Thermogravimetry-** Instruments for thermogravimetry, Applications of thermogravimetry

**Differential Techniques-** Differential Thermal Analysis (DTA) and Differential Scanning Calorimetry (DSC), Instruments for DTA and DSC, Experimental and Instrumental Factors, Applications of DTA and DSC

**Ref.-7:-Pages 503 - 519**

**Ref. 1,2,3,4,5,6,-Relevant Pages**

**Reference Books:-**

1. Analytical Chemistry by G.D. Christian, 5<sup>th</sup> Edition.
2. Analytical Chemistry, An Introduction: Skoog, West and Holler, 6<sup>th</sup> Edition
3. Instrumental method of Chemical Analysis by Chaitwal and Anand, 5<sup>th</sup> Edition.
4. Basic Concept of Analytical Chemistry- S.M. Khopkar
5. Instrumental Methods of chemical analysis- 6<sup>th</sup> edition Willard, Merritt, Dean and Settle
6. Introduction to instrumental analysis- R.D. Braun
7. Vogel's Textbook of Quantitative Chemical Analysis, 6<sup>th</sup> Edition, J. Mendham, R. C. Denney, J. D. Barnes, M. J. K. Thomas

**Sem. -V**

**T.Y.B.Sc. Chemistry**

**Course No:- CH-355**

**Subject: Industrial Chemistry.**

**Chapter-1: General Aspects of industrial Chemistry**

**(M-12, L-12)**

Introduction, Basic requirements of industrial chemistry, chemical production, raw materials, unit process and unit operations, quality control, quality assurance, process control, research and development, pollution control, human resource, safety measures, classification of chemical reactions, batch and continuous process, Conversion, selectivity, yield, copy right act, patent act and trade marks.

**Ref.1:-** Chapter 2(pp. 26, 27, 31 to 36)

**Ref. 2:-**Chapter 2 (Relevant Pages)

**Ref:** Websites–[www.wikipedia.org/wiki/patent act](http://www.wikipedia.org/wiki/patent_act) and [www.wikipedia.org/wiki/trademarks](http://www.wikipedia.org/wiki/trademarks)

**Chapter-2: Sugar Industry.**

**(M-12, L-12)**

Introduction, Sugar Industry in Maharashtra and India, Manufacture of cane sugar- [Refining (with flow sheet)], general idea of Sulphitation and Carbonation, Concentration /Evaporation, Crystallization Separation of crystals. Grades, Baggase, Cellotex.

**Ref.5:-**Chapter 38 (Relevant Pages)

**Chapter-3: Fermentation Industry.**

**(M-12, L-12)**

Introduction, Alcohol Fermentation, Uses of alcohol, Theory underlying process of making alcohols beverages, Manufacture of Beer, Manufacture of Spirit, Alcohol from Cane Sugar Molasses, Theory of fractional distillation – Coffey's still, Rectified spirit, Absolute alcohol, Fusel oil, Proof spirit, Denatured alcohol.

**Ref.2:-**pp. 578-596.

**Ref.5:-**Chapter 36 (Relevant Pages)

**Chapter-4:Fertilizers.**

**(M-12, L-12)**

Plant Nutrients, Nutrient functions, Fertilizer types, Need for fertilizers, Essential requirements, Classification of fertilizers, Natural inorganic fertilizers, Artificial-fertilizers- Nitrogenous fertilizers- Ammonium sulphate, Urea.(Manufacture of Urea & Ammonium Sulphate), Action of Ammonium Sulphate & Urea as Fertilizer, Phosphatic Fertilizers- Triple Super Phosphate (Manufacturing Process

Only),Potassium fertilizer, Importance of Bio-fertilizers.

**Ref.5:-**Chapter 26 (Relevant Pages)

**Chapter-5: Small Scale Industries .****(M-12, L-12)**

Introduction and Aspects of Small Scale Industries, Safety Matches, Agarbatties, Naphthalene balls, Wax Candles, Shoe Polishes, Gum Paste, Writing and fountain Pain ink, Plaster of Paris, Silicon Carbide Crucibles, How to Remove Stains and Liquid Phenyl Manufacturing.

**Ref.5:-**Chapter 60 (Relevant Pages)

**Reference Books:-**

1. Principles of Industrial Chemistry, by Chris A Clausen III and Guy Mattson  
A Wiley –Inter Science Publication .John Wiley and sons, New York
2. Shreve’s Chemical Process Industries 5 th Edition by George T. Austin
3. Drug and pharmaceutical Chemistry by Gurudeep Chatwal 2nd Edition, Himalaya Publishing House.
4. Comprehensive Industrial Chemistry - P.G. More, First Edition, 2010,  
5. Industrial Chemistry by B. K. Sharma, 16th Edition, 2011.



## T.Y.B.Sc. Chemistry

Sem. -VI

Course No:- CH-365

Subject: Industrial Chemistry.

