JAI HIND COLLEGE
BASANTSING INSTITUTE OF SCIENCE
&
J.T. LALVANI COLLEGE OF COMMERCE
(AUTONOMOUS)
"A" Road, Churchgate, Mumbai - 400 020, India.

Affiliated to
University of Mumbai

Program: B.Sc.

Proposed Course for: Chemistry

Semester VI

Credit Based Semester and Grading System (CBGS) with effect from the academic year 2020-21

T.Y. B.Sc. Chemistry Syllabus

Academic year 2020-2021

Semester VI			
Course Code	**Course Title**	**Credits**	**Lectures /Week**
SCHE601	Advanced Physical Chemistry-II	4	4
SCHE602	Advanced Inorganic Chemistry-II	4	4
SCHE603	Advanced Organic Chemistry-II	4	4
SCHE604	Advanced Analytical Chemistry-II	4	4
SCHE6PR1	Practical Coursework in Physical and Inorganic Chemistry-II	4	8
SCHE6PR2	Practical Coursework in Organic and Analytical Chemistry-II	4	8
SCHE6AC	Pharmaceutical Chemistry, Dyes, Paints & Pigments-II	2.5	4
SCHE6ACPR	Practical Coursework in Pharmaceutical Chemistry, Dyes, Paints & Pigments-II	2.5	4

Semester VI – Theory

Course: SCHE601	**Advanced Physical Chemistry – II (Credits: 4 Lectures/Week: 4)** **<u>Course description</u>: Electrochemistry, Polymers, Quantum chemistry, Renewable energy resources and NMR**	**4 Credits**
	Objectives: ➢ To understand Lewis concept of activity and activity coefficient of an electrolyte and its expressions for various types of electrolytes. ➢ To learn the concept of overvoltage and understand method of its determination using Tafel's theory. ➢ To have an understanding of polymers, its classification and various method of determination of its molecular weight and its applications. ➢ To understand use of polymers as Light emitting polymers, fillers and stabilizers. ➢ To introduce the basics of quantum mechanics and the concept of operators. ➢ To have in-depth knowledge of fuel for future, its advantages and limitations. ➢ To learn branches of spectroscopy as NMR & ESR, its instrumentation and applications. **Learning Outcomes:** ➢ Learner will be able to correlate the concept of activity and activity coefficient with concentration of electrolytes. ➢ Learner will be able to apply the concept of overvoltage to electrolytic processes. ➢ Learner will be acquainted with the physical properties of polymers, its testing & correlation to the application of polymers in diverse fields. ➢ Learner will be able to define quantum mechanical properties of sub atomic systems. ➢ With the understanding of all the desirable attributes of fuel, the learner will be able to weigh fuels of future based on efficiency and environmental impact. ➢ Learner will be conceptually sound on the origin of spectra with respect to NMR & ESR and extrapolate to the interpretation of various peaks observed.	
	THEROY	**45 lectures**
Sub Unit	**Unit – I: -ELECTROCHEMISTRY**	**15 L**
1.	**ELECTROCHEMISTRY**	**10L**
	a. **Activity and Activity Coefficient:** Lewis concept, ionic strength, Mean ionic activity and mean ionic activity coefficient of an electrolyte, expression for activities of different electrolytes. Variation of mean activity coefficient with concentration, Debye-Huckel limiting law (No derivation). b. **Classification of cells:** Chemical cells and Concentration cells. i) Chemical cell without transference	

	ii) Concentration cells with and without transference (derivations are expected) c. Origin of liquid -liquid junction potential and its elimination using a salt bridge d. **Applications of EMF Measurements** : i) Determination of liquid-liquid junction potential ii) Mean ionic activity coefficient of electrolyte iii) Solubility and k_{sp} of sparingly soluble salts using chemical and concentration cell. iv) pH of a solution using quinhydrone and glass electrode v) Ionic Product of water using chemical and concentration cell (Numericals are expected on all above topics)	
2.	**APPLIED ELECTROCHEMISTRY** a. Types of Electrochemical cells- Reversible and Irreversible cells (Test of reversibility), Primary and secondary cells with examples. b. **Polarization**: concentration polarization and it's elimination c. **Decomposition Potential and Overvoltage** : i. Introduction- Experimental determination of decomposition potential ii. Factors affecting decomposition potential. ii. Tafel's equation for hydrogen overvoltage, experimental determination of overvoltage d. Electroplating- objectives and applications.	**5L**
Unit II	**POLYMERS**	**15 L**
1.	**POLYMERS**	**15 L**
	a. Basic terms: macromolecule, monomer, repeat unit, degree of polymerization. **b. Classification of polymers:** Classification - based on sources, structure, thermal response and physical properties. **c. Molar masses of polymers:** Number average, Weight average, Viscosity average molar mass. **d.** Molecular mass and mechanical properties **e.** Monodispersity and Poly dispersity, polydispersity index of polymers **f. Methods of determining molar masses of polymers:** i) Determination of Number average molecular mass – end group analysis, cryoscopy and vapor phase osmometric, Gel	

	permeation chromatography ii) Ultra-centrifuge method iii) Viscosity method. (Derivation Expected) **g. Degradation of polymers:** by thermal, oxidative, mechanical and chemical methods. **h. Inorganic Polymers:** General properties - classification -Boron based polymers - Borazine, Polymeric boron nitride - Phosphorous based polymers - Polyphosphonitrilic chloride -polyphosphoric acids - Silicon based polymers – Organo tin polymers. **i. Fillers and Stabilizers:** i) Fillers and Reinforcement ii) Plasticizers iii) Antioxidants and Thermal Stabilizers iv) Ultraviolet stabilizers v) Fire retardants vi) Colourants vii) Antistatic agents and Curing agents. **j. Light Emitting Polymers:** Introduction, Characteristics, Method of preparation and applications. **Biodegradable polymers**	
Unit III	**BASICS OF QUANTUM CHEMISTRY & RENEWABLE ENERGY RESOURCES**	**15 L**
1.	**QUANTUM CHEMISTRY**	**10L**
	a. **Classical mechanics**: Introduction, limitations of classical mechanics, Black body radiation, photoelectric effect, Compton effect. **b. Quantum mechanics :** i) Introduction ii) Planck's theory of quantization iii) Wave particle duality iv) de –Broglie's equation v) Heisenberg's uncertainty principle. **c. Progressive and standing waves-** i) Introduction ii) Boundary conditions iii) Schrodinger's time independent wave equation (No derivation expected) iv) Interpretation and properties of wave function. d. **Postulates of quantum mechanics**: i) State function and its significance Concept of operators - definition, addition, subtraction and multiplication of operators, commutative and non - commutative operators, linear operator, Hamiltonian operator, Eigen function and Eigen value.	

