St. Xavier's College – Autonomous Mumbai

Syllabus for 6th Semester Course in Chemistry (June 2014 onwards)

Contents: Theory Syllabus for Courses:

S.CHE.6.01 - **GENERAL PHYSICAL CHEMISTRY**

S.CHE.6.02 - **SOLID STATE, SOLUTION AND MEDICINAL CHEMISTRY**

S.CHE.6.03 - **SPECTROMETRIC IDENTIFICATION AND SYNTHETIC CHEMISTRY**

S.CHE.6.04 - **INSTRUMENTAL METHODS OF ANALYSIS**

S.CHE.6.AC – **DRUGS AND COLOUR CHEMISTRY**

Practical Course Syllabus for S.CHE 6 PR AND S.CHE 6.AC. PR

SYLLABUS UNDER AUTONOMY
CHEMISTRY

SEMESTER 6 **Course: No. S.CHE.6.01**

GENERAL PHYSICAL CHEMISTRY **60 Lectures**

Learning objectives:

a) To encourage students to learn, integrate & analyze the concepts relevant to physical chemistry at the graduation level.

b) To learn the concept of concentration cells & its applications in determination of several constants & parameters.

c) To understand & appreciate the utility of electrochemistry in providing renewable sources of energy.

d) To study various aspects of chemical kinetics, catalysis, surface equilibria & phase equilibria.

e) To learn the utility of several colligative properties in determination of molecular weight of several solutes & state of solutes that are dissolved to form solutions using van't Hoff factor.

UNIT – I :

1.1. Electrochemical cells **15 L**

1.1.1 Lewis concept of Activity and Activity coefficient, Mean ionic activity and mean ionic activity coefficient $\gamma_{\pm}$ of an electrolyte. Variation of mean ionic activity coefficient with concentration, expression for activities of electrolytes of different valence type, ionic strength of a solution, Debye-Hückel limiting law (derivation not expected)

1.1.2 Classification of cells: (i) chemical cells without transference (ii) Concentration cells with and without transference (derivations of expression for concentration cell EMF are expected). Origin of liquid-liquid junction potential, and its elimination using a salt bridge.

1.1.3 Applications of EMF .measurements in the determination of (i) Mean ionic activity coefficient of an electrolyte (ii) pH of a solution using quinhydrone and glass electrode. (iii) solubility and solubility product of sparingly soluble salts using chemical cell and concentration cell method (iv) determination of liquid-liquid junction potential (v) determination of ionic product of water using chemical cell and concentration cell method.

UNIT II :

2.1 Applied Electrochemistry **7 L**

2.1.1 Polarization, concentration polarization and its elimination,

2.1.2 Decomposition potential, experimental determination of decomposition potential, factors affecting decomposition potential (nature of electrolyte, nature of electrodes and temperature, overvoltage, experimental determination of over-voltage, Tafel's theory

and Tafel's equation for hydrogen overvoltage, simultaneous deposition of metals,

2.1.3 Electroplating ---objectives and process

2.2 Renewable Energy Sources **8 L**

2.2.1 Batteries – Secondary cells, Lithium Ion Cell.

2.2.2 Fuel Cells--Choice of fuel and oxidant, thermodynamic and kinetic aspect of electrochemical energy transformation, efficiency of fuel cells , Bacon's H_2 and O_2 fuel cell.

2.2.3 Solar cells solar energy, photovoltaic effect, semiconductors as solar energy converters , Silicon solar cell.

2.2.4 Biomass energy from biomass and its sources, conversion of biomass into energy by alcohol fermentation and anaerobic digestion method.

2.2.5 Hydrogen: fuel of the future Production of hydrogen by direct electrolysis of water and. biomass gasification, advantages of hydrogen as a universal energy medium.

UNIT – III :

3.1 Colloids **6 L**

3.1.1 Introduction to colloidal state of matter.

3.1.**2.** Origin of charge on colloidal particles. Concept of electrical double layer, zeta potential, Helmholtz and Stern mode, Electrokinetic phenomena, (i). Electrophoresis (ii). Electro-osmosis (iii) Streaming potential (iv) Sedimentation potential

3.1.3 Colloidal electrolytes.

3.1.4 Donnan Membrane Equilibrium.

3.1.5 Surfactants, micelle formation, applications of surfactants in detergents, food industry, in pesticide formulations.

3.2. Surface Chemistry and Catalysis **9 L**

3.2.1 Adsorption Physical and Chemical Adsorption, types of adsorption isotherms, Langmuir's adsorption isotherm, (Postulates and derivation expected). B.E.T. equation for multilayer adsorption, (derivation not expected, significance of the terms involved in the equation is expected.), determination of surface area of an adsorbent using B.E.T. equation.

3.2.2 Catalysis Homogeneous and heterogeneous catalysis, catalytic activity and selectivity, promoters, inhibitors, catalyst poisoning and deactivation, TON and TOF (introduction only)

3.2.3 Acid-Base catalysis, mechanism and kinetics of acid-base catalyzed reactions, effect of pH on acid-base catalyzed reactions. Mechanics and kinetics of enzyme catalyzed reaction (Michaelis-Menten equation).