### Chapter-1: Petroleum Industry.

(M-12, L-12)

Occurrence, Petroleum producer countries in the world, Exploration Methods, Composition of Petroleum, Refining or Distillation of Petroleum, Anti-Knock Compounds, Octane number, Cetane number, petrohol (their definitions only), Manufacture of Petrol or Gasoline by Bergius Method, Cracking process- Thermal, Catalytic, Hydro cracking.

**Ref.1:** pp 340 to 352, 356 to358 and 363 to 368.

**Ref.5:-**Chapter 4 and 5(Relevant Pages)

### Chapter-2: Industrial Organic Synthesis from Petroleum

(M-10, L-10)

Manufacture of methanol from synthesis gas, Isopropanol from propylene, Glycerol from propylene via allyl chloride, Acetone by catalytic dehydrogenation of isopropanol. (with flow sheet diagram), Unsaturated Hydrocarbon –preparation of Acetylene from Natural gas (with flow sheet), Aromatic hydrocarbon-Preparation of toluene (with flow sheet)

**Ref.5:-**Chapter 14 (Relevant Pages)

### Chapter-3: Soaps and Detergents:

(M-12, L-12)

Soaps, Surfactants and its Importance, Raw Materials used in Soap Manufacture, Manufacture of Soaps (Continuous Process), Cleansing action of Soap, Classification of Soaps, Detergents, Principal group of Synthetic Detergents, Detergents builders and Additives, Comparison between Soap Detergent.

**Ref. 6:** Relevant pages

**Ref.5:-**Chapter 39 and 40 (Relevant Pages)

### Chapter-4. Drugs and Pharmaceuticals:

(M-12, L-12)

Introduction, Importance, Qualities of good drugs, Functional and chemotherapeutic drugs, Meaning of the terms: Prescriptions, Doses, Analgesic, Antipyretics, Diuretic Anesthetics, Antibiotics, Anti-inflammatory, Anti-viral, Tranquilizer, Antiulcer, Antiallergic, and Bronchodilators, Cardiovasculars, Cough And Cold Preparations Antihypertensive, Anti-

neoplastics, Sedatives And Hypnotics, Steroidal contraceptive Histamine and Antihistamines. Synthesis, uses, manufacture and properties of Paracetamol, Aspirin, Chloramphenicol.

**Ref. 1** Relevant pages.

**Ref. 2** Relevant pages.

**Ref. 3** Relevant pages.

**Ref. 4** Chapter 8 (Relevant pages.) Page No.144-194

#### **Chapter-5: Dyes, Pigments and paints**

**(M-14, L-14)**

- (a) **Dyes:** Introduction, properties of dyes, Otto Witts theory only, Classification of dyes according to their mode of application and Chemical Constitution. Synthesis and Uses of dyes:- Congo red, Methyl orange, Phenolphthalein, Erichrome Black-T and Indigotin from aniline.

**Ref.5:-**Chapter 54 (Relevant Pages)

- (b) **Paints:** Introduction of paints, ingredients and classification, new technologies; properties of coatings; solvents, plasticizers, dyes and bioactive additives.

- (c) **Pigments:** Introduction, classification and general physical properties.

**Ref.1: pp777-814**

**Ref.5:-**Chapter 43 (Relevant Pages)

#### **Reference Books:-**

1. Principles of Industrial Chemistry, by Chris A Clausen III and Guy Mattson

A Wiley –Inter Science Publication .John Wiley and sons, New York

2. Shreve's Chemical Process Industries 5 th Edition by George T. Austin

3. Drug and pharmaceutical Chemistry by Gurudeep Chatwal 2nd Edition, Himalaya Publishing House.

4. Comprehensive Industrial Chemistry - P.G. More, First Edition, 2010,

5. Industrial Chemistry by B. K. Sharma, 16th Edition, 2011.

6. Surfactants and Interfacial Phenomenon by M. J. Rosen, John Wiley and Sons, New York

Sem. -V

T.Y.B.Sc. Chemistry

Course No:- CH-356(A)

Subject: Biochemistry.

### Chapter 1:Carbohydrates

(L12, M 12)

a) Introduction,definition, classification.b) Monosaccharides:structure of glucose (open chain and ring structures). Reactions of glucose: oxidation with bromine water and nitric acid, reduction, acetylation, addition of HCN, NH<sub>2</sub>OH and phenyl hydrazine,mutarotation.c) Disaccharides: structure of sucrose, lactose and maltose.d) Polysaccharides:storage polysaccharides:structure of starch, Structural polysaccharides: structure of cellulose.  
Ref 1 and 2- Relevant pages

### Chapter 2 Amino Acids and Proteins

(L12, M12)

a) Introduction, Structure of ammo acids with zwitterion structure, classification of amino acids based on nature of R group, amphoteric nature of amino acids, reaction of amino acids with FDNB and Dansyl chloride, formation of peptide bondb) Classification of proteins: based on functions and based on shape,structure of proteins: primary, secondary, tertiary and quaternary structure.c) Separation of amino acids and proteins by paper electrophoresis and dialysis

Ref 1 and 2- Relevant pages

### Chapter -3Enzymes

(L6, M6)

Introduction, classification, role of enzymes in biochemical reactions,Michaelis Menten equation (no derivation). Effect of substrate concentration,pH and temperature on enzyme catalyzed reaction.Enzyme inhibitors: introduction and types.

