



TRIPURA UNIVERSITY

**(A Central University)
Suryamaninagar-799022**

Syllabus

OF

Chemistry

Semester – VI

2014

B.Sc. Pass, Semester – VI
Subject – Chemistry
Paper – Project
Full Marks: 100

In the final semester (vi), students have to carry out their project work under the guidance of a faculty member. The area of the work is to be decided by the faculty member. Upon completion of the project work students have to submit the work in the form of a dissertation followed by oral presentation.

RECOMMENDED BOOKS

Organic Chemistry(Pass):

1. Organic Chemistry - I.L. Finar, Vol. I, 6th Edn. ELBS
2. Advanced Organic Chemistry - B.S. Bahl & A. Bahl, S. Chand
3. Advanced Organic Chemistry, Reactions & Mechanism – Mukherjee & Singh
4. Organic Chemistry - R.T. Morrison & R.N. Boyd, Prentice – Hall.
5. Stereochemistry of Carbon Compounds - D. Nashipuri, John Wiley
6. Basic Stereochemistry of Organic Molecules - Subrata Sengupta, Book Syndicate
7. Advanced Organic Chemistry - N.K. Visnoi
8. Jaiba Rasayan - Subrata Sengupta, Book Syndicate.

Inorganic Chemistry(Pass):

1. Inorganic Chemistry Vol. I & II - R.L. Datta
2. Advanced Inorganic Chemistry Vol. I & II - Prakash, Tuli, Basu and Madan, S. Chand
3. Fundamental concepts of Inorganic Chemistry - A.K. Das
4. General and Inorganic Chemistry - R. P. Sarkar, Central...
5. General and inorganic chemistry - S.N. Podder & S.P. Ghosh

Physical Chemistry(Pass):

1. Bhouta Rasayan - N.N.Kundu, Vol. I & II
2. Essentials of Physical Chemistry - Bahl & Tuli, S. Chand
3. Bhouta Rasayan - P.C. Rakshit & P.R. Gupta, Sarat Book House.
4. Elementary Physical Chemistry - S.R. Palit, Syndicate Pvt. Ltd.

Practical Chemistry(Pass):

1. A Manual of Practical Chemistry (Vol. I & II) - R.C. Bhattacharjee
2. University hand book of undergraduate chemistry experiments – G.N. Mukherjee, University of Calcutta.
3. College practical chemistry - Ahluwalia, Dingra & Gulati.
4. Bebaharic Rasayan, Podder & Ghosh

Some Important Text Books

Inorganic Chemistry

- 1) Advanced Inorganic Chemistry – Satyaprakash, Basu, Tuli
- 2) Inorganic Chemistry – Puri, Sharma and Kalia
- 3) Inorganic Chemistry – J.D. Lee

Ref. Books:

- 1) General and Inorganic Chemistry (Part-I & II) R. Sarkar
- 2) Basic Inorganic chemistry – Cotton and Wilkinson
- 3) Inorganic Chemistry – Huhey

B.Sc. Honours, Semester – VI

Subject: Chemistry

Paper – H7,

Marks: 100 (80+20)

Time: 3 hours

Physical Chemistry (Marks:40) 60 Lectures

Unit-I: (Marks:20) 30 Lectures

A. ELECTROCHEMISTRY-II (8 Lectures)

Electromotive force: Measurement of e.m.f., Weston-Cadmium cell, types of reversible electrodes, e.m.f of reversible cells, Nernst equation, single electrode potentials, sign convention of e.m.f. a cell, reference electrode – Hydrogen electrode, calomel electrode, quinhydrone electrodes, standard electrode potential, electrochemical series, setting up of simple cells, cell reaction, application of e.m.f. measurements – determination of ionic activity, equilibrium constant, potentiometric titration, elementary ideas of polarization and over voltage- Tafel equation (no derivation), successive anodic and cathodic processes, Lead and alkali accumulators. **Concentration cells:** Cells with and without transference, liquid junction potential, corrosion- types of corrosion, theory of corrosion and methods for combating corrosion.

B. Surface properties (8 Lectures)

Adsorption: Absorption vis-à-vis adsorption; types of adsorption; theories of adsorption; Freundlich, Langmuir and Gibb's adsorption isotherms – their derivations; BET equation; determination of surface area of adsorbates ;application adsorption phenomenon in nature and industry.