3.2.4 Kinetics of surface reactions, heterogeneous catalysis)

i) unimolecular surface reactions,

ii) bimolecular surface reaction (relevant rate expressions expected)

UNIT IV

4.1. Chemical Kinetics **6 L**

4.1.1 Collision theory of reaction rates. Application of collision theory to (i) Bimolecular reaction (ii) Unimolecular reaction. (Lindemann theory, derivation expected). Merits and drawbacks of collision theory. Activated complex theory of bimolecular reactions, Expression for rate constant of bimolecular reaction (derivation not Expected), comparison of collision theory and activated complex theory.

4.1.2 Classification of reactions as Slow, Fast and Ultra-fast. Study of kinetics of fast reactions by Stop flow method.

4.2. Colligative Properties of Dilute Solutions **5 L**

4.2.1 Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure.

4.2.2 Elevation in boiling point of a solution, thermodynamic derivation relating elevation in the boiling point of a solution and the molar mass of the non-volatile solute.

4.2.3 Depression in freezing point of a solution, thermodynamic derivation relating the depression in the freezing point of a solution and the molar mass of the non-volatile solute.

4.2.4 Abnormal molar masses of solutes and van't Hoff factor (calculation of Degree of Association and Degree of Dissociation.)

4.3. Phase Rule **4 L**

4.3.1 Gibb's phase rule and terms involved in the equation.

4.3.2 Application of phase rule to TWO component systems, condensed systems, condensed phase rule, eutectic systems (Lead-Silver system), desilverisation of lead.

4.3.3 Introduction to THREE component systems, explanation of the phase diagram for three liquids forming one immiscible pair.

Evaluation: One of the two CIA evaluations will be an MCQ quiz

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SEMESTER 6 **Course No. S.CHE 6.02**

SOLID STATE, SOLUTION AND MEDICINAL CHEMISTRY **60 Lectures**

Learning Objectives:

1. To encourage students to analyze and integrate concepts relevant graduate level Inorganic chemistry
2. To understand structure of crystalline solids and defects that exists.
3. To expose students to concepts in Superconductivity..
4. To study aqueous and non-aqueous solvents
5. To introduce students to applications in Medicinal Chemistry

UNIT I : SOLID STATE CHEMISTRY

1.1 Structures of solids 10 L

1.1.1 Importance of solid state chemistry

1.1.2 Crystals: size and shape of crystals, interfacial angles in crystals, symmetry and elements of symmetry in crystals.

1.1.3 Designation of planes in crystals: Miller indices.

1.1.4 Classification of solids on the basis of bonding

1.1.5 Explanation of terms viz. crystal lattice, lattice points, unit cells, and lattice constants.

1.1.6 Closest packing of rigid spheres (hcp, ccp) packing density in simple cubic, bcc, fcc and hcp lattices (numerical problems expected).

1.1.7 Structures of metallic solids

1.1.8 Tetrahedral and octahedral interstitial voids in ccp lattice, tetrahedral holes, limiting radius ratios for different coordination numbers and their significance, calculation of ionic radii and limiting radius ratio for co-ordination number 4.

1.1.9 Structures of sodium chloride, cesium chloride and fluorite.

1.1.10 Structure of zinc chloride and failure of radius ratio rule (directional bonding), structure of wurtzite.

1.1.11 Defects in crystal structures; Effects of Schottky and Frenkel defects.

1.2 Superconductivity 5 L

1.2.1 Superconductivity, Meissner effect

1.2.2 Different superconducting materials viz., conventional superconductors, organic superconductors, alkali metal fullerides (A_3C_{60}) and high temperature superconductors.

Self Study: Applications of superconducting materials.

UNIT II

2.1 Nanomaterials 5 L

2.1.1 Introduction and Importance of nanomaterials

2.1.2 Properties (Comparison between bulk and nanomaterials) : (i) Optical properties, (ii) Electrical conductivity, (iii) Melting points, and (iv) Mechanical properties.

2.1.3 Forms of nanomaterials : nanofilms, nanolayers, nanotubes, nanowires and nanoparticles

2.1.4 Methods of preparation

2.2 Organometallic Chemistry **10 L**

2.2.1 Organometallic compounds of main group elements:

2.2.1.1 Introduction, general synthetic methods: i) Oxidative addition, ii) Metal-Metal exchange (Transmetallation), iii) Carbanion- Halide exchange (Metathesis), iv) Metal-Hydrogen exchange, v) Methylene insertion reactions.

2.2.1.2 Chemical reactions: i) Reactions with oxygen and halogens, ii) Alkylation and arylation reactions, iii) Reactions with protic reagents, iv) Redistribution reactions, v) Complex formation reactions.