Ref 1 and 2- Relevant pages

### Chapter -4Lipids

(L5, M5)

Introduction,classification of lipids, fatty acids, nomenclature of fatty acids, triacyl glycerols,phospholipids and waxes.

Ref 1 and 2- Relevant pages

## Chapter 5: Nucleic Acids

\* (L7, M7)

Introduction, Components of nucleic acids: sugars, bases, nucleosides and nucleotides. Watson and Crick model of DNA, types of RNA (structure not expected)  
Ref 1 and 2- Relevant pages

## Chapter 6: Energy rich compounds(L6, M6)

Introduction, Pyrophosphates, acyl phosphates, enolic phosphates, thiol esters (structure, hydrolytic reaction and energetics)Ref 1 and 2- Relevant pages

## Chapter7: Metabolism (L12, M12)

Definition of metabolism,

**Carbohydrate metabolism:** Glycolysis: reactions involved and energeticsTCA cycle (Kreb cycle) : Reactions involved and energetic

**Amino acid Metabolism:**Transamination, deamination (by enzymes - glutamic dehydrogenase, ammonia lyases, deaminases and deamidases), decarboxylation

**Lipid Metabolism:** $\beta$ - oxidation , reactions involved in  $\beta$  –oxidation, energetics of  $\beta$  –oxidation of palmitic acid.

## Reference Books

1. Outlines of Biochemistry - Conn and Stumpf (4<sup>th</sup>Edition)
2. Principles of Biochemistry - A L Lehninger (2nd Edition)

**Sem. -V**

**T.Y.B.Sc. Chemistry**

**Course No:- CH-356(B)**

**Subject: Environmental Chemistry**

**Chapter 1: Atmosphere and Air Pollution**

**(M-14 L-14)**

- 1.1 Composition and structure of atmosphere
- 1.2 Chemical and photochemical reactions in atmosphere
- 1.3 Chemistry of O<sub>3</sub>, SO<sub>x</sub>, NO<sub>x</sub> and chlorides in atmosphere
- 1.4 Primary air pollutants
- 1.5 Particulate matter: Inorganic and Organic
- 1.6 Smog: Reducing and Photochemical
- 1.7 Mechanism of ozone depletion
- 1.8 Stability and reactions of CFCs
- 1.9 Harmful effects of CFCs
- 1.10 CFCs substitutes

**Ref. 1, Ref. 3, Ref. 4 (Relevant Pages)**

**Chapter 2: Hydrosphere and water pollution**

**(M-12 L-12)**

- 2.1 Water resources
- 2.2 Microbially mediated aquatic reactions, nitrogen cycle, iron and manganese bacteria
- 2.3 Classification of water pollutants
- 2.4 Organic and Inorganic pollutants: Pesticides, Detergents, Eutrophication, Marine, Oil, Acid mine drainage, remedial measures and sediments
- 2.5 Thermal pollution
- 2.6 Water quality parameters: pH, D.O. (Winkler Method), COD, TOC, Total hardness, free chlorine.

**Ref. 1, 2, 3, and 4 (Relevant Pages)**

**Chapter 3: Water treatment and effluent management**

**(M-12 L-12)**

3.1 Domestic sewage, waste water treatment: primary, secondary and tertiary treatments, aerobic, anaerobic and upflow anaerobic sludge bed treatment processes

3.2 Industrial waste water treatment i) filtration method ii) ion-exchange method iii) membrane techniques: ultra filtration, reverse osmosis and electrodialysis

3.3 Treatment of drinking water

**Ref. 1, 2, 3, and 4 (Relevant Pages)**

**Chapter 4: Instrumental methods in environmental analysis (M-12 L-12)**

4.1 Atomic absorption spectroscopy: determination of Hg, As, Zn, Ag, Pb, Mn, Fe, Cu, Cr, Cd

4.2 Gas chromatography: detection and determination of CO, HC and pesticides

4.3 Spectrophotometry: determination of NO<sub>x</sub>, SO<sub>2</sub>, NH<sub>3</sub>, CN, PO<sub>4</sub>, Cd, Pb, Hg

**Ref. 1, Ref. 2 (Relevant Pages)**

**Chapter 5: Green House Effect and Global Warming (M-10 L-10)**

5.1 Introduction

5.2 Greenhouse gases

5.3 Radiative forcing

5.4 Sources and sinks of CO<sub>2</sub>

5.5 Causes of fluctuations in global temperature

5.6 Global warming and climate changes

5.7 Implications of climate changes

**Ref. 1, Ref. 2(Relevant Pages)**

**Reference Books:**

1: Environmental Chemistry – A. K. De, 5th Edition (New age international publishers)