Catalysis: Classification; criteria for a good catalyst; catalyst promoters and catalyst poisons; theories of catalysis; application of catalyst in the manufacture of ammonia; nitric acid and sulphuric acid; acid base catalysis and enzyme catalysis.

Colloids: Definition, classification, preparation and purification of colloids, properties of colloids – physical, mechanical (Brownian motion), optical (Tyndal effect), electrical (Zeta potential) properties, stability and protective action of colloids – Gold number; Hurdy – Schulze rule, coagulation, peptisation, salting out, mechanism of functioning of soap and detergents, micelle formation; critical micelles concentration (CMC), emulsions, application of colloids – determination of Avagadro's number from Perrin distribution equation and Einstein diffusion equation. Introduction of Nano Particles & Applications.

C. Macromolecules:

(8 Lectures)

Definition, types of macromolecules, degree of polymerization, molar mass, number-average and weight-average molar mass, distribution of molar mass, determination of molar mass by viscometry; osmometry; light-scattering; ultra-centrifuge and diffusion methods. Types of polymerization reactions – mechanism – kinetics of polymerization reactions; initiators-types functions. Conformation and configuration of macromolecules in solution. Crystallinity of macromolecules–factors influencing crystallinity; experimental determination of crystallinity of polymers. Properties of macromolecules, their uses.

D. Photochemistry:

(6 Lectures)

Interaction of radiation with matter, difference between dark (thermal) and photochemical reactions; elementary ideas of phosphorescence, fluorescence, luminescence; laws of photochemistry – Grothus – Draper law, Stark – Einstein law, Lambert's law, Beer's law, Lambert – Beer's law, quantum yield and quantum efficiency; photochemical equilibrium; photosensitized reactions ; photosynthesis and photochemistry of air and air pollution;

UNIT – II: (20 Marks)

(30 Lectures)

A. Atomic & Molecular Spectra:

(10 Lectures)

Electromagnetic radiation – Interaction of matter with electromagnetic radiation, different forms of energy viz. translational, electronic, vibrational, rotational energy in molecules, Born – Oppenheimer Approximation, types of spectra – absorption and emission spectra, atomic or line spectra and molecular or band spectra.

Rotational Spectra - diatomic molecules, energy levels of a rigid rotor, selection rules.

Vibrational Spectra: Hook's law, expression for vibrational energy in terms of quantum number, anharmonicity, fundamental modes of vibration, overtones, Morse curves force constant, selection rules, bond energy, bond distance, isotope effect, vibrational frequency of different functional groups.

Raman Spectra: Origin, Stokes lines and anti-stokes lines, explanation of Raman spectra based on Einstein theory, Raman frequency, selection rules, application of Raman spectra.

Molecular Electronic Spectra: Potential energy (PE) curves, bonding and anti-bonding molecular orbitals, Frank-Condon Principle, selection rules, qualitative description of sigma pi and non-bonding (n) molecular orbitals, their energy levels and respective transitions.

B. Quantum Mechanics:

(10 Lectures)

- i) **Elementary Quantum Mechanics:** Black body radiation, Photo-electric effect, Bohr model of hydrogen atom (no derivation) and its defects, Compton effect, de Broglie hypothesis, Heisenberg Uncertainty Principle, operators and observable, Hamiltonian operator; Schrodinger wave equation and its importance; interpretation of wave function.
- ii) **Molecular Orbital Theory(MOT):** Criteria for forming molecular orbitals (MO) from atomic orbitals (AO), construction of MOs using LCAO – hydrogen molecular ion; physical picture of bonding and anti-bonding wave functions; concept of σ , σ^* , π , π^* orbitals and their characteristics; hybrid orbitals – sp , sp^2 , sp^3 , sp^3d , d^2sp^3 hybridization, calculation of coefficient of AOs used in these hybrid orbitals, comparison (in brief) of MOT and VBT (valence bond theory); Geometry of simple molecules like H_2O , NH_3 , CH_4 , H_2O_2 , BF_3 in terms of molecular orbitals.

D. Statistical thermodynamics:

(10 Lectures)

Limitation of classical thermodynamics, brief resume of the concept of distribution of energy; thermodynamic probability and entropy; Boltzmann distribution law (with derivation), partition function and its significance, translational partition function of ideal monoatomic gas (with derivation). Preliminaries of Maxwell-Boltzmann statistics, Bose-Einstein Statistics and Fermi-Dirac statistics, Thermodynamic functions in terms of partition functions; Sackur Tetrode equation (with derivation), heat capacity of solids.

