***B.Sc., Chemistry, Iii Year,Cbcs Syllabus***

**Telangana State Council Of Higher Education, Govt. of Telangana, B.Sc., CBCS Common Core Syllabi for All Universities in Telangana Proposed Scheme for Choice Based Credit System in**

**B.Sc., Chemistry,**

**Generic Elective-I (GE-I) and Generic Elective-II (GE-II) Courses for B.Sc. Non Chemistry/B.A/B.Com Students**

**THIRD YEAR- SEMSTER - V**

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|  | ***Code*** | ***Course Title*** | |  | ***Course Type*** | ***HPW*** | ***Credits*** |  |  |
|  |  |  | | |  |  |  |  |  |
|  | BS 501 | **Materials and their Applications** | | | **SEC-3** | **2** | **2** |  |  |
|  | BS 502 |  | **Pharmaceuticals** |  | **GE-1** | **2T** | **2** |  |  |
|  |  | **(For B.Sc. Non Chemistry/B.A/B.Com Students)** | | |  |  |  |  |  |
|  | BS 503 |  | Optional –I |  | DSC-1E | 3T+2P=5 | 3+1=4 |  |  |
|  | BS 504 |  | Optional – II |  | DSC-2E | 3T+2P=5 | 3+1=4 |  |  |
|  |  | **Optional – III Chemistry - V** | | |  | **3T** | **3** |  |  |
|  | BS 505 |  |  |  | **DSC-3E** | **= 5** | **=4** |  |  |
|  | **Laboratory Course (Organic Synthesis and TLC)** | | |  |  |
|  |  |  | **2P** | **1** |  |  |
|  |  |  |  |  |  |  |  |
|  | BS 506 |  | Elective-A/B Optional – I | | DSC-1E | 3T+2P=5 | 3+1=4 |  |  |
|  | BS 507 |  | Elective-A/B Optional – II | | DSC-2E | 3T+2P=5 | 3+1=4 |  |  |
|  | BS508A | Elective-A | **(Chemistry–VI)** | **Instrumental** |  |  |  |  |  |
|  |  | **Methods of Analysis** | |  |  |  |  |  |  |
|  | BS508B | Elective-B | **(Chemistry – VI ) Industrial** | | **DSC-3E** | **3T** | **3** |  |  |
|  |  | **Chemistry and Catalysis** | |  | **= 5** | **= 4** |  |  |
|  |  |  | **Laboratory Course** |  |  | **2P** | **1** |  |  |
|  |  | **(Experiments in Physical Chemistry-I)** | | |  |  |  |  |  |
|  |  |  | **Total Credits** |  |  | **34** | **28** |  |  |
|  | **SEMSTER - VI** | |  |  |  |  |  |  |  |
|  | BS 601 | **Chemistry of Cosmetics and Food Processing** | | | **SEC-4** | **2** | **2** |  |  |
|  | BS 602 | **Materials and Their Applications** | | | **GE-2** | **2T** | **2** |  |  |
|  |  | **(For B.Sc. Non Chemistry/B.A/B.Com Students)** | | |  |  |  |  |  |
|  | BS 603 |  | Optional – I |  | DSC-1F | 3T+2P=5 | 3+1=4 |  |  |
|  | BS 604 |  | Optional – II |  | DSC-2F | 3T+2P=5 | 3+1=4 |  |  |
|  | BS 605 | **Optional – III Chemistry - VII** | | |  | **3T** | **3** |  |  |
|  |  | **Laboratory Course (Qualitative and Spectral** | | | **DSC-3F** | **= 5** | **=4** |  |  |
|  |  | **Analysis of Organic Compounds)** | |  |  | **2P** | **1** |  |  |
|  | BS 606 |  | Elective-A/B Optional – I | | DSC-1F | 3T+2P=5 | 3+1=4 |  |  |
|  | BS 607 |  | Elective-A/B Optional – II | | DSC-2F | 3T+2P=5 | 3+1=4 |  |  |
|  | BS 608A | Elective-A **(Chemistry – VIII) Medicinal** | | |  |  |  |  |  |
|  |  | **Chemistry** |  |  | **DSC-3F** | **3T** | **3** |  |  |
|  | BS 608B | Elective-B **(Chemistry – VIII) Agricultural and** | | | **= 5** | **= 4** |  |  |
|  |  | **Fuel Chemistry** | |  |  | **2P** | **1** |  |  |
|  |  |  | **Laboratory Course** |  |  |  |  |  |  |
|  |  | **(Experiments in Physical Chemistry-II)** | | |  |  |  |  |  |
|  |  |  |  |  |  | 34 | 28 |  |  |
|  |  |  | **Total Credits** |  |  |  | 164 |  |  |