2.	**RENEWABLE ENERGY RESOURCES**	**5 L**
	a. **Renewable energy resources**: Introduction. b. **Solar energy**: i) Solar cells-Photovoltaic effect ii) Semiconductors as solar energy converters iii) Silicon solar cell **c. Fuel cells:** i) Choice of fuel and oxidant ii) Bacon's H_2 and O_2 fuel cell. **d. Hydrogen:** i) Fuel of the future- Production of hydrogen by direct electrolysis of water a. Advantages of hydrogen as a universal energy medium	
Unit IV	**NMR & ESR**	**15 L**
1.	**NMR -Nuclear Magnetic Resonance Spectroscopy**	**8L**
	b. Principle c. Nuclear spin, magnetic moment, nuclear 'g' factor, energy levels d. Larmor precession e. Relaxation processes in NMR (spin-spin relaxation and spin - lattice relaxation). f. Instrumentation- NMR Spectrometer g. Chemical shift h. Shielding and Deshielding of protons i. Low- and high-resolution NMR spectrum of methanol and ethanol.	
2.	**Electron Spin Resonance Spectroscopy**	**7L**
	Electron Spin Resonance Spectroscopy – a. Principle b. Fundamental equation, g-value -dimensionless constant or electron g-factor c. Hyperfine splitting. d. Instrumentation-ESR spectrometer e. ESR spectrum of hydrogen and deuterium.	

	References	
	1. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co.Ltd. 2. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House. 3. Modern Electrochemistry, J.O.M Bockris& A.K.N. Reddy, Maria Gamboa – Aldeco 2nd Edition, 1st Indian reprint,2006 Springer 4. Fundamental of Molecular Spectroscopy, 4th Edn., Colin N Banwell and Elaine M Mc CashTata McGraw Hill Publishing Co. Ltd. New Delhi, 2008. 5. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi. 6. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford University Press Oxford 10. 7. Physical Chemistry, G.K. Vemullapallie, 1997, Prentice Hall of India, Pvt.Ltd. New Delhi. 8. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, VISHAL PUBLISHING Company, 2008. 9. Textbook of Polymer Science, Fred W Bilmeyer, John Wiley & Sons (Asia) Ple. Ltd., Singapore, 2007. 10. Polymer Science, V.R. Gowariker, N.V. Viswanathan, JayadevSreedhar, New Age International (P) Ltd., Publishers, 2005. 11. V. K. Ahluwalia & A. Misra, Polymer Science-A Text Book, AneBooks, India, NewDelhi. 12. PremamoyGhosh, Polymer Science & Technology, 3rd edition, Tata McGraw HillEducation Pvt. Ltd., New Delhi. 13. B.K. Sharma, Polymer Chemistry, Goel Publishing House, Meerut. 14. M.G. Arora, M. Singh and M.S. Yadav, Polymer Chemistry, 2nd Revised edition, AnmolPublications Private Ltd. 15. D.D. Deshpande, “Physical chemistry of macromolecules”, Vishal publications,New Delhi, 1985. 16. K.J. Laidler and J.H. Meiser, Physical Chemistry: 2nd ed. CBS , First Indian ed,1999. 8. Publishers and Distributors, New Delhi.	

Semester VI – Theory

Course: SCHE602	**Advanced Inorganic Chemistry - II (Credits: 4 Lectures/Week: 4)** **<u>Course description:</u> Coordination Compounds, Properties of Coordination compounds, Organometallic Chemistry, Inorganic Polymers, pharmaceuticals and nanomaterials.**	
	Objectives: ➢ To understand how the transition metals splits the d-orbital in presence of ligand field. ➢ To understand the MOT of the complexes of transition elements with octahedral geometry. ➢ To a systematic introductory treatment of organometallic compounds, emphasizing synthesis, properties, structure and reactivity. ➢ To learn through bioinorganic chemistry as to how nature selects specific elements to carryout various biological processes. **Learning Outcomes:** ➢ Students would also be to draw MOTs of the complexes with different ligand field. ➢ Students would be able to know the reactivity of organometallic compounds including their application in synthesis. ➢ Students would be able to solve problems in coordination chemistry w.r.t predicting the shape of the complex, CFSE value calculations, etc ➢ Students would be able to categorize the inorganic elements according to their roles in the biological system and identify the general aspects of storage and transport of metal-ions.	
Unit I	**<u>Coordination Chemistry:</u> Theories of bonding**	**15 L**
	a. Crystal Field Theory (CFT)	**10L**
	i. Basic concepts of Crystal field theory and effect of crystal field on central metal valence orbitals. ii. Splitting of d orbitals in octahedral, tetrahedral and square planar complexes. iii. Crystal field splitting energy ($10D_q$) for octahedral complexes and factors affecting the magnitude of D_q. iv. Crystal field stabilization energy (CFSE), calculation of CFSE, for octahedral and tetrahedral complexes with d^1 to d^{10} metal ion configurations. v. Tetragonal distortion of octahedral complexes (Jahn-Teller distortion) vi. Effect of crystal field splitting on: Ionic radius and Lattice energy vii. Consequences of crystal field splitting on various properties such as ionic radii, hydration energy, lattice energy, enthalpies of formation, colour and magnetic properties. viii. Experimental evidence for co-valence in co -ordination compounds. (i) ESR spectrum of $[IrCl_6]^{-2}$ (ii) NMR spectrum of tris (acetyl acetanato) vanadium complex, (iii) Intensities of d-d	

	transitions, and (iv) Nephelauxetic effect.	
	b. Molecular Orbital Theory for coordination compounds.	**5L**
	i. Identification of the central metal orbitals and their symmetry suitable for formation of σ bonds with ligand orbitals. ii. Construction of ligand group orbitals. iii. Construction of σ molecular orbitals for ML_n complex. iv. Application to octahedral complexes in case of (i) $[Ti(H_2O)]^{+3}$ (ii) Fluoro complexes of Fe(II) and Fe (III) and (iii) Cyano complexes of Fe(II) and Fe (III). v. Effect of pi -bonding a ligand field splitting parameter in M→L and L→M interactions.	
Unit II	**<u>Properties of Coordination compounds</u>** **a. Stability of Complexes** i. Thermodynamic stability and kinetic stability of complexes with examples. ii. Stability constants: Stepwise and overall constants and their inter - relationship. iii. Factors affecting thermodynamic stability. iv. Potentiometric method of determination of stability constants with example of silver -ammonia complex. **b. Substitution reactions in Octahedral Complexes** i. Introduction, types of reactions in complexes. ii. Ligand substitution reactions: basic mechanisms. iii. Inert and labile complexes and electronic configurations and lability of complexes. iv. Acid hydrolysis, base hydrolysis and anation reactions. **c. Electronic Spectra** i. Types of electronic transitions like intra –ligand transitions, charge transfer transitions and intra -metal transitions and (d-d or ligand field transitions for transition metals). ii. Rules for electronic transitions: Spin and Orbital or Laporte selection rules. Orgel Diagrams for D & F Terms (i.e. d^1 , d^4 and d^6 d^9 electronic configurations in octahedral and tetrahedral environment), Splitting of d^2,d^3,d^7 &d^8 metal ion in octahedral and tetrahedral environment and its use in interpretation of visible electronic absorption spectra of these configurations.	**15 L** **(3L)** **(3L)** **(9L)**
Unit III	**<u>Organometallic Chemistry</u>** **a. Organometallic Compounds of main group metals** i. Introduction ii. General synthetic methods: (i) Oxidative addition, (ii) Metal - Metal exchange (Transmetallation), (iii) Carbanion -Halide	**15L** **(9L)**