Industrial and Green Chemistry (Marks:40)

60 Lectures

Industrial Chemistry: Inorganic Based:

Marks; 10

Water : Modern methods of water treatment and purification.

Fertilisers : Different types of N and P fertilizers, manufacture of ammonia, ammonium nitrate, urea phosphates and superphosphates. Nitrogen fixation by plants.

Glass : Various types of glass fibers, optical glass, glazing and vitrification, glass ceramics.

Cement : Various types of cement, their composition and manufacture. Portland cement, setting of cement.

Paints : Constituents of different paints, Role of binder and solvent, Lead and Zinc containing paints. Paints of common use.

Metals and Alloys : General procedure of extraction of metals. Manufacture, properties, composition and uses of important alloys. Manufacture of steel and stainless steel. Galvanization, rusting and corrosion.

Chemical Toxicology:

Metal poisoning due to Pb, Cd and Hg, hazard from radioactive fallout. Definition and principles of green chemistry.

Industrial Chemistry – Organic Based

(Marks 10)

Coal : Fisher-Tropsch process. Chemicals from coal.

Petroleum : Manufacture and industrial reactions of ethane, propane, butadiene, acetylene and xylene. Synthesis of methanol from natural gas. Cracking of petroleum, knocking and octane number. Synthetic petrol, LPG and CNG. Biodiesel.

Oils, Fats and Detergents : Catalytic hydrogenation of vegetable oil and fat for production of soap, synthesis of detergents. Principles of cleansing action.

Polymers :

- a. Synthetic rubber (including principle of cross-linking and vulcanization), b. Plastics
- c. Resins, d. Silicones

Enzymes in industries : Production of alcohol by fermentation of starch and sugar (reaction conditions, nature of enzymes used, structural transformation during reaction).

Preparation and use of cellulose.

Green Chemistry:

(Marks 20)

Definition, Principles of green chemistry, atom economy, environmental factor; Green synthesis (acetylation of primary amines, cycloaddition, benzyl-benzilic acid rearrangement reaction, thiamine catalyzed benzoin condensation, bromination of acetanilide), reaction conditions, solvent free reaction (three components synthesis of dihydropyrimidinone, ammonium formate mediated Knoevenagel reaction), sonochemical reaction (Ulman coupling), Use of green reagents (tetrabutyl ammonium tribromide, green oxidizing agents), green catalysts, and green solvents.

B.Sc. Honours, Semester – VI
Subject: Chemistry (Practical)
Paper – H8,
Marks:100 (80+20)

A. Physical Chemistry Practical (50 Marks);	Time: 6 hours
Internal Assessment :	10 Marks
Experiment:	30 Marks
Laboratory Note Books :	05 Marks
Viva-voce :	05 Marks

List of experiments to be performed:

1. Determination of the concentration of a supplied solution by surface tension method using stalagmometer.
2. Determination of the concentration of a supplied solution by viscosity method using Ostwald viscometer
3. Determination of partition coefficient of ammonia between water and an organic solvent.
4. Potentiometric titration of Fe^{2+} with dichromate and determination of $E^0 \text{Fe}^{3+}/\text{Fe}^{2+}$ and of concentration of unknown iron solution.
5. Verification of Freundlich's adsorption isotherm by study of the adsorption of acetic acid solution on activated charcoal and determination of concentration of acetic acid of unknown strength.
6. Determination of concentration of mixed acid by standard 0.1(N) NaOH conductometrically.
7. Verification of Beer's law and determination of concentration of supplied dichromate solution.
8. Determination of the rate constant of acid catalyzed hydrolysis of ethyl acetate ester at room temperature.
9. Determination of rate constant of Iodination of Acetone.
10. Determination of concentration of supplied BaCl_2 by standard $\text{Na}_2\text{SO}_4/\text{K}_2\text{SO}_4$ conductometrically.

B. Industrial and Green Chemistry Practical (40 Marks)
Time: 4 hours

Industrial Chemistry Practicals:

Marks:20

1. [4+2] Cycloaddition reaction (Diels-Alder reaction between furan and maleic acid using water as solvent)
2. Base catalyzed aldol condensation (Synthesis of dibenzalpropanone).
3. Separation of reactions products by Column chromatography.