2.2.2 Metallocenes: Synthesis, structure and bonding, reactions and applications of Ferrocene.

2.2.3 Bonding in Rhenium and Molybdenum halide complexes.

2.2.4 Catalysis with reference to: i) Hydrogenation of alkenes (Wilkinson catalyst), ii) Hydroformylation reaction (Roelen catalyst)

UNIT III : SOLUTION CHEMISTRY **15 L**

3.1 Acid-base chemistry in aqueous medium

3.1.1 Acidity of mono- and polyatomic cations.

3.1.2 Basicity of mono- and polyatomic anions (Latimer equation and predominance diagrams).

3.1.3 Measure of acidity and basicity : concepts based on electronegativity and thermodynamic aspects (Drago-Wayland equation).

3.3 Chemistry in Non-aqueous solvents

3.2.1 Classification of solvents and importance of non-aqueous solvents.

3.2.2 Characteristics of study of liquid ammonia, dinitrogentetraoxide and acetic acid as non-aqueous solvents with respect to (i) acid base reactions (ii) redox reactions.

UNIT IV:
MEDICINAL CHEMISTRY AND INORGANIC PHARMACEUTICALS **15 L**

4.1 Bioligands in biocoordination chemistry

4.1.1 Biological functions of biometals and role of metal ions in basic biological reactions

4.1.2 Dependence of biological growth on the concentration of essential and toxic metals

Diseases due to metal deficiency and its treatment (iron, zinc)

4.1.3 Metal ion toxicity
Toxic effects of metals (2 examples)

4.1.4 Detoxification of metal ion induced toxicity and clean up of toxic metals by plants

4.1.5 Thermodynamic and pharmacokinetic properties of chelating drugs (examples)
Limitations of chelation therapy

4.1.6 Radioisotopes in medicine

4.2 Inorganic Pharmaceuticals

4.2.1 Gastrointestinal agents viz. (i) antacids (aluminium hydroxide, milk of magnesia, sodium bicarbonate and (ii) cathartics (magnesium sulphate and sodium phosphate).

4.2.2 Topical agents viz. (i) protectives and adsorbents (talc, calamine), (ii) antimicrobial agents (potassium permanganate, tincture iodine, boric acid) and astringents (alum). Introduction to Platins.

CIA: Assignment

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SEMESTER 6 **Course: No. S.CHE.6.03**

SPECTROMETRIC IDENTIFICATION AND SYNTHETIC CHEMISTRY 60 Lectures

UNIT I : Spectroscopy 15 L

1.1. Introduction: Electromagnetic spectrum, units of wavelength and frequency.

1.2 UV-Visible Spectroscopy: Basic theory, solvents, nature of UV-VIS spectrum, concept of – chromophore, auxochrome, bathochromic shift, hypsochromic shift, hyperchromic effect and hypochromic effect. Chromophore-chromophore and chromophore-auxochrome interactions.

1.3 IR Spectroscopy: Basic theory, nature of IR spectrum, selection rule, fingerprint region.

1.4 PMR Spectroscopy: Basic theory of NMR, nature of PMR spectrum, chemical shift (δ unit), standard for PMR and solvents used. Factors affecting chemical shift: (**a**) inductive effect (**b**) anisotropic effect (with reference to C=C, C≡C, C=O and benzene ring). Spin-spin coupling and coupling constant. Proton exchange – Application of deuterium exchange. Application of PMR in structure determination

1.5 Spectral characteristics of the following classes of organic compounds, with respect to UV-VIS, IR, PMR (broad regions characteristic of different groups).:

(**a**) alkanes (**b**) alkenes and polyenes (**c**) alkynes (**d**) haloalkanes (**e**) alcohols (**f**) carbonyl compounds (**g**) ethers (**h**) carboxylic acids (**i**) esters (**j**) amines (**k**) amides (**l**) benzene and monosubstituted benzenes.

1.6 Mass Spectrometry: Basic theory. Nature of mass spectrum. General rules of fragmentation. Importance of: molecular ion peak, isotopic peaks, base peak. Nitrogen rule. Illustrative fragmentation of alkanes and aliphatic carbonyl compounds (Mclafferty rearrangement not expected).

1.7 Problems on structure elucidation of simple organic compounds using individual or a combination of spectra mentioned above. (index of hydrogen deficiency should be the first step in solving the problems).

UNIT II: Name Reactions and Molecular Rearrangements 15 L

2.1 Mechanism of the following reactions with examples and synthetic applications:
(**a**) Claisen Condensation (**b**) Michael Reaction (**c**) Oppenauer Oxidation (d) Stobbe
Condensation (**e**) Wolff-Kishner Reduction.

2.2 Mechanism of rearrangements with examples and stereochemistry wherever applicable:

(a) Pinacol-Pinacolone (b) Wolff (c) Beckmann (d) Hofmann (e) Baeyer-Villiger Oxidation.