\***Optional III Chemistry,**

AECC: Ability Enhancement Compulsory Course: SEC: Skill Enhancement Course; DSC: Discipline Specific Course; GE: Generic Elective

**B.Sc. Chemistry III Year**

**Semester - V**

**Skill Enhancement Course- III (SEC - III) (2 Credits)**

**Materials and their Applications** **30 Hrs**

**Unit – I: Types of Materials** **15 Hrs**

**Introduction:** Materials and their importance. Classification of Materials, Advanced materialsand their need.

Types of Materials**:** Metals, ceramics, polymers and composites; Nature of bonding (Type of bond present).

Types and applications of metal alloys**:** Classification- ferrous and non-ferrous alloys. Ferrous alloys -types and their applications. Non-ferrous alloys **–** Cu, Al, Ti alloys, their applications and super alloys.

**Field Work- Collection of Metal Alloy Samples**

**Types and Applications of Ceramics:**

Classification of Ceramics based on their application- glasses, clay products, refractories, abrasives, cements, and advanced ceramics.

**Glasses:** Compositions and Characteristics of Some of the Common Commercial Glasses;Properties and applications of glass ceramics **-** preparation of charts depicting various types of glass and their use.

**Clay products:** Structural clay products and the white wares.

**Refractories:** Compositions of four Common Ceramic Refractory Materials, fireclay, silica, basicrefractories ex. MgO and special refractories ex. Alumina and Zirconia

**Cements:** Classification, preparation of cement and the setting process; quick setting cements;applications.

**Field Work-Visit to industries and collection of samples of materials**

**Unit - II Types of Polymers and Applications 15 Hrs Classification of Polymeric materials based on application:** Coatings, adhesives, films, foams examples

**Polymer Additives:** Fillers, Plasticizers, Stabilizers, Colorants, Flame Retardants with examples. **Advanced Materials**: Types of advanced materials - semiconductors, bio-compatible materials,smart materials, advanced polymeric materials and nano-engineered materials.

Biocompatible materials**:** Definition. Materials used as biomaterials and their properties. Metals and alloys used in bone and joint replacement. Filling and restoration materials **–** dental cements, dental amalgams, dental adhesives.

**Field Work- Visit to Dental Clinics and interaction with Doctors regarding materials used in Dental treatments**

Smart materials**: S**hape memory alloys- definition and examples (Ni-Ti alloys, Cu based alloys), applications. Conducting polymers**:** - Introduction, Electrically conducting polymers and their uses (polyaniline, polypyrrole, polyacetylene and polythiophene).

**References:**

1. A Text book on ‘Materials and their Applications’, First Edition, Authors: Dr Mudvath Ravi, Gopu Srinivas, Putta Venkat Reddy, Vuradi Ravi Kumar, Battini Ushaiah.
2. Materials Science and Engineering An Introduction by William D. Callister, Jr. John Wiley & Sons, Inc.
3. Material Science by Kakani and Kakani New Age International Pvt Ltd, 2004
4. Sujata V., Bhat., **―**Biomaterials**‖**, Narosa Publication House, New Delhi, 2002
5. M. V. Gandhi and B. S. Thompson, **―**Smart Materials and Structures**‖**, Chapman and Hall, London, First Edition, 1992.
6. Duerig,T.W., Melton, K. N, Stockel, D. and Wayman, C.M., **―**Engineering aspects of Shapememory Alloys**‖**, Butterworth **–** Heinemann, 1990.
7. Chandrasekhar, Prasanna Ashwin-Ushas Conducting Polymers, Fundamentals and Applications A Practical Approach Authors: Corp., Inc. Kluwer Academic Publishers. Boston.

**Semester V**

**Generic Elective (GE) Course - I (2 Credits)**

**Generic Elective-I (GE-I) Course for B.Sc. Non Chemistry/B.A/B.Com Students**

**Pharmaceuticals** **30Hrs**

**Unit – I: General Characteristics of Drugs** **15Hrs**

**Introduction** - Diseases – causes of diseases, Drug – definition and sources.

ADME of drugs (brief) – Absorption, distribution, drug action (site of action), metabolism (in liver), elimination (brief).