2: Environmental Chemistry – J. W. Moore and E. A. Moore (Academic Press, New York)

3: Environmental Chemistry – A. K. Bhagi and C. R. Chatwal (Himalaya Publishing House)

4: Environmental Chemistry – H. Kaur 2nd Edition 2007, PragatiPrakashan, Meerut, India

Sem. -VI

T.Y.B.Sc. Chemistry

Course No:- CH-366(C)

Subject: Polymer Chemistry

### Chapter-1 Basic concepts of polymers

(M-12, L-12)

Brief history, definition, functionality and reactivity, degree of polymerisation, polydispersity index, monomers, polymers, homopolymers, copolymers, types of copolymers. Tacticity (stereochemistry) of polymers: isotactic, syndiotactic and atactic polymers. Molecular weights of polymer, types of molecular weights.

Classification of polymers based on origin, native backbone chain, thermal response, applications and physical properties (Plastics, elastomers, fibres and liquid resins)

Degradation, types of degradation: chain end degradation, random degradation.

Ref- 1 : Relevant pages

Ref-2: Relevant pages

### Chapter-2 Chemistry of polymerisation

(M-10, L-10)

Introduction, chain growth polymerisation, Addition polymerization (initiation, propagation, termination and kinetics): free radical polymerisation, ionic polymerisation, step growth polymerisation, condensation polymerization (mechanism and kinetics), ring opening polymerisation.

Ref- 1 : Relevant pages

Ref - 2: Relevant pages

### Chapter-3 Polymerisation techniques

(M-08, L-08)

Bulk polymerisation, solution polymerisation, suspension polymerisation, emulsion polymerisation, interfacial condensation polymerisation.

Ref- 1: Relevant pages

Ref -2: Relevant pages

#### **Chapter-4 Study of some important polymers**

**(M-20, L-20)**

Preparation, properties and applications of following polymers-

Polyethylene, Polypropylene, Polyvinyl chloride, Polystyrene, Polyacrylonitrile, Polycarbonates, Phenol-formaldehyde resins, Epoxy resins, Polyester (PET), Polyamides (nylon 6 and nylon 66), Polyvinyl alcohol, Polylactic acid and Polyaniline.

Ref-1: Relevant pages

Ref - 2: Relevant pages.

#### **Chapter-5 Glass transition temperature**

**(M-10, L-10)**

Glass transition temperature - Definition and explanation, importance of glass transition temperature, factors affecting glass transition temperature, Glass transition temperature and molecular weight, Glass transition temperature and melting point ,determination of glass transition temperature by dilatometry or specific volume technique.

Ref-1: Relevant pages

Ref -2: Relevant pages.

#### **Reference Books:**

1. Polymer Science - V. R. Govarikar.
2. Text books of Polymer Science – F. W. Billmeyer.



**Chapter-1 Chemistry in day-to-day life**

**(15 L, 15M)**

Types of water, desalination, Fresh water, Dissolved Oxygen and water quality. Milk: Definition, Chemical composition of milk of different species such as cow, buffalo and goat. Adulteration in milk like Sugar, Urea, Starch. Essential nutrients for plants, Classification, Major, minor & trace their sources and forms. Importance of Inorganic Compounds as Medicine- Antacid products  $\text{Na}_2\text{CO}_3$ ,  $\text{Al}(\text{OH})_3$ ,  $\text{AlPO}_4$ ,  $\text{Mg}(\text{OH})_2$ .

**Chapter- 2 Cosmetic Chemistry**

**(15L, 15 M )**

**A] - Hair Care Products**

Principle constituents of Shampoos (thickeners and foam stabilizers , perfumes, preservatives , conditioning agents , antidandruff shampoos.), Hair cream, hair dye, dye removals.

**B] Skin Care Product and bleaching agents**

Principle constituents of Skin cleansers , cold cream , moisturizers , body lotions – sun screen lotions .

**C] Colour Cosmetics**

Principle constituents of Lipstick , lip glosses , nail polish, face powder .

**D] Dental Product**

Principle constituents of , toothpaste , toothpowder , oral rinses

**E] Perfumes :**

Definition, Synthesis and uses of (1) Phenyl alcohol (2) Linalool (3) Musk Ketone (4) Vanilline

**Chapter-3. Surfactants in Detergents**

**(10 L, 10 M)**

**Soaps** – Introduction, detergent action of soap. Toilet soap, bathing bars, washing soaps, liquid soap, additives, fillers and flavours, Significances of acidity and alkalinity.

**Detergents** – Surface active agents, types of detergents – cationic, anionic, amphiphilic detergents. Common detergent chemicals, Additives, colours and flavours, Enzymes used in commercial detergents, Environmental Hazards.