UNIT III : Synthetic Chemistry **15 L**

3.1 Retro Synthetic Analysis **8 L**

3.1.1 Introduction: Definitions: (i) Disconnection (ii) Functional Group Interconversion (iii) Reagents (iv) Synthon (v) Synthetic equivalent (vi) Target Molecule.

3.1.2 Introduction to disconnections with respect to some simple molecules.

3.1.3 One Group Disconnections: Disconnection in molecules of alcohols, olefins, ketones.

3.2. Catalysts and Reagents **7 L**

Study of the following catalysts and reagents with respect to functional group transformations and selectivity (no mechanism).

3.2.1. Catalysts: Catalysts for hydrogenation: Raney Ni, Pt and PtO_2: C=C, CN, NO_2, aromatic ring; Pd/C: C=C, COCl □ CHO (Rosenmund); Lindlar catalyst: alkynes; Wilkinson's catalyst for stereoselective reduction of olefins.

3.2.2 Reagents : (**a**) $LiAlH_4$ and Red-Al: reduction of CO, COOR, CN, NO_2. (**b**) $NaBH_4$: reduction of CO. (**c**) Diborane: olefins to alcohols through hydroboration, reduction of COOH. (**d**) SeO_2: hydroxylation of allylic and benzylic positions, oxidation of CH_2 alpha to CO to CO. (**e**) *m*CPBA and H_2O_2/ NaOH for epoxidation of enones. (**f**) NBS: allylic and benzylic bromination and bromination of position alpha to CO.

3.2.3 Organolithium compounds: Preparation using alkyl/aryl halides. Reactions with compounds containing acidic hydrogen, alkyl halides, carbonyl compounds, cyanides and CO_2.

Lithium dialkyl cuprates: Preparation and reactions with **aliphatic/ aromatic/ vinylic halides.**

UNIT IV **15 L**

4.1 Polymers **15 L**

4.1.1 Introduction: General idea of monomers, polymers, and polymerization. natural and synthetic polymers. Homopolymers and copolymers. Classification of polymers. Copolymers – alternating, block, random and graft.

4.1.2 Mechanism of free radical addition polymerisation.

4.1.3 Elastomers: Natural and synthetic rubbers. Diene polymerization: 1,2-and 1,4-addition (*cis* and *trans)* polymerization of isoprene. 1,3-Butadiene- styrene copolymer.

4.1.4 Stereochemistry of polymers: Tacticity. Role of Ziegler–Natta catalyst (coordination polymerization) in directing the tacticity in polypropylene (no mechanism).

4.1.5 Preparation and uses of polymers:

(**a**) Addition polymers: (**i**) polyethylene (**ii**) polypropylene (**iii**) PVC (**iv**) polystyrene (**v**) polyacrylonitrile (**vi**) polyvinylalcohol (**vii**) teflon. (**b**) Condensation polymers: (**i**) polyesters (**ii**) polyamides (**iii**) polyurethans (**iv**) phenol-formaldehyde resin (**v**) epoxy resin (**vi**) polycarbonates.

4.1.6 Recyclable polymers: Biodegradable polymers and their uses. Biomedical uses of polymers.

4.1.7 Additives to polymers: Plasticizers, stabilizers and filler

(Students are expected to identify monomers in a given polymer and draw the structure of a polymer from a given set of monomers).

CIA II: Problem solving based on Spectroscopy and Retrosynthesis.

Reference Books:

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SEMESTER 6 **Course: No. S.CHE.6.04**

INSTRUMENTAL METHODS OF ANALYSIS **60 Lectures**

Learning Objectives:

1. To expose students to instrumental techniques involving sophisticated instruments that are commonly used in industry
2. To understand the principles, theory, instrumentation and applications of instrumental methods
3. To understand the need for validation of analytical methods
4. To familiarize students with concept of quality and good laboratory practices

UNIT I: Optical Methods: **15 L**

1.1. UV-Visible spectrophotometry: Instrumentation of single and double beam spectrophotometer. Quantitative analysis: calibration curve method.

1.2. Atomic spectroscopy: Absorption and emission spectra, energy level diagrams, processes involved in atomization. Flame photometry: flame atomizer, types of burners, monochromators and detectors. Atomic absorption spectroscopy: flame and electrothermal atomizer, hollow cathode lamp, construction and working of instruments. Quantitative applications of atomic absorption spectroscopy and flame photometry. Calibration curve method, standard addition method and internal standard method.

1.3. **Turbidimetry and Nephelometry:** scattering of light, effect of concentration, particle size and wavelength on light scattering, instrumentation and applications**.**

UNIT II : Electroanalytical Methods **15 L**

2.1. Potentiometric Titrations: Principles, titration curves and location of equivalence point in acid-base and redox titrations, applications**.**

2.2. D.C. Polarography: Polarizable and nonpolarizable electrodes, basic principles of polarography, polarographic cell, residual current, diffusion current, limiting current, dropping mercury electrode, supporting electrolyte, half wave potential. Derivation of the polarographic wave equation for a reversible reaction, Ilkovic equation, oxygen interference and its removal, polarographic maxima and maxima suppressors, qualitative and quantitative analysis, calibration curve and standard addition method, applications.