Examples (i) Zintac (Ranitidine, antacid) (ii) Paracetamol (antipyretic) (iii) Benadryl (Cough syrup). Characteristics of an ideal drug.

**Nomenclature of Drugs** – chemical name – generic name – trade name. Trade names for thegiven generic names – (i) Aspirin (ii) Amoxycillin (iii) Ciprofloxacin (iv) Paracetamol

(v) Mebendazole

**Drug formulations**: Definition – need for conversion of drug into medicine (drug formulations)

– Additives – diluents, binders, lubricants, antioxidants, flavourants, sweeteners, colourants, coating agents. Classification of Drug formulations: oral, parenterals and topical dosage forms – advantages and disadvantages.

1. **Oral Dosage forms**: Tablets (Aspirin – analgesic; Ciprofloxacin - antibacterial). Capsules(Amoxycillin – antibiotic; Omeprazole-antacid). Syrups (B-complex syrup; Benadryl- Cough syrup).
2. **Parenterals** (Injection forms): Propranolol (antihypertensive), Heparin (anticoagulant)
3. **Topical dosage forms**: Creams and Ointments
4. **Antiallergic:** Aclometasone (Aclovate), Betamethasone valerate(2%) Multiple purposes, **(v)Anti-itching**: Doxepin Zonalon), **Antifungal**: Miconozole (Dactarin, Neomicol),Ketoconazole, (Nizoral Cream), Fluconazole, **Anesthetic**- Lidocaine, (Lidocaine ointment) and **Antiseptic**: Boro Plus Cream, For burns -Iodine ointment

**Unit – II: Classification of Drugs** **15Hrs**

Classification of Drugs based on therapeutic action–Chemotherapeutic agents, Pharmacodynamic agents and drugs acting on metabolic processes. (brief explanation for the following)

1. **Chemotherapeutic agents**: Antimalarials – Chloroquine; Antibiotic – Amoxicillin;Antitubercular drugs – isoniazide; Antiprotozoals – metronidazole
2. **Pharmacodynamic agents**
3. Drugs acting on CNS: Diazepam (CNS depressant), General anesthetic (thiopental sodium), antipyretic and analgesic (Iburofen)
4. Drugs acting on PNS : local anaesthetics (Benzocaine)
5. Drugs acting on cardiovascular system : Metoprolol (antihypertensive agents), Nefidipine antianginal and antihypertensive agent )
6. Drugs acting on renal system: Diuretics (Acetazolamide)

**(iii) Drugs acting on metabolic processes**

(a) Vitamins: Common name, source, deficiency, vitamin A, B2, B6, C, D, E and K – remedy

(b) Hormones: Function (brief) - deficiency of hormones (Insulin, Testosterone and Osterone)

**References:**

1. Drugs by G.L.David Krupadanam, D.Vijaya Prasad, K.Varaprasad Rao, K.L.N.Reddy, C.Sudhakar,Universities Press (India) Limited 2007.

1. An Introduction to Medicinal Chemistry by Graham L. Patrick, Oxford University Press, New York. 1995
2. Chemistry text book for B.Sc., Vol. IV published by Telugu Academy, Govt. of Telangana

**B.Sc III yr CHEMISTRY**

**SEMESTER WISE SYLLABUS**

**SEMESTER V**

**Paper-V**

**Chemistry - V**

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| **Unit-I ( Inorganic Chemistry)** | **11 h** |
| **S5-I-1: Coordination compounds –II** | **9 h** |
| Crystal field theory (CFT)- Postulates of CFT, splitting patterns of d-orbitals in | ctahedral, |

tetrahedral, square planer with suitable examples. Crystalfield stabilization energies and its calculations for various dn configurations in octahedral complexes. High Spin Low Spin complexes.

Magnetic properties of transition metal complexes- para, dia, ferro, anti ferromagnetic properties, determination of magnetic susceptibility (Guoy method), spin only formula, calculations of magnetic moments.

Electronic spectra of metal complexes **–** colour of transtion metal aqua complexes**–** d-d transitions.Detection of complex formation - basic principles of various methods- change in chemical properties, solubility, colour, pH, conductivity, magnetic susceptibility.