**Chapter-4. Synthetic Drugs and Dyes:**

**(10 L, 10 M)**

**A] Synthetic Drugs:**

a) Introduction.

b) Definition: i) Pharmacy ii) Pharmacology iii) Chemotherapy iv) Metabolites

and anti- metabolites v) Bacteria vi) Gram positive and Gram negative. c) Define on the basis of: Antimalerials, Antiseptic, Antibacterial, Antibiotics, Antifungal, Anticancer, Analgesics, Antipyretics, Sedatives, Anaesthetics

**B] Synthetic Dyes:**

Introduction, properties of good dye and application.

## **Chapter-5 Chemistry of food products**

**(10 L, 10 M)**

Introduction, Packed food, Bread, Butter, cheese, Synthetic food, juice, jam and jelly, squash, sauce- preparation, preservative and adulteration.

### **References**

1. T.P. Coultate, Food – The Chemistry of its components. Royal Society of Chemistry London, (paperback)
2. Shashi Chowls, Engineering Chemistry, Darpat Rai Publication.
3. B.K. Sharma, Industrial Chemistry.
4. CNR Rao, Understanding Chemistry, Universities Press.
5. A text book of Pharmaceutical Chemistry –II : Dr. A V Kasture & Dr. S G Wadodkar : Nirali Prakashan (2) Organic Pharmaceutical Chemistry : Harkishan Singh & V K Kapoor : Vallabh Prakashan, Delhi
6. Synthetic Organic Chemistry: O.P.Agarwal
7. Modern Technology of Cosmetics, Asia Pacific Business Press Inc., New Delhi, 2004

**Instructions**

1. During preparation of solutions use molar solutions where ever possible.
2. Take minimum volume of solution (10 ml for titrations) and dilute concentration as per as possible.
3. Take at least 10 experiments from each semester.

**Colorimeter / Spectrophotometer (At least 2)**

1. To obtain the calibration curve of  $\text{KMnO}_4$  using Colorimeter and determine  $\lambda_{\text{max}}$  for of  $\text{KMnO}_4$  and concentration of  $\text{KMnO}_4$  unknown solution. Hence verify the beers law.
2. Determination of  $\lambda_{\text{max}}$  and concentration of unknown  $\text{Cu}^{2+}$  solution and verify the beers law.
3. To determine the amount of  $\text{Fe}^{3+}$  ion present in the given solution by using salicylic acid by colorimetric titration( $\lambda_{\text{max}} = 525$ )

**Potentiometer (At least 2)**

1. Determine Ecal and pH of buffer solution ( $\text{Citric acid} + \text{Na}_2\text{HPO}_4$ ) using quinhydrone electrode.
2. Determine the pKa and Ka of weak monobasic acid by potentiometric titration.
3. Determine formal redox potential of  $\text{Fe}^{2+}$  to  $\text{Fe}^{3+}$  by potentiometric titration.

**Refractometer (At least 2)**

1. Determine the refractive index of four liquids, hence specific and molar refraction.
2. Determine the molar refraction of homologous methyl, ethyl and propyl alcohol and show that constancy configuration to molar refraction by  $-\text{CH}_2$  group.

3. Determination of unknown concentration of A and B by using mixture law.

### **Radioactivity**

1. Determine the  $E_{\max}$  of Beta particle.

### **Turbidimetry**

1. Determine the molecular weight of a given polymer by turbidimetry.

### **Non-Instrumental**

1. Molecular weight determination by steam distillation.
2. Draw five graphs using Microsoft excel or Origin and find out slope and intercepts of the graphs.

### **Partition coefficient**

1. Study molecular condition of benzoic acid in toluene and water by determining its partition between toluene and water.

### **Viscosity (At least 1)**

1. Determine the molecular weight of high polymer using its solution of different concentration.
2. Determine the radius of glycerol molecule by viscosity measurement.

**Conductometry (At least 2)**

1. Conductometric titration of mixture of acid and hence determine the strength of acid.
2. Determine the relative strength of monochloro acetic acid and acetic acid conductometrically.
3. Determine the basicity of organic acid by conductometric measurement.

**Chemical Kinetics (At least 2)**

1. To investigate the reaction between  $\text{H}_2\text{O}_2$  and KI by gas burette method.
2. Study the hydrolysis of methyl acetate in presence of hydrochloric acid.
3. Determine the energy of activation of the reaction between  $\text{K}_2\text{S}_2\text{O}_8$  and KI.
4. To study the effect of concentration and temperature on the rate of reaction between iodic acid and sodium bisulphite

**Polorimeter (At least 2)**

1. To study the kinetics of inversion of cane sugar by polorimeter.
2. Determine the concentration of given solution of an optically active substance (cane sugar) by polorimetric measurement

**pHmetry(At least 2)**

1. Determine the pKa and Ka of weak monobasic acid by pH metric titration.
2. Determine the degree of hydrolysis of aniline hydrochloride pH metrically.
3. Determine the pKa of various mixtures of sodium acetate and acetic acid in aqueous solution and hence to find the dissociation constant.