{Numerical problems expected]

2.3. Amperometric Titrations: Basic principles, rotating platinum electrode, nature of the titration curves, applications, advantages and limitations.

UNIT III **15 L**

3.1. Chromatographic Methods: **12 L**

3.1.1.Gas chromatography: gas liquid chromatography, basic principles, retention time, retention volume, resolution, peak width, theoretical plates, HETP, instrumentation, columns, detectors, applications.

3.1.2.High performance liquid chromatography: instrumentation, types of stationary phases, types of elution, U.V. and R.I. detector and applications**.**

3.1.3. HPTLC : instrumentation, applications

3.2. Introduction to Radio-analytical Methods **3 L**

3.2.1. Neutron Activation Analysis: theory, technique and applications

UNIT IV **15 L**

4.1 Thermal methods: **4 L**

4.1.1 Thermogravimetric Analysis: basic principles, instrumentation, factors affecting the TG curve, applications.

4.2. Analytical method validation and Total Quality Management: **11 L**

4.2.1. Need for validation of an analytical method

4.2.2 Parameters of method validation.

4.2.3. Total quality management**:** concept of quality, Quality Control, Quality Assurance, Total Quality Management,

4.2.4 ISO series, Good Laboratory Practices.

CIA: Instrumentation, including Schematic diagrams of instruments

Reference Books:

1 **D. A. Skoog, D.M.West, F.J.Holler** Fundamantals of Analytical Chemistry, 8th ed. Philadelphia, Saunders college Publishing, 1996

2 **D. A. Skoog, F.J.Holler, T.A.Nieman,** Principles of Instrumental Analysis, 6th ed. Philadelphia, Saunders college Publishing, 1996

3 **G.D.Christian,** Analytical Chemistry, 6th ed. John Wiley &Sons, Singapore, 2004.

4 **J.G.Dick,** Analytical Chemistry, International Student's Edition, McGraw Hill, Kogakusha Limited, New Delhi, 1973.

5 **R.A.Dey & D.L.Underwood,** Quantitative Analysis, 6th ed. Prentice Hall Of India Pvt. Ltd. New Delhi, 1993.

6 **M.Valcarcel,** Principles Of Analytical Chemistry, Springer International Edition, Berlin, 2000

7 **E..Prichard, & V. Barwick,** Quality Assurance in Analytical Chemistry, Wiley.

8 **S. M. Khopkar,** Basic Concepts of Analytical Chemistry, 3rd ed,New Age International Publishers, 2008

9 **S. M. Khopkar,** Analytical Chemistry Problems and Solutions, New Age International Publishers, 2002

10 **A I Vogel,** Textbook of Quantitative Chemical Analysis, 6th ed, Pearson Education, 2002

11 **Kolthoff and Elving,** Treatise on Analytical Chemistry, Part I Vol 1, Interscience Encyclopedia 1959

12 **J M Miller,** Separation methods in Chemical Analysis, John Wiley, 1975

13 **J A Dean,** Chemical Separation Methods,1969

14 **R.D. Braun,** Introduction to Instrumental methods of Analysis, McGraw Hill, 1987

15 **G R Chatwal and S K Anand** : Instrumental methods of Chemical Analysis, 5th ed, Himalaya Publishing House, 2002

16 **H H Willard, L L Merritt and J A Dean**; Instrumental methods of Analysis, 7th ed CBS Publishers, 1986

17 **A K Srivastava, P C Jain,** Chemical Analysis, an Instrumental Approach 3rd ed , S Chand 1997

18 **G W Ewing,** Instrumental methods of chemical analysis, 5th ed, McGraw Hill, 1976

19 **Ed Newman, N T Crosby, J A Day,** Quality in the Analytical laboratory, Wiley, 2008

20 **Value engineering and quality assurance,** IGNOU School of Management studies,1993

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Semester 6 **Course No: S.CHE.PR.6**

Course 6.01: Physical Chemistry

Non Instrumental Experiments

CHEMICAL KINETICS

1. To determine the energy of activation of acid catalyzed hydrolysis of methyl acetate.
2. To study the effect of ionic strength (KCl) on the reaction between $K_2S_2O_8$ and KI.
3. To study the Saponification of ethyl acetate with sodium hydroxide at equal concentrations of ester and alkali.

PARTITION COEFFICIENT

4. To determine the partition co-efficient of I_2 between CCl_4 and H_2O.
5. To determine the equilibrium constant for the reaction $KI + I_2 = KI_3$ by partition method.

ADSORPTION EXPERIMENT

6. To study the adsorption of acetic acid / oxalic acid on charcoal.

PHASE RULE

7. To determine the phase diagram for the system water, chloroform, acetic acid at room temperature.

SOLUBILITY MEASUREMENT

8. To determine the solubility product of calcium hydroxide at room temperature.

VISCOSITY

9 . To determine the molecular weight of polyvinyl alcohol by viscosity measurements.