	exchange, (iv) Metal Hydrogen exchange and (v) Methylene insertion reactions. iii. Chemical reactions: (i) Reactions with oxygen, (ii) Alkylation and arylation reactions (iii) Reactions with protic reagents, (iv) Redistribution reactions and (iv) Complex formation reactions. **b. Organometallic compounds of transition metals** i. Synthesis, structure and reactions of ferrocene. ii. Bonding in ferrocene on the basis of VBT. **c. Catalysis by Transition metal complexes:** i. Hydrogenation of alkenes (Wilkinson catalyst) ii. Hydroformylation reaction (Rolen's catalyst) iii. Polymerization reaction (Zeigler-Natta catalyst).	**(3L)** **(3L)**
Unit IV	**<u>Some Selected Topics</u>** **a. Inorganic Polymers** i. Various methods of classification with examples. ii. Chemistry of borazine with reference to preparation, properties, structures, bonding and applications. **b. Inorganic Pharmaceuticals** i. Gastrointestinal agents viz., (i) antacids (aluminum hydroxide, milk of magnesia, sodium bicarbonate and (ii) cathartics (magnesium sulphate and sodium phosphate). ii. Topical agents viz., (i) protectives and adsorbents (talc, calamine), (ii) antimicrobial agents (potassium permanganate, tincture iodine, boric acid) and astringents (alum) **c. Nanomaterials** i. Introduction and importance of nanomaterials. ii. Properties (Comparison between bulk and nanomaterials): (i) Optical properties, (ii) Electrical conductivity, and (iii) Mechanical properties. iii. Forms of nanomaterials: nanofilms, nanolayers, nanotubes, nanowires, and nanoparticles. iv. Chemical methods of preparation: (i) Colloidal route, and (ii) Sol-gel method. **d. Bioinorganic chemistry** i. Introduction, ii. Essential and non-essential elements in biological systems, iii. Role of metal ions such as Na(I), K(I), Fe(II)/(III) and Cu(II) in biological systems; iv. Introduction to biological roles of metalloenzymes w.r.t. myoglobin, hemoglobin, Structure and function; dioxygen binding, transfer and utilization.	**15 L** **(3L)** **(3L)** **(4L)** **(5L)**

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Semester VI – Practical

Course: SCHE6PR1	**Practical Course work in Physical and Inorganic Chemistry – II (Credits: 4 Practicals/Week: 2)**

Objectives:

- To learn the calculation of order of reaction graphically from given data.
- To encourage students to understand the calculation of number of electrons from redox reaction.
- To estimate amount of acid present in mixture of acid from conductance measurements.
- To apply static method for determination of empirical formula of the complex.
- To understand the shape and geometry of various complexes having different ligands attached to it
- To understand the setupof glassware and apparatus to conduct volumetric experiments in inorganic Chemistry
- To understand the use of various indicators for specific metal ions in titration

Learning Outcomes:

- Developed knowledge in finding the order of reaction from the data.
- Understanding of the redox reaction and the number of electrons involved.
- In depth learning of the determination of various physical parameters and using electrometric determination of the concentration of unknown species.
- Learner will have learnt the techniques of preparing and drying complexes at different temperature and pressure.
- Having prepared complexes of different coordination spheres, learner will be able to understand the cationic/anionic coordination complex ions
- Learner will be able to understand the titration/estimation of metal ions with different complexing agents

PRACTICAL I

PHYSICAL CHEMISTRY PRACTICAL

1. Non-Instrumental Experiments

a. Chemical Kinetics:

To study the effect of ionic strength on the rate of reaction between $K_2S_2O_8$ and KI using KCl.

b. Viscosity:

i. To determine the molecular weight of polyvinyl alcohol (PVA) by viscosity measurements.

2. Instrumental Experiments

a. Potentiometry:

i. To determine solubility and solubility product of silver chloride using chemical cell.

ii. To determine amount of given acid present in given solution by titrating against strong base potentiometrically using quinhydrone electrode.

b. Conductometry:

i. To titrate a mixture of weak acid and strong acid against a strong base and estimate amount of each acid in mixture condutometrically.

c. Colorimetry:

i. To determine the empirical formula of the complex between Fe(III) and salicylic acid by static method.

PRACTICAL II

INORGANIC CHEMISTRY PRACTICAL

Inorganic preparations

1. Mercury tetrathiocyanato cobaltate (II) $Hg[Co(SCN)_4]$
2. Magnesium oxinate $[Mg(Ox)_2]$
3. Tris-acetyl acetanato iron(III) $[Fe(AcAc)_3]$
4. Hexamine cobalt (III)chloride $[Co(NH_3)_6]\ Cl_3$

Volumetric analysis

1. Estimation of Lead by complexometric titration.
2. Determination of Fe(II) using $KMnO_4$
3. Determination of Al by complexometric titration
4. Estimation of Co present in the given solution of $CoSO_4.7H_2O$

Semester VI – Theory

Course: SCHE603	**Advanced Organic Chemistry - II (Credits: 4 Lectures/Week: 4)** **Course description:** **Nomenclature and Stereochemistry of Organic compounds, Mechanism of Organic reactions, Photochemistry, Pericyclic reactions and Organometallic Chemistry**	
	Objectives: ➢ To understand the stereo chemical implications of organic reactions ➢ To write the uses of catalysts and reagents in different organic reactions ➢ To familiarize the learner with the chemistry of biomolecules ➢ To correlate reactivity of specified heterocycles with their reactions ➢ To study the structural elucidation of certain natural products ➢ To be aware of the physiological importance of certain natural products ➢ To acquaint the learner with the basic principles of different spectroscopic techniques **Learning Outcomes:** ➢ Learner will be able to predict the stereochemical outcome of an organic reaction based on its mechanism ➢ Learner will be able to apply the conditions of catalysis to different organic reactions ➢ Learner will be able to assign the stability order of different conformations of cycloalkanes based on the strain in the molecule ➢ Learner will be able to predict the outcome of a heterocyclic reactions based on their reactivity. ➢ Learner will be able to draw a logical conclusion between the structure of natural products and its reactions ➢ Learner will be able to establish the structure of an organic compound based on spectroscopic data	
Unit I	**Unit – I: Stereochemistry II; Catalysis & reagents in organic synthesis** **1. Stereochemistry of Organic Compounds II:** **a) Stereoselectivity & stereospecificity:** i. Definition & differences ii. Enantioselectivity (ee) iii. Diastereoselectivity (de) **b) Topicity (Addition substitution criteria):** i. Homotopic atoms/groups/faces ii. Heterotopic atoms/groups/faces (enantiotopic & diastereotopic) **c) Dynamic Stereochemistry of:** i. Substitution reaction: S_N^i (reaction of alcohol with thionyl	**15L** **10L** **(2L)** **(2L)** **(6L)**