**Flame Photometry.**

1. Estimation of Na, K, Li and Ca by flame photometer in given sample (any two metals).

## Adsorption

1. Investigate the adsorption of acetic acid in aqueous solution by using activated charcoal.

## Thermochemistry.

1. Determine the integral heat of dilution of  $\text{H}_2\text{SO}_4$  starting with solution of different concentration.
2. To determine the heat of hydration of  $\text{CuSO}_4$
3.  $\Delta G$ ,  $\Delta H$ ,  $\Delta S$  of silver benzoate by solubility product and by conductometry.

## Spectroscopy

1. To determine rotational constant by analysis of rotational spectra of CO and HCl molecule.

## Application of Microsoft Excel or Origin

1. To draw graphs of different experiments which are performed and find out their slope, intercept using Microsoft Excel or Origin (at least 5 graphs).

## Reference Books:-

1. Advanced Practical Physical Chemistry by J.B. Yadav, Goel publishing House Meerut.
2. Systematic experimental Physical Chemistry by Rajboj & Chondekar, Anjali Publication.
3. Experimental Physical Chemistry by R.C. Das & B. Behra, Tata McGraw Hill.
4. Experiments of Physical Chemistry by Wilson, NewCombe, Denaro Pergaman Press Rickett.
5. Findlay's Practical Physical Chemistry. Revised By J.A. Kitchener and B.P. Lavitt.
6. Applied Chemistry Theory and Practices by O. P. Vermani, A. K. Narula, New Edge International Publications, Second Edition

**Course No:- CH-357 and CH-367**

**Subject: Physical Chemistry Practical**

**Scheme of marks for Internal Examination:-**

<b>Q. 1 :- Experiment Instrumental or Non Instrumental</b>	<b>30</b>
<b>Q. 2 :-Journal</b>	<b>10</b>
	<b>Total - 40</b>

**Scheme of marks for University Examination:-**

<b>Q. 1 :- Experiment Instrumental or Non Instrumental</b>	<b>50</b>
<b>Q. 2 :- Oral-</b>	<b>10</b>
	<b>Total - 60</b>

**Subject: Inorganic Chemistry Practical.**

**1. Gravimetric Estimations: ( Any Two)**

- i) Fe as  $\text{Fe}_2\text{O}_3$
- ii) Zn as  $\text{ZnP}_2\text{O}_7$
- iii) Pb as  $\text{PbSO}_4$

**2. Volumetric Analysis: (Any Two)**

- i) Manganese by Volhards method.
- ii) Estimation of Nickel by EDTA method.
- iii) Determination of strength of NaOH and  $\text{Na}_2\text{CO}_3$  in a given solution.

**3. Inorganic Preparations:(Any Three)**

- i) Bis ( ethylenediamine ) copper (II) sulphate.
- ii) Potassium trioxalato chromate (III).
- iii) Tris (acetylacetonato) Iron (III).
- iv) 8-hydroxyquinoline Nickel (II)

**4. Colourimetric Analysis: (Any One)**

- i) Estimation of Titanium using  $\text{H}_2\text{O}_2$ .
- ii) Estimation of Iron using thiocyanate method.

**5. Paper Chromatography : (Any Two mixtures)**

Separation and identification of binary mixture of cations. (  $\text{Fe}^{3+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Co}^{2+}$  )

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**References:**

- 1. A Text Book of Quantitative Inorganic Analysis by A.I.Vogel,4<sup>th</sup> Edition.
- 2. Vogel's Qualitative Inorganic Analysis by A.I.Vogel.
- 3. Practical Chemistry-O.P.Pandey,D.N.Bajpai,S.Giri,by S.Chand Publication New Delhi.
- 4. Post Graduate Practical Chemistry by H.N.Patel,S.P.Turakhia,S.S.kelker,S.R.Puniyani.  
Himalaya Publishing House.



5. College Practical Chemistry by H.N.Patel,S.P.Turakhia,S.S.kelker,S.R.Puniyani.  
Himalaya Publishing House.
6. Practical Chemistry by K.K.Sharma,D.S.Sharma .Vikas Publications.

**IMPORTANT NOTE:**

- For volumetric analysis pipette solution should be 10 ml instead of 25 ml.
- Preparation of stock solution or standard solution should be in 100 ml measuring instead of 250 ml in order to avoid wastage of chemicals.