10. To determine the size (radius) of a glycerol molecule by viscosity.

Course 6.02 : Inorganic Chemistry

1. Gravimetric Analysis

(i) Estimation of Barium as Barium Chromate in the presence of Iron.
(ii) Estimation of Nickel as Nickel dimethyl glyoxime in the presence of Copper.

2. Inorganic Preparations

(i) 8-(Hydroxyquinolinato) magnesium (II).
(ii) Nickel dimethyl glyoxime.
(iii) Copper chloride dimethyl sulfoxide.

3. Titrimetric analysis

(i) Estimation of Cobalt by EDTA method using Xylenol Orange.
(ii) Estimation of Aluminium using EDTA.

Course 6.03: Organic Chemistry

[A] Organic Separation:

Separation of a binary mixture: Type of mixture, Separation and identification (**microscale**) of both components through systematic scheme of identification.

Types: Solid + Solid, Volatile Liquid + Solid, Volatile Liquid + Nonvolatile Liquid
(No carbohydrates to be given).

Mass of solid: ~ 3-4g, Liquid: Volatile ~ 6-8mL, Nonvolatile ~ 4-6 mL

[B] Preparation of Organic compounds :

Preparation of Organic compound as per the procedure given. Measuring the mass of crude, purification of the separated product by crystallization and recording of the m.p. Quantity of reactant to be given 1g.

1) Benzaldehyde/p-nitrobenzaldehyde Acid (oxidation).
2) Acetanilide p-bromoacetanilide
3) p-Bromoacetanilide to p-bromoaniline
4) m-Dinitrobenzene m-nitroaniline.

Note: A minimum 6 mixtures and 3 preparations should be covered in each semester

Course 6.04: Analytical Chemistry

Instrumental Experiments

1. Determination of amount of Fe (III) present in the given solution by EDTA titration Colorimetrically.
2. Determination of the amount of fluoride in the given solution colorimetrically.
3. Determination of potassium content of a commercial salt sample by flame photometry using Calibration Curve Method.
4. Estimation of sodium in given solution by flame photometry using Standard Addition Method.
5. Estimation of aspirin / Vitamin C content of a tablet by pH metry.
6. Estimation of acetic acid in vinegar using potentiometric titration.
7. Determination of the amount of iron present in the given vitamin tablet colorimetrically.
8. Determination of HCl and H_2SO_4 in a mixture by titration with NaOH and $BaCl_2$.
9. Determination of Glucose by Folin-Wu method colorimetrically.
10. Nephelometric determination of sulphate.

References:

1. Panday, O.P., D. N. Bajpai and S. Giri, *Practical Chemistry*, Delhi: S. Chand, 2008.
2. V.D.Athawale and P. Mathur, Experimental Physical Chemistry: New Age International. 2008

PRACTICAL

❖ CIA AND END SEMESTER PRACTICAL EXAMINATION

Course 6.01: Physical Chemistry – Non –Instrumental experiment
Course 6.02: Inorganic Chemistry – Gravimetric analysis
Course 6.03: Organic Chemistry – Separation and Identification of liquid-liquid and liquid-Solid mixture.
Preparation of Organic compounds
Course 6.04: Analytical Chemistry – Instrumental Experiment.

Journal: 5 marks per course.

CIA: 15 marks per course.

Duration: 4 periods to be conducted during regular practicals by the Faculty-in- charge.

One or more practical skills will be tested in the CIA.

End Semester Examination: 30 marks per course. This includes a 5 mark viva-voce based on the theory behind all the experiments conducted per course.

There will be an External Examiner and an Internal Examiner responsible for two courses each.

Duration: 3½ hrs per course.

Batch size: Max 20 students per batch for courses 2 and 3 and 10 students per batch for courses 1 and 4 (involving instruments).

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SEMESTER 6

DRUGS AND COLOR CHEMISTRY **Course No: S.CHE.6.AC**
FOUR CREDIT COURSE **60 L**

Learning Objectives:

1) To familiarize students with the mode of action of drugs.
2) To understand the uses and the side effects of certain drugs for various diseases.
3) To study the synthesis of different drugs
4) To study the nomenclature and characteristics of dyes.
5) To study the concept of colour and its relation to chemical structure.
6) To familiarize the students with the types of fibres, application of dyes and how the dyes are attached to them.
7) To familiarize the students with the syntheses of some representative dyes.
8) To create an awareness of the current concern about the toxicity of dyes and their effect on ecology.

UNIT I **15 L**

1.1 General Introduction to drugs. **7 L**

1.1.1: Definition of drug, requirement of an ideal drug, classification of drugs (based on Therapeutic action)

1.1.2: Nomenclature of drugs, generic name, brand name, systematic name.

1.1.3: Definition of the following medicinal terms: Pharmacon, Pharmacophore, Prodrug, Half-life efficiency, LD_{50}, ED_{50}, Therapeutic index.