	chloride) ii. Walden inversion: S_N^2 reaction iii. Elimination reaction: E_2- base induced dehydrohalogenation of 1-bromo-1,2-diphenylpropane iv. Addition reaction of olefins: A. bromination (electrophilic anti addition) B. syn hydroxylation with OsO_4& $KMnO_4$ C. epoxidation followed by hydrolysis **2. Catalysis & Reagents in Organic Synthesis:** Study of the following catalysts and reagents with respect to functional group transformation, selectivity & stereochemistry: **a) Catalysts for hydrogenation** i. Raney Nickel ii. Pt & PtO_2 (>C=C<; -CN; $-NO_2$; aromatic ring) iii. Lindlar catalyst: alkynes **b) Reagents** i. $LiAlH_4$ (reduction of >CO, -COOR, -CN; $-NO_2$) ii. $NaBH_4$ (reduction of >CO) iii. SeO_2 (oxidation of $-CH_2-$ alpha to >CO) iv. mCPBA (epoxidation of >C=C<) v. NBS (allylic and benzylic bromination)	**5L** **(1L)** **(4L)**
Unit II	**Unit – II: Chemistry of Biomolecules** **1. Carbohydrates** **a) Introduction:** classification, reducing & non-reducing sugars, DL notation **b)** Structures of monosaccharides: i. Fischer projection (4-6 carbon monosaccharides) ii. Haworth formula (furanose & pyranose forms of pentoses and hexoses) iii. Interconversion: open chain and Haworth form with 5 & 6 carbons **c)** Anomeric carbon atom; mutarotation and its mechanism **d)** Conformation of D-glucose: Chair conformation of D-glucose with relative stabilities of α & β forms. **e)** Stereoisomerism in D-gluocose: enantiomer, diastereomers, epimers & anomers **f)** Chain lengthening & shortening reactions: i. Modified Killiani-Fischer synthesis (D-arabinose to D-glucose & D-mannose) ii. Wohl method (D-glucose to D-arabinose) **g)** Reactions of D-glucose and D-fructose: i. Osazone formation ii. Reduction: H_2/Ni, $NaBH_4$ iii. Oxidation: Br_2 water, HNO_3, HIO_4 iv. Acetylation (With cyclic pyranose form)	**15L** **(9L)**

	v. Methylation (With cyclic pyranose form) **h)** Glycosides: general structure, formation of alkyl glycosides and anomeric effect **i)** Disaccharides: structures of sucrose and maltose (cyclic forms: Haworth & chair) **j)** Polysaccharides **2. Amino acids & proteins:** **a)** α-amino acids: i. Introduction: nomenclature, structure & configuration ii. Essential/Non-essential amino acids iii. Classification on the basis of side chain iv. Physical properties: Isoelectric point & zwitter ion v. Separation of amino acids: Electrophoresis, chromatography vi. Synthesis: reductive amination, N-phthalidomalonic ester synthesis, Strecker synthesis. vii. Resolution of amino acids **b)** Proteins: i. Peptide bond & disulfide bonds ii. Strategy of peptide synthesis, automated peptide synthesis iii. Structure of proteins: primary, secondary, tertiary & quaternary iv. Denaturation of proteins **3. Nucleic acids:** **a)** Nucleosides & nucelotides **b)** Structure of DNA **c)** Determination of base sequence of DNA **d)** Antiviral drugs	**(4L)** **(2L)**
Unit III	**Unit III: Heterocyclic & Natural Product Chemistry** **1. Heterocyclic Chemistry-II:** **a.** Pyridine-N-oxide i. Preparation ii. Reactivity (comparison with pyridine) iii. Reactions: halogenation, nitration & reaction with $NaNH_2$/liq. NH_3, n-BuLi **b.** Quinoline i. Preparation: Skraup synthesis ii. Reactions: electrophilic substitution, nucleophilic substitution, metallation reactions. **2. Natural Products** **a.** Terpenoids: Introduction, Isoprene rule, special isoprene rule and the gem-dialkyl rule **b.** Citral:	**15L** **(5L)** **(10L)**

	i. Structural determination of citral ii. Synthesis of citral from methyl heptenone iii. Isomerism in citral (cis and trans forms) **c.** Alkaloids: introduction and occurrence: Hofmann's degradation in: simple open chain & N-substituted monocyclic amines. **d.** Nicotine: i. Structural determination of nicotine (Pinner's work included) ii. Synthesis of nicotine from nicotinic acid iii. Harmful effects of nicotine **e.** Hormones: i. Introduction ii. Structure of adrenaline (epinephrine) iii. Physiological action of adrenaline iv. Synthesis of adrenaline from- (a) catechol & (b) p-hydroxybenzaldehyde (Ott's synthesis)	
Unit IV	**Unit IV: Spectroscopy of Organic Compounds** **1. Introduction:** electromagnetic spectrum, properties of electromagnetic radiations: wavelength, frequency, wavenumber and interconversions. **2. UV-visible spectroscopy:** i. Basic theory, solvents & nature of spectrum ii. Concept of chromophore &auxochrome iii. Chromophore-chromophore & chromophore-auxochrome interaction iv. Bathochromic, hypsochromic shifts v. Hyperchromic, hypochromic effects **3. IR spectroscopy:** i. Basic theory, selection rule & nature of IR spectrum ii. Characteristic vibrational frequency of functional groups iii. Fingerprint region **4. ^{1}H-NMR spectroscopy:** i. Basic theory of NMR spectroscopy (NMR active nuclei) ii. ^{1}H-NMR, nature of spectrum & solvents used iii. Chemical shift (δ unit) & factors affecting chemical shift iv. Standard used in ^{1}H-NMR v. Spin-spin coupling & coupling constant vi. Application of deuterium exchange technique **5. Mass spectrometry:** i. Basic theory, nature of mass spectrum ii. General rules of fragmentation iii. Molecular ion peak iv. Base peak v. Isotopic peaks vi. Nitrogen rule	**15L** **(1L)** **(3L)** **(2L)** **(5L)** **(3L)**

	vii. Rule of 13 for determination of empirical and molecular formula **6.** Spectral characteristics of the following classes of organic compounds including benzene, mono and disubstituted benzenes with respect to UV, IR, NMR & mass spectra: i. Alkanes ii. Alkenes iii. Alkynes iv. Haloalkanes v. Alcohols vi. Carbonyl compounds vii. Ethers viii. Amines ix. Acid & acid derivatives Problems based on structure elucidation of simple organic compounds using either individual or combined use of UV-vis, IR, Mass & NMR spectroscopic technique expected (Index of hydrogen deficiency should be the first step in solving the problems)	**(1L)**