Green Chemistry Practicals:**Marks:20**

1. Preparation of Manganese(III) acetylacetonate by using KMnO_4 and acetylacetone.
2. Preparation of Iron(III) acetylacetonate by using FeCl_3 , KOH and acetylacetone.
3. Acetylation of primary amine by using Aniline, Glacial acetic acid and Zinc dust catalyst.

RECOMMENDED BOOKS**Organic Chemistry(Honours):**

1. Organic Chemistry - I.L. Finar, Vol. I, 6th Edn. ELBS
2. Advanced Organic Chemistry - J. March
3. A guide to Organic Reaction Mechanism - P. Sykes, Orient Longman.
4. Organic Chemistry - R.T. Morrison & R.N. Boyd, Prentice – Hall.
5. Fundamentals of Organic Chemistry - Solomon
6. Organic Chemistry - Wade (Jr)
7. Stereochemistry of Carbon Compounds - E. Eliel.
8. Stereochemistry of Carbon Compounds - D. Nasipuri, John Wiley
9. Organic Spectroscopy - Y.R. Sharma
10. Organic Spectroscopy - W. Kemp
11. Organic Spectroscopy - P.S. Kalshi
12. Organic Reaction Mechanism - P.S. Kalsi
13. Organic Reaction mechanism - R.K. Bansal
14. Advanced Organic Organic hemistry - N.K. Visnoi
15. Advanced Practical Chemistry - R. Mukhopadhaya & P. Chatterjee.
16. Advanced Organic Chemistry – Miller
17. Organic Chemistry - Loudon

Inorganic Chemistry(Honours):

1. Basic Inorganic Chemistry - F.A. Cotton & G. Wilkinson & Gous
2. New concise Inorganic Chemistry - J.D. Lee
3. Inorganic Chemistry - Huheey, Keitar & Medhi
4. Selected topics in inorganic chemistry – Mallick, Tuli, Madan
5. Inorganic Chemistry - Sharpe
6. Inorganic Chemistry - W.W. Porterfield
7. Introduction to Modern Inorganic Chemistry - Mackay & Mackay
8. Elements of Bioinorganic Chemistry - G.N. Nukherjee & A. Das
9. Fundamental Concepts of Inorganic Chemistry-A.K. Das

Physical Chemistry(Honours):

1. Physical Chemistry - P.C. Rakshit
2. Physical Chemistry - P.W. Atkins
3. Physical Chemistry - G. W. Castellan
4. Physical Chemistry - S. Glasstone
5. Physical Chemistry - Marron & Pruton/ Marron & Lando
6. Molecular Spectroscopy - Barrow
7. Molecular Spectroscopy - Banwell
8. Introductory Quantum Chemistry – A.K. Chandra, TATA McGraw Hill.
9. Quantum Chemistry – D.A. Mcquarrie, Viva Books, Pvt. Ltd.
10. Atomic Structure and Chemical Bonds – Manas Chandra
12. Programming in Basic –S. Gottfried
13. Programming in Basic –Balaguruswamy.
14. Statistical Methods – N.G. Das
15. J.O'M, Bockris and A.K.N. Reddy, *Modern Electrochemistry*, Vol.1&2 (1998). Plenum Press, New York.
16. P.W. Atkins and R.S.Friedman, *Molecular Quantum Mechanics*, 3rd Ed.(1997) Oxford University Press.
17. K.J.Laidler, *Chemical Kinetics*, 3rd Ed.(1967), Harper and Row Publishers, New York
18. H.Eyring, S.H. Lin and S.M.Lin, *Chemical Kinetics*, (1999)Jhon Willey, New York.

Practical Chemistry(Honours):

1. Vogel's Qualitative Inorganic Analysis - G. Svehla
2. Hand Book of Organic Analysis-qualitative & quantitative-H.T. Clarke
3. Qualitative Analysis - V. Alexeyev
4. University Hand Book of Undergraduate Chemistry Experiments, University of Calcutta-G.N. Mukherjee (ed)
5. College Practical Chemistry-V.K. Ahluwalia, S. Dhingra & A. Gulati
6. Text Book of Practical Organic Chemistry-A.I. Vogel
7. Vogels Text Book of Practical Organic Chemistry

Industrial Chemistry(Honours):

1. Industrial Chemistry, B.K. Sharma