1.1.4: Brief idea of the following terms: receptors, drug-receptor interaction, drug potency, Bioavailability, drug toxicity, drug addiction, spurious drugs, misbranded drugs, Adulterated drugs, Pharmacopoeia.

1.2 Routes of drug administration and dosage forms: **3 L**

1.2.1: Oral and parenteral routes with advantages and disadvantages.

1.2.2: Formulations, different dosage forms (emphasis on sustained release formulations.)

1.3 Synthesis of following drugs. **5 L**

Paracetamol, Aceclofenac, Salbutamol, Ciprofloxacin, Metronidazole, Mebendazole, Ethambutol , 5-Fluorouracil, Atenolol, Dapsone and Trimethadione.

UNIT II **15 L**

2.1 Pharmacodynamic agents **9 L**

A brief introduction of the pharmacodynamic agents and study of their chemical class, Chemical structure, therapeutic uses and side effects.

2.1.1: Analgesics (Narcotics and non-narcotics) and Antipyretics: Classification of analgesics: narcotics and non narcotics. Morphine(phenanthrene alkaloids), Tramadol, Aspirin(salicylates) , Paracetamol (p-amino phenol)

2.1.2: Anti-inflammatory drugs: Mechanism of inflammation and various inflammatory conditions: Prednisolone, Betamethasone (steroids), Aceclophenac (aryl acetic acid), Mefenamic acid (N-aryl anthranilic acid.)

2.1.3: Drugs for respiratory system: General idea of Expectorant, Mucolyte, Bronchodialators, Decongestants and Antitussives. Bromhexine (phenyl methyl amines), Salbutamol, Pseudo-ephedrine (phenyl ethyl amines), Oxymetazoline (imidazolines), Codeine phosphate (opiates)

2.1.4: Drug metabolism: Introduction, absorption, distribution, bio-transformation, excretion, different types of chemical transformation of drug with specific examples .

2.2 Chemotherapeutic agents **6**

A brief introduction of the chemotherapeutic agents and study of their chemical class, chemical structure, therapeutic uses and side effects.

2.2.1: Antibiotics: Definition, characteristics and properties: Amoxicillin, Cloxicillin (β-lactum antibiotic), Cephalexin (cephalosporins), Doxycycline (tetracyclines), Ciprofloxacin (quinolone)

2.2.2: Antitubercular and antileprotic drugs: Study of tuberculosis – types, symptoms, and diagnosis of tuberculosis.

Types of leprosy: General idea of antibiotics used in their treatment: PAS (aminosalicylates), Isoniazid (hydrazides), Pyrazinamide (pyrazine), (+) Ethambutol (aliphatic diamines), Ethionamide (thioamides), Dapsone(sulfonamides), Clofazimine(phenazines) .Combination therapy to be discussed.:

i)Rifampicin +Ethambutol +Pyrazinamide.

ii)Rifampicin +Isoniazide + Pyrazinamide.

iii)Rifampicin + Clofazimine + Ethionamide.

Unit III: 15 L

3.1 : Introduction to dyestuff chemistry 3 L

3.1.1 : Definition of dyes, properties (colour and fastness).

3.1.2 : Important milestones in the development of synthetic dyes.

3.1.3 : Nomenclature of commercial dyes with at least one example.

Suffixes – G, O, R, B, 6B, L, S; colour index and colour index number.

3.2 : Classification of dyes based on constitution 3 L

(Examples as mentioned below with structures)

I : Nitro dyes – Naphthol Yellow S

II : Nitroso dyes – Gambine Y

III : Azo dyes –

a) Monoazo dyes – Orange IV

b) Disazo dyes – Congo Red

c) Trisazo dyes – Direct Deep Black

IV : Diphenylmethane dyes – Auramine O

V : Triphenylmethane dyes –

a) Diamines – Malachite Green

b) Triamines – Crystal Violet

c) Phenols – Phenolphthalein

VI : Heterocyclic dyes –

a) Xanthenes – Eosine

b) Azines – Safranine-T

c) Thiazines – Methylene Blue

VII : Anthraquinone dyes- Alizarin, Alizarin Cyanine Green G, Indanthrone

VIII : Indigoide dyes- Indigo

IX : Phthalocyanines-Monastral Fast Blue BS

3.3 : Classification of dyes based on application 6 L

Definition, fastness properties and applicability on substrates, examples with structures.

a) Acid dyes – Orange II, Alizarin Cyanine Green G.
b) Basic dyes – Crystal Violet, Bismark Brown.
c) Direct Cotton Dyes – Chrysophenine G.
d) Azoic dyes – Diazo components: Fast Red B Base, Fast Blue B Base; Coupling components: Naphtol AS, Naphtol AS-G.
e) Mordant dyes – Eriochrome Black T, Alizarin.
f) Vat dyes – Indigo, Indanthrene.
g) Disperse dyes–Celliton Scarlet B, Disperse Yellow 6G
h) Fluorescent dyes–Rhodamine B

3.4 : Colour and chemical constitution of dyes 3 L

3.4.1 Absorption of visible light, colour of wavelength absorbed and complementary colour, chromogen, chromophore, auxochrome, bathochromic and hypsochromic shifts.