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Semester VI – Theory

Course Code: SCHE604	**Advanced Analytical Chemistry - II (Credits: 4 Lectures/Week: 4)** **<u>Course description:</u> Quality concepts, chemical calculations, method validation, Electroanalytical techniques methods of separation - II and Thermal methods**	
	Objectives: ➢ To understand difference between potentiometry and voltammetry. ➢ To learn different methods of quantification of polarographic techniques. ➢ To do comparative study of Gas solid chromatography and Gas Liquid Chromatography. ➢ To understand factors affecting separation of ions by ion exchange chromatography technique. ➢ To study the concept of quality, quality control and quality assurance used in Industries. ➢ To have knowledge of various thermal methods and its classifications. ➢ To learn principle of various thermal methods and its instrumentations as a block diagram and its working. **Learning Outcomes:** ➢ Students will learn electroanalytical techniques such as Polarography and amperometry. ➢ On completion of course students should know various chromatographic methods of separation such as Gas Chromatography and Ion exchange chromatography along with their applications. ➢ Students will learn how quality plays an important role in manufacturing of any product in Industry. ➢ Knowing comparative account of various thermal methods and its classification will help students to update his/her knowledge in the field of Analytical Chemistry**.**	
Unit - I	**QUALITY CONCEPTS, CHEMICAL CALCULATIONS, & METHOD VALIDATION**	**15L**
	1. Quality in Analytical Chemistry	**6L**
	a) Concepts of Quality, Quality Control and Quality Assurance b) Importance of Quality concepts in Industry c) Chemical Standard and Certified Reference Materials d) Importance in chemical analysis e) Quality of material: AR, GR, LR grades of laboratory reagents f) Performance characteristics of an analytical method: Accuracy, precision, detection limit, dynamic range, sensitivity, LOD, LOQ	
	2. Chemical Calculations a) Review of units of concentration* (%, w/w, w/v or v/w, v/v), Normality(N), Molarity (M), Formality (F), Molality (m), mole fraction(X), ppm and ppb b) Inter conversion of concentration units* (Conversion of concentration from one unit to another unit with examples)	**5L**

	c) Percent composition of elements in chemical compounds ***(Numerical expected)**	
	3. Analytical Method Development and Validation	**4L**
	a) Concept of Analytical Method development b) Need for method development c) Selecting the method d) Factors to consider in choosing a method e) Performance criteria for methods to determine analyte in samples with the complex matrix f) Reasons for incorrect analytical results g) Regulatory framework h) Validation of analytical method i) Need for validation j) Validation characteristics	
Unit – II	**ELECTRO ANALYTICAL TECHNIQUES**	**15 L**
	1. D. C. Polarography	**10L**
	a) **Difference between potentiometry and voltammetry**, Polarizable and non-polarizable electrodes, Faradic & Non-Faradic currents **b) Basic principle of polarography** a. H-shaped polarographic cell, DME (construction, working, advantages and limitations) c) **DC polarogram**: Terms involved - Residual current, Diffusion current, Limiting current, Half-Wave Potential i) Derivation for polarographic wave equation for a reversible reaction. ii) Role and selection of supporting electrolyte iii) Interference of oxygen and its removal iv) Polarographic Maxima and Maxima Suppressors d) **Qualitative aspects of Polarography**: Half wave potential $E_{1/2}$, Factors affecting $E_{1/2}$ e) **Quantitative aspects of polarography**: Ilkovic equations*: various terms involved in it (No derivation) i) Quantification (from wave height–Concentration plots)* ii) Calibration curve method iii) Internal standard (pilot ion) method iv) Standard addition method* f) Applications advantages and limitations (Numerical expected) *	**(1L)** **(1L)** **(3L)** **(2L)** **(3L)**
	2. Amperometric Titrations	**5L**
	a) Principle, Rotating Platinum Electrode (Construction, advantages and limitations) b) Titration curves with examples c) Advantages and limitations d) Applications	

Unit III	**METHODS OF SEPARATION – II**	**15 L**
	1. Gas Chromatography a) Introduction- Principle and terms involved* b) Instrumentation of GSC and GLC: i) Block diagram and components ii) Types of Columns and their packing iii) Detectors: TCD, FID, ECD c) Qualitative and Quantitative analysis* d) Applications e) Comparison between GSC and GLC (Numerical Problems Expected) *	**8L**
	2. Ion Exchange Chromatography a) Introduction- Principle. b) Types of Ion Exchangers and their structures, Ideal properties of resin c) Ion Exchange equilibria and mechanism i) Selectivity coefficient ii) Separation factor d) Factors affecting separation of ions e) Ion exchange capacity and its determination for cation and anion exchangers. f) Applications of Ion Exchange Chromatography i) Preparation of demineralised water ii) Separation of Lanthanide g) Preparation of standard solution of acid or base h) Separation of amino acids	**7L**
Unit IV	**THERMAL METHODS**	**15 L**
	1. Introduction to Thermal Methods **a) Classification of Thermal methods** **2. Thermogravimetric Analysis (TGA)** i) Principle ii) Instrumentation- block diagram, thermobalance (Basic components: balance, furnace, temperature measurement and control, recorder) iii) Thermogram (TG curve) for $CaC_2O_4.H_2O$ and $CuSO_4.5H_2O$ iv) Factors affecting Thermogram -Instrumental factors and	**(1L)** **(4L)**

	Sample characteristics **b) Applications** i) Determination of drying and ignition temperature range. ii) Determination of percent composition of binary mixtures (Estimation of Calcium and Magnesium oxalate)	
	3. Differential Thermal Analysis (DTA): a) Principle, Instrumentation and Reference material used b) Differential thermogram (DTA curve) $CaC_2O_4.H_2O$ and $CuSO_4.5H_2O$ c) Applications d) Comparison between TGA and DTA.	**(4L)**
	4. Thermometric Titrations a) Principle and Instrumentation b) Thermometric titrations of: i) HCl v/s NaOH ii) Boric acid v/s NaOH iii) Mixture of Ca^{+2} and Mg^{+2} v/s EDTA iv) Zn^{+2} with Disodium tartarate.	**(3L)**
	5. Differential Scanning Colorimetry (DSC) a) Principle and Instrumentation b) Factors affecting DSC curve	**(3L)**

References:

Common references;

1. David Harvey, Modern Analytical Chemistry, McGraw-Hill, 1999.
2. Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd
3. Fundamentals of Analytical Chemistry by Skoog and West, 8th Edition.
4. Instrumental Methods of Chemical Analysis, Gurdeep Chatwal, Himalaya Pub, House, 2014.