**Inorganic Chemistry Practicals CH-358**

**Semester – V**

**External Examination Pattern**

**Time Allowed: 3 Hrs.**

**Max. Marks: 60**

1. Gravimetric Estimations / Volumetric Analysis / Colorimetric Analysis  
/ Inorganic Preparation and Paper Chromatography **50 Marks**
2. Oral **05 Marks**
3. Journal ( Completed and Certified ) **05 Marks**

**Internal Examination Pattern**

**Time Allowed: 3 Hrs.**

**Max. Marks: 40**

1. Gravimetric Estimations / Volumetric Analysis / Colorimetric Analysis  
/ Inorganic Preparation and Paper Chromatography **30 Marks**
2. Oral **05 Marks**
3. Journal ( Completed and Certified ) **05 Marks**

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**T.Y.B.Sc. Chemistry**

**Sem. -VI**

**Course No:- CH-368**

**Subject: Inorganic Chemistry Practical.**

**1. Inorganic Qualitative Analysis: (Six binary Mixtures containing common anions)**

(Excluding phosphates and borates)

**2. Ore Analysis: (Any Two)**

Haematite ore - Estimation of Iron volumetrically

Pyrolusite ore- Estimation of Manganese volumetrically

Dolomite ore - Estimation of Calcium volumetrically

**3. Alloy Analysis : (Any Two)**

i) Estimation of Zinc from Brass Alloy by EDTA method.

ii) Estimation of Tin gravimetrically as SnO<sub>2</sub> from solder alloy.

iii) Estimation of Copper iodometrically from nichrome alloy.

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**References:**

1. A Text Book of Quantitative Inorganic Analysis by A.I.Vogel,4<sup>th</sup> Edition.
2. Vogel's Qualitative Inorganic Analysis by A.I.Vogel.
3. Practical Chemistry-O.P.Pandey,D.N.Bajpai,S.Giri,by S.Chand Publication New Delhi.
4. Post Graduate Practical Chemistry by H.N.Patel,S.P.Turakhia,S.S.kelker,S.R.Puniyani.  
Himalaya Publishing House.
5. College Practical Chemistry by H.N.Patel,S.P.Turakhia,S.S.kelker,S.R.Puniyani.  
Himalaya Publishing House.
6. Practical Chemistry by K.K.Sharma,D.S.Sharma. Vikas Publication

## **Inorganic Chemistry Practicals CH- 368**

**Semester – VI**

### **External Examination Pattern**

**Time Allowed: 3 Hrs.**

**Max. Marks: 60**

- |   |                 |
|---|-----------------|
| 1. Inorganic Qualitative Analysis / Ore Analysis / Alloy Analysis | <b>50 Marks</b> |
| 2. Oral   | <b>05 Marks</b> |
| 3. Journal ( Completed and Certified )                            | <b>05 Marks</b> |

### **Internal Examination Pattern**

**Time Allowed: 3 Hrs.**

**Max. Marks: 40**

- |   |                 |
|---|-----------------|
| 1. Inorganic Qualitative Analysis / Ore Analysis / Alloy Analysis | <b>30 Marks</b> |
| 2. Oral   | <b>05 Marks</b> |
| 3. Journal (Completed and Certified)                              | <b>05 Marks</b> |

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**T.Y.B.Sc. Chemistry**  
**Sem. -V** **Course No:- CH-359**  
**Subject: Organic Chemistry Practical.**

**I) Separation of Binary Mixtures and Qualitative Analysis** **(Any 7)**

Any five mixtures from the following types should be given 1) acid – phenol, 2) acid – base, 3) acid – neutral, 4) phenol – base, 5) phenol – neutral, 6) base – neutral 7) neutral – neutral

(Two mixture must be insoluble in water)

**II) Organic Estimations** **(Any 3)**

- 1) Estimation of acetamide
  - 2) Estimation of basicity (number of COOH groups) of acid
  - 3) Estimation of glucose
  - 4) Estimation of glycine
  - 5) Saponification value of oil
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**T.Y.B.Sc. Chemistry**  
**Sem. -VI** **Course No:- CH-369**  
**Subject: Organic Chemistry Practical.**

**I) Organic Preparations** **(Any 5)**

- 1) Quinone from Hydroquinone
- 2) Preparation of Sudan
- 3) Dibenzal propanone from Benzaldehyde and Acetone using LiOH.H<sub>2</sub>O.
- 4) β-naphthymethyl ether from β-naphthol
- 5) Meta nitro aniline from m-dinitro benzene
- 6) Para iodo nitrobenzene from para nitro aniline
- 7) Glucosazone from glucose
- 8) Acetanilide to para nitroacetanilide

**II) Preparation of Derivatives** **(Any 5)**

- 1) Oxime derivative of aldehydes or Ketones
  - 2) Aryloxyacetic acid of Phenol
  - 3) 2, 4 DNP derivative of aldehydes or Ketones
  - 4) Acetyl derivative of Aniline by using Zn dust / Acetic acid
  - 5) Benzylidene devative of primary aromatic amine
  - 6) Annilide derivative of acid
  - 7) Amide derivative of acid
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## Reference Books

- 1) Practical organic chemistry – A I Vogel
  - 2) Practical organic chemistry – O P Agarwal
  - 3) University practical chemistry – P C Kamboj
  - 4) Comprehensive practical organic chemistry – V K Ahluwalia and Renu Aggarwal (university press, 2016)
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## STRUCTURE OF EXTERNAL PRACTICAL EXAMINATION