Thermodynamic and kinetic stability of transition of metal complexes . Stability of metal complexes **–**stepwise and overall stability constant andf their relationship.Factors effecting the stability constants. Chelate effect, determination of composition of complex by Job**’**s method and mole ratio method.

**Applications of coordination compounds**

Applications of coordination compounds a) in quantitative and qualitative analysis with suitable examples b) in medicine for removal of toxic metal ions and cancer therapy c) in industry as catalysts polymerization **–** Ziegler Natta catalyst d) water softening.

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| **S5-I-2: Boranes and Carboranes:** | **2 h** |

Definition of clusters. Structures of boranes and carboranes- Wade**’**s rules,closo,nido, arachno

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| Boranes and carboranes.   |  |  |  | | --- | --- | --- | | **S5-G-2:** | **Molecular spectroscopy** | **8 h** |   Introduction to electromagnetic radiation, interaction of electromagnetic rations with molecules, various types of molecular spectra.  **Rotational spectroscopy (Microwave spectroscopy)**  Rotational axis, moment of inertia, classification of molecules (based on moment of inertia), rotational energies, selection rules, determination of bond length of rigid diatomic molecules eg. HCl. |  | |
| **Unit-II (Organic Chemistry)** | **11 h** | |
| **S5-O-1: Amines, Cyanides and Isocyanides** | | **7 h** | |
| **Amines:** | |  | |
| Nomenclature, classification into 10, 20, 30Amines and Quarternary ammonium |  | |

compounds.Preparative methods **–** 1. Ammonolysis of alkyl halides 2. Gabriel synthesis 3. Hoffman**’**s bromamide reaction (mechanism). Reduction of Amides and Schmidt reaction. Physical properties and basic character **–** Comparative basic strength of Ammonia, methyl amine, dimethyl amine, trimethyl amine and aniline- comparative basic strength of aniline, N-methylaniline and N,N- dimethyl aniline (in aqueous and non- aqueous medium), steric effects and substituent effects. Use of amine salts as phase transfer catalysts. 4. Chemical Properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation. 5. Reaction with Nitrous acid of 10, 20, 30 (Aliphatic and aromatic amines).

Electophilic substitutions of Aromatic amines **–** Bromination and Nitration, oxidation of aryl

and 30 Amines, diazotisation. 6. Diazonium salts: Preparation with mechanism. Synthetic importance **–** a) Replacement of diazonium group by **–** OH, X (Cl)- Sandmeyer and

Gatterman reaction, by fluorine (Schiemann**’**s reaction), by iodine, CN, NO2, H and aryl

groups. Coupling Reaction of diazonium salts. i) with phenols ii) with anilines. Reduction to phenyl hydrazines.

**Cyanides and isocyanides:**

Nomenclature (aliphatic and aromatic) structure. Preparation of cyanides from a) Alkyl halides b) from amides c) from aldoximes. Preparation of isocyanides from Alkyl halides and Amines. 2. Properties of cyanides and isocyanides, a)hydrolysis b) addition of Grignard reagent iii) reduction iv) oxidation.

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| **S5-O-2: Heterocyclic Compounds** | **4 h** |

Introduction and definition: Simple 5 membered ring compounds with one hetero atom Ex. Furan. Thiophene and pyrrole. Importance of ring systems **–** presence in important natural products like hemoglobin and chlorophyll. Numbering the ring systems as per Greek letter and Numbers. Aromatic character **–** 6- electron system (four-electrons from two double bonds and a pair of non-bonded electrons from the hetero atom). Tendency to undergo substitution reactions.

Resonance structures: Indicating electron surplus carbons and electron deficient hetero atom. Explanation of feebly acidic character of pyrrol, electrophillic substitution at 2 or 5 position, Halogenation, Nitration and Sulphonation under mild conditions. Reactivity of furan as 1,3-diene, Diels Alder reactions (one example). Sulphonation of thiophene purification of Benzene obtained from coal tar). Preparation of furan, Pyrrole and thiophene from 1,4,-dicarbonyl compounds only, Paul-Knorr synthesis, structure of pyridine, Basicity **–** Aromaticity **–** Comparison with pyrrole **–** one method of preparation and properties **–** Reactivity towards Nucleophilic substitution reaction **–** chichibabin reaction.