UNIT I:

1. Prichard, Elizabeth; Crosby, Neil T.; Prichard, Florence Elizabeth; *Quality in the Analytical Chemistry Laboratory*, John Wiley and Sons, 1995.
2. Elizebeth Prichard & Vicki Barwick, Quality Assurance in Analytical Chemistry, Wiley, 2007.
3. Goldberg, David E.; *3000 solved problems in Chemistry*, Schaums Outline
4. A guide to Quality in Analytical Chemistry: An aid to accreditation, CITAC and EURACHEM, (2002)
5. Smith, Patricia I.*; A premier sampling solids, liquids and gases,* American statistical association and the society for industrial and applied mathematics, (2001)
6. Dux VanNostr, James P.; Reinhold, *Handbook of quality assurance for the analytical*

chemistry laboratory, 2nd Edn.,1990
7. Konieczka, Piotr; Namiesnik, Jacek; *Quality control and Quality assurance in Amalytical Chemical Laboratory*, CRC press (2018)
8. Jeffery, G. H.; Bassett, J.; Memdham, J., Denney, R C; *Vogel's Textbook of Quantitative Chemical Analysis*, 5thEdn and ELBS with Longmann (1989)

UNIT II:

1. Introduction to Polarography and Allied Techniques, By Kamala Zutshi, New Age International, 2006.

UNIT III:

1. Chemical methods of separation, J A Dean, Van Nostrand Reinhold, 1969
2. Analytical Chromatography, Gurdeep R Chatwal, Himalaya publication

UNIT IV:

1. Thermal analysis Theory and applications by R.T. Sane, JagdishGhadge, Quest Publications
2. Introduction to Thermal Analysis Techniques and Applications, Michael E. Brown, Kluwer Academic Publishers, 2001. (free download)
3. Analytical Chemistry, D Kealey & Haines, BIOS Scientific Publishers Ltd, 2002 (free download)
4. Handbook of Thermal Analysis and Calorimetry, S Vyazovkin, N Koga & C Schick, Vol. 6, 2nd Ed, Elsevier, 2011. (downloadable)

Course: SCHE6PR2	**Practical Course work in Organic and Analytical Chemistry - II (Credits: 4 Practicals/Week: 2)**

Objectives:

- To identify the nature of the components of a binary mixture
- To separate the components of a binary mixture by chemical/physical method
- To purify the components of binary mixture by recrystallization
- To identify the components of a binary mixture
- To gain expertise in handling spectrophotometer.
- To inculcate aptitude for experimentation and treatment of data in learners
- To provide knowledge on preparation of analytical reagents, solutions and their molar calculations

Learning Outcomes:

- Learner will gain expertise at quantitative separation of organic compounds in a binary mixture & subsequently identify them
- Learner will be able to adjudge the method of separation (physical or chemical) for a given mixture of organic compounds
- Learner will be able to understand the theory and practical aspects of crystallisation and to determine purity of the crystallised compounds based on the physical constant
- Learning of different electrometric methods for the determination of the unknown component and their application to various samples
- Learning of the ion-exchange methodology and application of it for separation and estimation of sample
- Understanding of spectrometry and practical training of determining the analyte from sample matrix.

ORGANIC CHEMISTRY PRACTICAL

Quantified Chemical Separation of a Solid-Solid Binary Mixture comprising identification of type of mixture, chemical separation, recrystallisation of one component using a suitable solvent, identification of the second component based on organic spotting.

The following broad types of mixtures are to be included:

a. Water soluble -water insoluble and
b. Water insoluble-water insoluble;

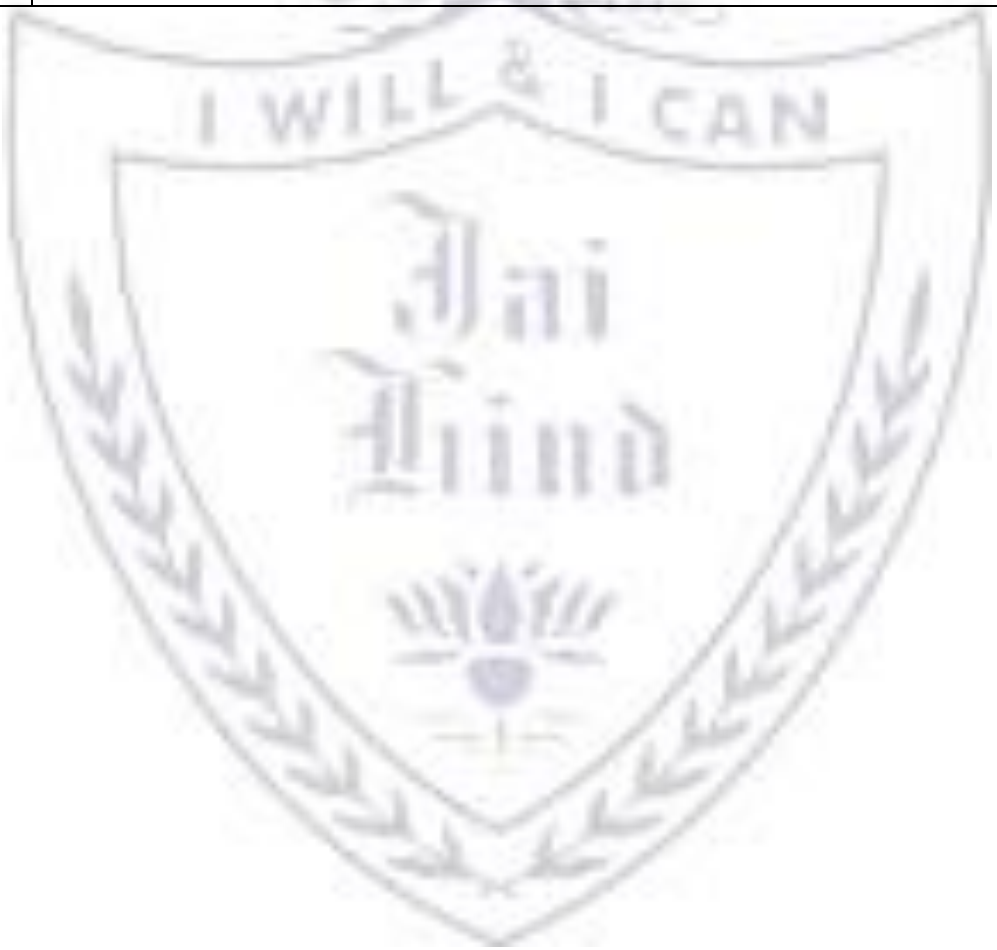
consisting of compounds belonging to acidic, phenolic, basic or neutral types.