**Time allowed – 3 Hours**

**Marks – 60**

### Semester V (CH-359)

- Q.1 Separation of Binary Mixtures and Qualitative Analysis of anyone Compound. 50 Marks**
- OR**
- Organic Estimations**
- Q.2 Oral 10 Marks**

### Semester VI (CH-369)

- Q.1 Organic Preparation / Preparation of derivative 40 Marks**
- Q.2 Oral 10 Marks**
- Q.3 Industrial Tour Report 10Marks**

## Instructions

- 1) In case of binary mixture experiment, examinee should identify type of mixture and should separate the mixture. After separation, examiner should ask the examinee to analyse any one compound of the mixture.
  - 2) In case of organic preparation and preparation of derivative, product should be purified by recrystallisation.
  - 3) Industrial tour is necessary for every student.
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## STRUCTURE OF INTERNAL PRACTICAL EXAMINATION

**Time allowed – 3 Hours**

**Marks – 40**

**Q.1 Any one experiment 30 Marks**

**Q.2 Journal 10 marks**

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**Equivalent courses for TYBSc Chemistry:**

<b>Semester</b>	<b>Course Title (Old)</b>	<b>Semester</b>	<b>Course Title (New)</b>
V	CH-351: Physical Chemistry	V	CH-351: Physical Chemistry
	CH-352: Inorganic Chemistry		CH-352: Inorganic Chemistry
	CH-353: Organic Chemistry		CH-353: Organic Chemistry
	CH-354: Analytical Chemistry		CH-354: Analytical Chemistry
	CH-355: Industrial Chemistry		CH-355: Industrial Chemistry
	CH-356-A: Biochemistry <b>or</b> CH-356-B: Environmental Chemistry		CH-356-A: Biochemistry <b>or</b> CH-366-B: Environmental Chemistry
VI	CH-361: Physical Chemistry	VI	CH-361: Physical Chemistry
	CH-362: Inorganic Chemistry		CH-362: Inorganic Chemistry
	CH-363: Organic Chemistry		CH-363: Organic Chemistry
	CH-364: Analytical Chemistry		CH-364: Analytical Chemistry
	CH-365: Industrial Chemistry		CH-365: Industrial Chemistry
	CH-366-C: Polymer Chemistry <b>or</b> CH-366-D: Chemistry in Every Day Life		CH-366-C: Polymer Chemistry <b>or</b> CH-366-D: Chemistry in Every Day Life
	CH-307: Physical Chemistry Practical(Annual)	CH-357 & CH-367: Physical Chemistry Practical	
	CH-308: Inorganic Chemistry Practical(Annual)	CH-358 & CH-368: Inorganic Chemistry Practical	
	CH-309: Organic Chemistry Practical(Annual)	CH-359 & CH-369: Organic Chemistry Practical	

## **Job opportunities for B.Sc. (Chemistry) students**

- The course helps the students in improving their diverse skills in various areas such as laboratory skills, numerical and computing skills, ability to approach to the problems both analytically and logically, time management skills, etc.
- As a Chemist in the Sugar, Pharmaceutical, Chemical, Soap, Detergent, Surfactant, Cement, Fermentation, Textile Dyeing and Printing, Rubber, Petroleum, Pesticide, Food industries.
- As a Chemist in Municipal Corporation, Water treatment plant.
- For Research and Development department of Pharmaceutical, Chemical, Soap, Detergent, Surfactant, Cement, Fermentation, Textile Dyeing and Printing, Rubber, Petroleum, Pesticide, Food, Plastic, Ceramic, Perfumery, Agrochemical industries.
- In the Q.C. department of pharmaceutical, chemical, soap, detergent, surfactant, cement, fermentation, dye, rubber, petroleum and pesticides industries.
- In the Q.A. Executive in Pharmaceutical, Chemical, Soap, Detergent, Surfactant, Cement, Fermentation, Textile Dyeing and Printing, Rubber, Petroleum, Pesticide, Food industries.
- In the Production section and plant operator in Pharmaceutical, Chemical, Soap, Detergent, Surfactant, Cement, Fermentation, Textile Dyeing and Printing, Paper Rubber, Petroleum, Pesticide, Food industries.
- As an analyst in synthetic labs, Forensic Science Department, etc.
- As a Marketing Representative (M.R.) for the Pharmaceutical, Chemical, Soap, Detergent, Surfactant, Cement, Fermentation, Textile Dyeing and Printing, Paper, Rubber, Petroleum, Pesticide, Food products.
- As a Analytical Chemist, Biomedical Chemist, Chemical Engineering Assistant, Industrial Research Scientist, Lab Chemist, Materials Technologist, Production Chemist, Production Officer, Quality Controller, R&D Chemist, Research & Development, Safety Health And Environment Specialist, Teacher.