**Infra red spectroscopy**

Energy levels of simple harmonic oscillator, molecular vibration spectrum, selection rules. Determination of force constant. Qualitative relation of force constant to bond energies. Anharmonic motion of real molecules and energy levels. Modes of vibrations in polyatomic molecules. Characteristic absorption bands of various functional groups. Finger print nature of infrared spectrum.

**Electronic spectroscopy:**

Bonding and antibonding molecular o**rbitals,electronic energy levels of molecules (σ, π, n),** **types of electronic transitions:σ**-**σ\*, n**-**σ\*, n**-**л\*, л**-**л\* with suitable examples.Selection**

rules,Terminology of chromophore, auxochrome, bathochromic and hypsochromic shifts. Absorption of characteristicsof chromophones: diene, enone and aromatic chromophores. Representation of UV-visible spectra.

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| **Unit-III(Physical Chemistry)** |  |
| **S5-P-1: Chemical Kinetics** | **11 h** |

Introduction to chemical kinetics, rate of reaction, variation of concentration with time, rate laws and rate constant. Specific reaction rate.Factors influencing reaction rates: effect of concentration of reactants, effect of temperature, effect of pressure, effect of reaction medium, effect of radiation, effect of catalyst with simple examples, order of reaction.

First order reaction, derivation of equation for rate constant. Characteristics of first order reaction. Units

for rate constant. Half- life period, graph of 1st order reaction, examples. Decomposition of H2O2 and decomposition of oxalic acid.

Pseudo first order reaction, Hydrolysis of methyl acetate, inversion of cane sugar, problems. Second order reaction, derivation of expression for 2nd order rate constant, examples-

Saponification of ester, 2O3 **→ 3O**2, C2H4 +H2 **→ C**2H6. Characteristics of second order reaction, units for rate constants, half- life period and second order plots.

Zero order reaction: derivation of rate expression, examples i)combination of H2 and Cl2 to form HCl, ii) thermal decomposition of HI on gold surface characteristics of Zero order reaction units of k, half-life period and graph, problems.

Determination of order of reaction: i) method of integration, ii) half life method, iii) Vant-Hoff differential method iv) Ostwald**’**s isolation method. Problems

Kinetics of complex reactions (first order only): opposing reactions, parallel reactions, consecutive reactions and chain reactions. Problems.

Effect of temperature on reaction rate, Arrhenius equation. Temperature coefficient. Concept of energy of activation, determination of energy of activation from Arrhenius equation and by graphical method, problems.Simple collision theory based on hard sphere model explanation of frequency factor, orientation or steric factor. The transition state theory (elementary treatment).

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| **S5-G-3: Photochemistry** | **4 h** |

Introduction to photochemical reactions, Difference between thermal and photochemical reactions, Laws of photo chemistry- Grotthus - Draper law, Stark **–** Einstein**’**s Law of photo chemical equivalence. Quantum yield. Examples of photo chemical reactions with different

quantum yields. Photo chemical combinations of H2 **–** Cl2 and H2 **–** Br2 reactions, reasons for the high and low quantum yield. Problems based on quantum efficiency, Consequences of light absorptions. Singlet and triplet states. Jablonski diagram Explanation of internal conversion, inter- system crossing, Phosphorescence, fluorescence.