ANALYTICAL CHEMISTRY PRACTICAL

Instrumental Experiments

1. Estimation of Chromium in water sample spectrophotometrically by

	using diphenylamine carbazide. 2. Estimation of acetic acid in vinegar sample by using quinhydrone electrode potentiometrically. 3. To determine pka values of maleic acid by titrating against sodium hydroxide pH metrically. 4. To determine Iron in pharmaceutical preparations by visible Spectrophotometry **Non- Instrumental experiments** 1. Estimate the amount of zinc and magnesium present in the given solution of magnesium –zinc mixture, using anion exchanger resin column. 2. To determine percentage composition of dolomite ore.



Semester VI – Theory

Course: SCHE6AC	**Pharmaceutical Chemistry, Dyes, Paints & Pigments -II** **(Credits: 2.5 Lectures/Week: 4)** **Course description:** **Drug Discovery, Design and Development; Chemotherapeutic agents and Nanoparticles in Medicinal Chemistry; and Nomenclature, Classification and Application of Dyes (non-textile); Dye Industry and its Future Prospects**	
	Objectives: ➢ To understand the different parameters associated with drug discovery, design and development ➢ To acquaint the learner with different classes of chemotherapeutic drugs; their uses and side effects ➢ To reproduce the syntheses of some common drugs and drug intermediates ➢ To reproduce the classification and nomenclature of dyes brighteners ➢ To analyse the future prospects of the dyestuff industry **Learning outcomes:** ➢ Learner will be able to reason the synthesis & application of a drug molecule based on its properties ➢ Learner will be acquainted with the different classes of drugs used to bring about a characteristic chemotherapeutic action. ➢ Learner will be able to design retrosynthesis of drug molecules based on the its structure & the common routes of synthesis of various classes of drugs studied. ➢ Learner will be able to classify the commercially available dyes and brighteners & hence will be able to reflect on its application as well as environmental impact. ➢ Learner will be able to probe the entrepreneurial avenues linked with dyestuff industry in India.	
	PHARMACEUTICAL CHEMISTRY	
Unit I	**Drug Discovery, Design and Development**	**15L**
	a) Medicinal compounds from natural sources: Turmeric, Tulsi	**(1L)**
	b) Synthetic development of medicinal drugs: i. Lead ii. Sources of lead: Serendipity, Drug metabolism studies, Clinical trial observations iii. Screening: Random and Non-random screening	**(4L)**
	c) Development of drugs:	**(6L)**

	i. Identification of pharmacophore ii. Methods to increase potency through structure modification: Homologation, Chain branching, Ring-chain transformation iii. Structure-activity relationship with respect to: Sulphonamides iv. Preclinical development v. Clinical development: phase-wise trials vi. Schedule H: Spurious drugs, Adulterated drugs, Misbranded drugs vii. Pharmacopeia and its significance **d) Chirality in drugs:** i. Introduction: Concept of chiral drugs and their significance ii. Pharmacokinetics of racemic drugs in the biological system iii. Synthesis of chiral drugs: 1. (+) Ibuprofen 2. (+) Amphetamine	**(4L)**
Unit II	**Chemotherapeutic agents and Nanoparticles in Medicinal Chemistry** **Study of the following chemotherapeutic agents with respect to their classification, therapeutic use and side -effects:** **a) Antibiotics** i. Definition ii. Classification on the basis of Gram stain, spectrum of activity, chemical class (one representative example of each category) iii. Synthesis of Levofloxacin from 2,3,4-trifluoro-1-nitrobenzene **b) Antimalarials** i. Cause & types of malaria ii. Symptoms of malaria iii. Pathological detection through window period (life cycle of parasite not expected) iv. Representative example from each of the following classes with respect to uses and side effects: 1. 4-Aminoquinolines: Chloroquine 2. Benzodioxepins: Artemether v. Synthesis of Hydroxychloroquine **c) Anthelmintics** i. Classification of helminths ii. Causes and symptoms of helminth infection iii. Representative example from each of the following classes of anthelminitic drugs with respect to uses and side effects:	**15L** **(2L)** **(2L)** **(2L)**

1. Piperazines: Diethyl carbamazine
2. Benzimidazoles: Albendazole

iv. Synthesis of Albendazole from 2-nitroaniline

d) Antiamoebic drugs **(1L)**

i. Causes and symptoms of amoebiasis
ii. Representative examples from the following class of antiamoebic drugs with respect to uses and side effects: Imidazoles e.g. Ornidazole, Tinidazole
iii. Combination therapy for treatment: Ciprofoxacin-Tinidazole

e) Antitubercular and Antileprotic drugs **(2L)**

i. Types and symptoms of tuberculosis
ii. Types and symptoms of leprosy
iii. Diagnosis of tuberculosis
iv. Representative example from the following classes with respect to structure, uses & side effects:
   1. Aminosalicylates: PAS
   2. Hydrazides: Isoniazid
   3. Pyrazines: Pyrazinamide
   4. Aliphatic diamines: (+)-Ethambutol
   5. Sulphonamides: Dapsone
   6. Phenazines: Clofazimine
v. Combination therapy for treatment: Rifampin + Isoniazid + Pyrazinamide
vi. Synthesis of the following: Isoniazid, (+)-Ethambutol, Dapsone.

f) Anti-neoplastic drugs **(2L)**

i. Concept of malignancy
ii. Causes of cancer
iii. Uses of the following anti-neoplastic drugs:
   1. 5-fluorouracil
   2. Cisplatin
   3. Vinca alkaloids (structure not expected)
iv. Synthesis of 5-fluorouracil

g) Anti-AIDS drugs **(1L)**

i. Idea of HIV pathogenicity
ii. Symptoms of AIDS
iii. Examples of Anti-AIDS drugs and their uses: Zidovudine, DDI

	h) Drug Intermediates Synthesis of the following drug intermediates and their uses: i. 4-(p-Chlorophenyl)-4-hydroxypiperidine from 4-chloroacetophenone ii. p-Acetylamino benzenesulphonyl chloride from aniline iii. Epichlorohydrin from propene **i) Nanoparticles in Medicinal Chemistry** i. Targeted drug delivery with carbon nanotubes ii. Use of gold nanoparticles in the treatment of Parkinson's disease, Alzheimer's disease.	**(2L)** **(1L)**
	DYES, PAINTS, PIGMENTS	
Unit III	**Classification, Synthesis & Environmental Impact of Dyes** **(A) Classification of Dyes based on Chemical Constitution and Synthesis of Selected Dyes (synthesis of the dyes marked with * is expected)** (i) Nitro Dye: Naphthol Yellow S (ii) Nitroso Dye: Gambine Y (iii) Azo dyes: (a) Monoazo dyes: Orange IV*(from sulphanilic acid) and Eriochrome Black T* (from β-naphthol) (b) Bisazo dyes: Congo Red* (from nitrobenzene) (c) Trisazo Dye: Direct Deep Black EW* (from benzidine) (iv) Diphenylmethane dye: Auramine O* (from NN-dimethyl aniline) (v) Triphenylmethane dyes (a) Diamine series: Malachite Green* (from benzaldehyde) (b) Triamine series: Acid Magenta (c) Phenol series Rosolic acid (vi) Triphenylmethane dyes (a) Diamine series: Malachite Green* (from benzaldehyde) (b) Triamine series: Acid Magenta (c) Phenol series Rosolic acid (vii) Heterocyclic Dyes (a) Thiazine dyes: Methylene Blue (b) Azine dyes: Safranin T* (from o-toluidine	**15L** **(8L)**