3.4.2 : Relation of colour to resonance in the following classes of dyes : Azo, Triphenylmethane, Anthraquinone.

Unit IV: 15L

4.1 : Organic Pigments 2 L

General idea, difference between dyes and pigments. Important characteristics of organic pigments, toners and lakes. Classification of organic pigments with suitable examples, i.e. ionic pigments (lakes of acid and basic dyes), nonionic pigments (azo, indigoids, anthraquinone), uses of pigments.

4.2 : Synthesis of specific dyes and their uses 7 L

i) Orange IV from sulphanilic acid

ii) Bismark Brown from m-phenylenediamine

iii) Malachite Green by using benzaldehyde and N,N-dimethylaniline

iv) Methylene Blue by using 4-amino-N,N dimethylaniline and N,N dimethylaniline

v) Congo Red from nitrobenzene

vi) Eriochrome Black T from β – naphthol

vii) Alizarin from anthraquinone

viii) Indigo from aniline

ix) Indanthrene from anthraquinone

x) Disperse Yellow 6G from benzanthrone

4.3 : Types of fibres and classes of dyes applicable to it 2 L

4.3.1 : Introduction to the following types of fibres with structures and classes of dyes applicable to these fibres : Cotton, wool, silk, polyester.

4.4 : Forces binding dyes to the fibres: Ionic forces, hydrogen bonds, Van der Waal's forces, covalent linkages. **2 L**

4.5 : Basic operations involved in a dyeing process 1 L

Preparation of fibre for dyeing, preparation of the dye bath, application of the dye

And finishing

4.6 : Ecology and toxicity of dyes 1L

Brief idea of environmental pollution and health effects due to dyes.

REFERENCES

1) Pharmacology and pharmaceutics Vol.I and II, Satoskar
2) Textbook of organic, medicinal, and pharmaceutical chemistry, Wilson and Gisvold
3) Textbook of medicinal chemistry, William O. Foye and David A. William
4) Medicinal chemistry, G. R . Chatwal
5) Chemistry of synthetic dyes, Vol. I to VI, K. Venkataraman
6) Chemistry of synthetic dyes and pigments, H. A. Lubs
7) Colour Chemistry, H. Zollinger
8) Colour Chemistry, R. L. M. Allen
9) Unit process, Groggins
10) Synthetic dyes, M. S. Yadav
11) Physical Chemistry of dyeing, Thomas Vickerstaff
12) Chemistry of dyes and principles of dyeing, V. A. Shenai
13) Practical Organic Chemistry, A. I. Vogel

CIA I : Short answer questions 20 MARKS

CIA II: Questions on syntheses of drugs and dyes 20 MARKS

Template of Question Paper

DRUGS AND COLOR CHEMISTRY **COURSE: S.CHE.6.AC.01**

OBJECTIVES

UNIT	KNOWLEDGE	UNDERSTANDING	APPLICATION	TOTAL MARKS
I	6	6	3	15
II	6	6	3	15
III	6	6	3	15
IV	6	6	3	15
TOTAL MARKS PER OBJECTIVES	24	24	12	60
% WEIGHTAGE	40	40	20	100

End Semester Paper Pattern :

Total marks : 60 **Maximum time : 2 hours**

Total no. of questions: 4 [all compulsory] of 15 marks each

1 question per unit:

Questions set out of 22 marks [50 % internal choice]

Sub questions will not exceed 5 marks

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SYLLABUS UNDER AUTONOMY

CHEMISTRY

PRACTICAL COURSE IN T.Y.B.Sc. **COURSE: S.CHE.6.AC.01.PR**

I. PREPARATIONS

1. Aspirin from Salicylic acid.
2. p-Nitroacetanilide from Acetanilide.
3. p-Nitroaniline from p-Nitroacetanilide.
4. m-Dinitrobenzene from Nitrobenzene
5. Fluorescein from Phthalic Anhydride
6. Anthraquinone from Anthracene

II. ESTIMATIONS

1. Estimation of Iodine in Tincture Iodine
2. Estimation of Ibuprofen
3. Estimation of Methyl Orange/Eriochrome Black T/Congo Red by colorimetry

CIA : ESTIMATION OF DRUG/DYE **15 MARKS**

JOURNAL **5 Marks**

END SEMESTER PRACTICAL EXAMINATION **30 MARKS**

PREPARATION OF DRUG/DYE

The practical exam will be conducted for 1 session of 3 hours duration.

BATCH SIZE FOR:

REGULAR PRACTICALS **20 STUDENTS PER IN-CHARGE**

EXAMINATIONS **MAXIMUM 20 STUDENTS PER BATCH**

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