**References:**

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications (1996).
2. Concise Inorganic Chemistry by J.D. Lee 3rd edn. Van Nostrand Reinhold Company(1977)
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers (2001). Chem.
4. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey, E.A. Keiter and R.L. Keiter 4th edn. (2006)
5. Chemistry of the elements by N.N.Greenwood and A. Earnshaw Pergamon Press (1989).
6. Inorganic Chemistry by Shriver and Atkins 3rd edn Oxford Press (1999).
7. Text book of organic chemistry by Soni. Sultan Chand & Sons; Twenty Ninth edition (2012)
8. General Organic chemistry by Sachin Kumar Ghosh.  [New Age Publishers Pv](https://www.bookdepository.com/publishers/New-Age-Publishers-Pvt-Ltd)t  [Ltd](https://www.bookdepository.com/publishers/New-Age-Publishers-Pvt-Ltd) (2008)
9. Text book of organic chemistry by Morrison and Boyd. Person(2009)
10. Text book of organic chemistry by Graham Solomons. Wiley(2015)
11. Text book of organic chemistry by Bruice Yuranis Powla. (2012)
12. Principles of physical chemistry by Prutton and Marron. The Macmillan Company; 4th edition (1970)
13. Text Book of Physical Chemistry by Soni and Dharmahara. Sulthan Chand & sons.(2011).
14. Text Book of Physical Chemistry by Puri,Sharmaand Pattania. chand and Co.(2017)
15. Physical Chemistry by Atkins & De Paula, 8th Edition
16. Text Book of Physical Chemistry by K. L. Kapoor. (2012)
17. Physical Chemistry through problems by S.K. Dogra. (2015)
18. Text Book of Physical Chemistry by R.P. Verma.
19. Elements of Physical Chemistry byLewis Glasstone. Macmillan (1966)
20. Basics of Chemical Kinetics by G.L. Agarwal, New Delhi : Tata-McGraw-Hill, 1990.
21. Kinetics and mechanism of chemical transformations by Rajaram & Kuriacose, Macmillan/Laxmi Publications (P) Ltd., New Delhi(2010)
22. Bioinorganic Chemistry, M.N.Huges,  [Hussain K. Redd](https://www.amazon.in/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=Hussain+K.+Reddy&search-alias=stripbooks)y(2013)
23. Organic spectroscopy, William Kemp, Palgrave Macmillan; 2nd Revised edition edition (1 February 1987)
24. Text Book of Physical Chemistry by Puri,Sharmaand Pattania. chand and Co.(2017)
25. Photochemistry by Gurdeep Raj, Goel publishing house, 5th edition

**Laboratory Course:**

**Paper V(Organic Synthesis and TLC) (CHE 551)** **45 h (3h/w)**

1. **Synthesis of Organic compounds:**

Acetylation: Acetylation of salicylic acid, Benzoylation of Aniline.

Aromatic electrophilic substitution: Nitration: Preparation of nitro benzene and m-dinitro benzene.

Halogenation: Preparation of p-bromo acetanilide, Preparation of 2,4,6-tribromo phenol Oxidation: Preparation of benzoic acid from benzyl chloride.

Esterification: Preparation of n-butyl acetate from acetic acid. Methylation: Preparation of - naphthyl methyl ether.

Condensation: Preparation of benzilidine aniline and Benzaldehyde and aniline.

**Diazotisation: Azocoupling of β**-Naphthol.

1. **Thin layer Chromatography**

Determination of Rf values and identification of organic compounds: preparation and separation of 2,4-dinitrophenyl hydrazones of acetione and 2-butanone using toluene and light petroleum(40:60)

Separation of ortho & para nitro aniline mixtures

**B.Sc. Chemistry III Year**

**Semester-V, Paper-VI**

**Elective- A (3 Credits)**

**Instrumental Methods of Analysis** **45Hrs**

**Unit I: Chromatography I** **11Hrs**

**S5-E-A-I: Solvent Extraction-** Principle, Methods of extraction: Batch extraction, continuousextraction and counter current extraction. Application **–** Determination of Iron (III). **Chromatography:** Classification of chromatographic methods, principles of differentialmigration, adsorption phenomenon, nature of adsorbents, solvent systems.

**Thin layer Chromatography (TLC):** Advantages, preparation of plates, development of thechromatogram, Detection of the spots, factors effecting Rf values and applications.

**Paper Chromatography:** Principle, choice of paper and solvent systems, development ofchromatogram **–** ascending, descending, radial and two dimensional chromatography and applications.

**Column Chromatography-** Principle, Types ofstationary phases, Column packing **–** Wet packing technique, Dry packing technique. Selection criteria of mobile phase solvents for eluting polar, non-polar compounds and its applications.

**Unit II:**

**i) Chromatography II 11Hrs S5-E-A-I:**

**Ion exchange chromatography**: Principle, cation and anion exchange resins, its application inseparation of ions.

**Gas Chromatography:** Theory and instrumentation (Block Diagram), Types of stationaryphases and carrier gases (mobile phase).

**High performance liquid chromatography**: Theory and instrumentation, stationary phases andmobile phases. Analysis of paracetamol.

**ii) Colorimetry and Spectrophotometry 12Hrs S5-E-A-III:** General features ofabsorption **–** spectroscopy, transmittance, absorbance, and molar absorptivity. Beer Lambert**’**s law and its limitations, difference between Colorimetry and Spectrophotometry.