	(c) Xanthene Dyes: Eosin* (from phthalic anhydride) (d) Oxazine Dyes: Capri Blue (e) Acridine Dyes: Acriflavine (viii)Quinone Dyes: (a) Naphthaquinone: Naphthazarin (b) Anthraquinone Dyes: Indanthrene Blue* (from anthraquinone) (ix) Indigoid Dyes: Indigo* (from aniline, monochloroacetic acid) (x) Phthalocyanine Dyes: Monastral Fast Blue B **(B) Health and Environmental Hazards of Synthetic Dyes and their Remediation processes** **(C) lmpact of the textile and leather dye industry on the environment with special emphasis on water pollution.** Health Hazards: Toxicity of dyes with respect to food colours **(D) Effluent Treatment Strategies:** i. Brief introduction to effluent treatment plants (ETP). ii. Primary Remediation processes (Physical Processes) iii. Sedimentation, Aeration, Sorption (activated charcoal, fly ash etc), iv. Secondary Remediation processes: Biological Remediation, Biosorption, bioremediation and biodegradation v. Chemical Remediation: Oxidation Processes (chlorination), Coagulation-Flocculation-Precipitation	**(2L)** **(1L)** **(3L)**
Unit IV	**Applications of Dyes & Pigments** **(A) Non-textile uses of dyes** (i) Dyes used in formulations (Tablets, capsules, syrups, etc.) (ii) Biological staining agents Methylene blue. Crystal violet (iii) DNA markers Indigo carmine, Sunset yellow, Tartrazine and Safranine T, Bromophenol blue, Orange G Cresol red (iv) Dyes as therapeutics: Mercurochrome, Acriflavine, Crystal Violet, Prontosil **(B) Dyes used in food and cosmetics** (i)Properties of dyes used in food and cosmetics. (ii) Introduction to FDA and FSSAL iii) Commonly used food colours and their limits **(C) Paper and leather dyes** (i) Structural features of paper and leather.	**15L** **(4L)** **(3L)** **(2L)**

	(ii) Dyes applicable to paper and leather **(D) Miscellaneous dyes** (i) Hair dyes (ii) Laser dyes (iii) Indicators (iv) Security inks (project work) (v) Coloured smokes and camouflage colours **(E) Pigments and introduction to paints** (i) Definition of pigments, examples, properties of pigments, difference between dyes and pigments (ii) Definition of Lakes and Toners (iii) Dyestuff Industry -Indian Perspective (iv) Introduction, definition and classification of paints and coatings. (v) Introduction to function of paints, varnishes, lacquers and enamels (Course Material for reference will be provided by the concerned teacher in the form of handout) (vi) Growth and development of the Indian Dyestuff Industry	**(3L)** **(3L)**

References:

Unit I and II

1. Silverman, Richard, B., *Organic Chemistry of Drug Design and Drug Action*, 2nd Edition. (2005). Elsevier (Academic Press)
2. Bruice, Paula Y., *Organic Chemistry*, 8th Edition (2013). Pearson Education India.
3. Voet, Donald, &Voet, Judith G., *Biochemistry*, 4th Edition, (2011). International Student version
4. Sriram, D., Yogeeswari, P., *Medicinal Chemistry*, 2nd Edition, Pearson
5. Kar, Ashutosh, *Medicinal Chemistry*, Revised 3rd Edition, (2006).
6. Alagarsamy, V., *Textbook of Medicinal Chemistry*, Vol. 2, 3rd Edition. CBS Publications and Distributors Pvt. Ltd.
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8. Thomas, Gareth,*Medicinal Chemistry: An Introduction*, 2nd Edition, (2010). Wiley India Pvt. Ltd.
9. Lemke, Thomas, L., William, Zito, S., Roche, Victoria, S., Williams, Davis, A., *Essentials of Foye's Principles of Medicinal Chemistry*, 1st Edition, 2016, South Asian Edition (Wolters Kuwer).
10. Patrick, Graham, L., *An Introduction to Medicinal Chemistry*, 4th Edition (2011), OUP India

Unit III and IV

1. Venkatraman, K., *Chemistry of Synthetic Dyes, Vol. I-VIII*, Academic Press, 1972
2. Lubs, H.A., Krieger, Robert, E., *The Chemistry of Synthetic Dyes and Pigments*, Publishing Company, NY, 1995
3. Shenai, V.A., *Chemistry of Dyes & Principles of Dyeing*, Sevak Publications, 1973

Semester VI – Practical

Course: SCHE6ACPR	**Practical Course Work in Pharmaceutical Chemistry, Dyes, Paints & Pigments -II (Credits: 2.5 Practicals/Week: 1)**

Objectives:

- To prepare dye intermediates on a bench scale
- To estimate the concentration of drugs in a given sample, quantitatively
- To understand the significance of monograph
- To develop the skill of dyeing of fibres with Orange II

Learning Outcomes:

- Learner will be equipped with the requisite skills to perform a bench scale synthesis of dye intermediates
- Learner will be acquainted with procedures for assay of drugs in commercial samples.
- Learner will be exposed to monograph and to pharmacopeia for all information about a drug, its action, toxicity and assay.
- Learner will be able to develop entrepreneurial ideas with respect to dyeing techniques and its potential in the market for dyed fabric

PHARMACEUTICAL CHEMISTRY PRACTICAL

1. Estimation of acid neutralising capacity
2. Estimation of free acid in vegetable oil
3. Estimation of aspirin colorimetrically
4. Monograph

DYES, PAINTS & PIGMENTS PRACTICAL

1. Preparation of fluorescein
2. Preparation of m-dinitrobenzene from nitrobenzene
3. Preparation of m-nitroaniline from m-dinitrobenzene
4. Preparation of Orange II and dyeing of fibres as project

Evaluation Scheme

A. Evaluation scheme for Theory courses

I. Semester End Examination (SEE)- 60 Marks

II. Internal Continuous Assessment (CA) – 40 Marks

a. Knowledge and Application based: Online objective test of 20 Marks
b. Skill based (20 marks): Learner will be assessed on relevant skills pertaining to the course content of a particular paper which could involve but not limited to
    (i) Review of research paper/Worksheets/demonstration of instruments followed by evaluation
    (ii) Report writing with presentation of visit to Pharmaceutical industry/Paints/Pigments industry
    (iii) Literature review/ survey.

B. Evaluation scheme for Practical courses

I. Semester End Examination (SEE)- 100 Marks per course [SCHE6PR1, SCHE6PR2, SCHE6ACPR]