**Unit III: Spectrophotometry & Electroanalytical methods** **11Hrs**

**i) Spectrophotometry**

Instruments **–** Single beam UV- Visible Spectrophotometer, Double beam UV- Visible Spectrophotometer. Lamps used as energy sources. Verification of Beer**’**s law. Estimation of iron in water samples by thiocyanate method. Estimation of (i) Chromium and (ii) Manganese in steel.

**IR Spectrophotometer**: Principle, Sources of Radiations, Sampling, Block diagram of FT-IRSpectrophotometer.

**ii) Types of Electroanalytical Methods.**

**I) Interfacial methods –** a) Potentiometry: Principle, Electrochemical cell, Electrodes- (i)Indicator and (ii) Reference electrodes **–** Normal Hydrogen Electrode, Quinhydrone Electrode, Saturated Calomel Electrode. Numerical Problems. Application of Potentiometry **–** Assay of Sulphanilamide

b) Voltametry **–** three electrode assembly; Intoduction to types of voltametric techniques, micro electrodes, Over potential and Polarization.

**II) Bulk methods –** Conductometry, Conductivity Cell, Specific Conductivity, EquivalentConductivity. Numerical Problems. Applications of conductometry. Estimation of Cl- using AgNO3. Determination of Aspirin with KOH.

**Recommended Text Books and Reference Books**

1. Analytical Chemistry by David Krupadanam,  [Universities Press (India) Limited](https://www.sapnaonline.com/shop/Publisher/Universities%20Press%20(India)%20Limited).

1. D.A. Skoog, F.J. Holler, T.A. Nieman, Principles of Instrumental Analysis, Engage earning India Ed.
2. D. A. Skoog, D.M. West, F.J. Holler, Fundamentals of Analytical Chemistry 6th Ed., Saunders College Publishing, Fort worth (1992).
3. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
4. Harris, D. C. Quantitative Chemical Analysis, W. H. Freeman.2007.
5. Dean, J. A. Analytical Chemistry Notebook, McGraw Hill.
6. Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India.
7. Freifelder, D. Physical Biochemistry 2nd Ed., W.H. Freeman and Co., N.Y. USA, 1982.
8. Cooper, T.G. The Tools of Biochemistry, John Wiley and Sons, N.Y. USA. 16, 1977.
9. Vogel, A. I. Vogel**’**s Qualitative Inorganic Analysis 7th Ed., Prentice Hall.
10. Vogel, A. I. Vogel**’**s Quantitative Chemical Analysis 6th Ed., Prentice Hall.
11. Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc, New York (1995).
12. Analytical Chemistry 7th edition by Gary D. Christian (2004).
13. B. K. Sharma, Industrial Chemistry (including Chemical Engineering). Edn. (1997).
14. M.N Sastry, Separation Methods, Paperback (2004), Himalaya Publications.
15. [Usharani](https://www.amazon.in/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=Usharani&search-alias=stripbooks)  Analytical Chemistry Paperback (2000) Narosa Publications.

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| **B.Sc. Chemistry III Year** |  |
| **Semester-V, Paper-VI** |  |
| **Elective-B(3 Credits)** |  |
| **Industrial Chemistry and Catalysis** | **45 Hrs** |
| **Unit I: General Principles of Metallurgy and Production of Non Ferrous Metals** | **11 Hrs** |

**S5-E-B-I: Pyrometallurgy:** Drying and calcination, roasting, smelting, products of smelting, **Hydrometallurgy:** Leaching methods, leaching agents, leaching of metals, oxides and sulphides.

**Separation of liquid and solid phases and processing of aqueous solutions Electrometallurgy:** Electrolysis, Refining electrolysis, electrolysis from aqueous solutions,fused-salt electrolysis

**Refining processes:** Chemical and physical refining processes

**Production of selected non-ferrous metals (Copper, Nickel, Zinc):** Properties, raw materials,production (flow charts presentations and chemical reactions involved) and uses.

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| **Unit II: Natural and Synthetic Dyes** | **12Hrs** |
| **S5-E-B-II:** Classification of dyes. Sources of natural dyes: Indigoid, Anthraquinone, Naphthoquinone, Benzoquinone, Flavonoid, Carotenoid and Tannin-based dyes. | |

**Synthetic Dyes**: Acidic, basic, dispersive, direct, reactive and vat dyes with examples.Extraction of natural dyes and their sustainability: The different methods for extraction of coloring materials from natural dyes. Aqueous extraction, alkali or acid extraction, microwave and ultrasonic assisted extraction, fermentation, solvent extraction, super critical fluid extraction. Drying methods. Application of natural dyes on textiles, Mordanting- types of mordanting - metallic mordants, oil mordants, Tannins and Tannic acid. Present scenario and sustainability issues in usage of natural dyes and cost considerations.

**Unit III: Catalysis I 11Hrs S5-E-B-III: Homogeneous and heterogeneous catalysis** -Definition of a catalyst and catalysis. Comparison of homogeneous and heterogeneous catalysis with specific examples. General characteristics of catalytic reactions.

**Acid-base catalysis**- Examples of acid and base catalysed reactions, hydrolysis of esters.Kinetics of acid catalysed reactions. Specific acid and general acid catalysis, Kinetics of base catalysed reactions. Specific base and general base catalysis. Examples-Aldol condensation and decomposition of nitramide, base catalysed conversion of acetone to di acetone alcohol. Effect of PH on reaction rate of acid and base catalysed reactions.

**Phase transfer catalysis:** Principle of phase transfer catalysis, classification of phase transfercatalysts. Factors influencing the rate of PTC reactions.

**Enzyme catalysis**- Characteristics of enzymecatalysis, Examples: (i) Invertase in inversion of cane sugar (ii) Maltase in conversion of maltose to glucose (iii) Urease in decomposition of urea and (iv) Zymase in conversion of glucose to ethanol.

**References**

1. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.

2. R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.

3. J. A. Kent: Riegel**’**s Handbook of Industrial Chemistry, CBS Publishers, New Delhi.

4. **Kateřina Skotnicová, Monika Losertová, Miroslav Kursa, Theo**ry of production of non-ferrous metals and alloys Study.

5. K Venkataraman, the Chemistry of Synthetic Dyes, Volume 4, Elsevier,  [Technology](https://www.google.co.in/search?tbo=p&tbm=bks&q=subject:%22Technology+%26+Engineering%22&source=gbs_ge_summary_r&cad=0) &  [Engineering](https://www.google.co.in/search?tbo=p&tbm=bks&q=subject:%22Technology+%26+Engineering%22&source=gbs_ge_summary_r&cad=0).

6. Sujata Saxena and A. S. M. Raja by Natural Dyes: Sources, Chemistry, Application and Sustainability Issues.

7**.** Physical Chemistry by Atkins and De Paula, 8th Edn.

1. Physical Chemistry by Puri, Sharma and Pattania, 2017.
2. Kinetics and mechanism of chemical transformations by Rajarajm and Kuraiacose, Published by  [Macmillan India Ltd](https://www.sapnaonline.com/shop/Publisher/Macmillan%20India%20Limited).
3. Text book of Physical Chemistry by K.L. Kapoor Macmillan, 1999.

**Semester - V**

**Laboratory Course**

**Experiments in Physical Chemistry-I**

**Paper VI (Physical Chemistry)** **45hrs (3 h / w)**

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| **1.** | **Distribution law** | |  |  |  |  |  |  |
| a) Determination | | of distribution coefficient of iodine between water and carbon | | | | | | |
|  | Tetrachloride/determination | | of molecular | status | and | partition | coefficient | of benzoic |
|  | acid in Toluene and water. | |  |  |  |  |  |  |
| b) Determination of distribution coefficient | | | | of acetic | acid | between | n-butanol | and water. |
| **2.** | **Electrochemistry** | |  |  |  |  |  |  |
| a) Determination of cell constant of conductivity cell. | | | | |  |  |  |  |
| b) Determination | | ofdissociationconstant | | (Ka) | ofaceticacidbyconductivity | | | |
|  | measurements. |  |  |  |  |  |  |  |
| **3**. **Colorimetry** | |  |  |  |  |  |  |  |
|  | Verification of Beer**’**slaw | | using KMnO4 | and | determination of the concentration of | | | |
|  | the given solution. | |  |  |  |  |  |  |

**4. Adsorption**

Adsorption of acetic acid on animal charcoal, Verification of Freundlich adsorption isotherm.

**5. Physical constants**

Surface tension and viscosity of liquids. (Demonstration Experiment