**UNIVERSITY OF MUMBAI**

No. UG/73of 2018-19

**CIRCULAR:-**

Attention of the Principals of the affiliated Colleges and Directors of the recognized Institutions in Science & Technology Faculty is invited to this office Circular Nos. UG/156 of 2016-17, dated 16th November, 2016 relating to syllabus of the Bachelor of Science (B.Sc.) degree course.

They are hereby informed that the recommendations made by the Board of Studies in Chemistry at its meeting held on 28th May, 2018 have been accepted by the Academic Council at its meeting held on 14th June, 2018 **vide** item No. 4.41 and that in accordance therewith, the revised syllabus as per the (CBCS) for the Chemistry of T.Y.B.Sc. Physical Chemistry, Inorganic Chemistry, Organic Chemistry and Analytical Chemistry (Sem - V & VI) (3 and 6 Units) including Applied Component Drugs and Dyes, Heavy Fine Chemicals and Petrochemicals has been brought into force with effect from the academic year 2018-19, accordingly. (The same is available on the University's website www.mu.ac.in).

(Dr. Dinesh Kamble)
I/c REGISTRAR

MUMBAI – 400 032
6th ~~June~~ July, 2018

To

The Principals of the affiliated Colleges & Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

**A.C./4.41/14/06/2018**

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No. UG/ 73 -A of 2018 MUMBAI-400 032 6th ~~June~~ July, 2018

Copy forwarded with Compliments for information to:-

1) The I/c Dean, Faculty of Science & Technology,
2) The Chairman, Board of Studies in Chemistry,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Co-Ordinator, University Computerization Centre,

(Dr. Dinesh Kamble)
I/c REGISTRAR

# T.Y.B.Sc. CHEMISTRY (6 UNITS)
# Choice Based Semester and Grading System
# To be implemented from the Academic year 2018-2019

**SEMESTER V**

**PHYSICAL CHEMISTRY**

**COURSE CODE: USCH502 CREDITS: 02 LECTURES: 60**

| UNIT | TOPIC | NO. OF Lectures |
|---|---|---|
| UNIT I | 1.0 MOLECULAR SPECTROSCOPY | 15L |
| | 1.1 **Rotational Spectrum**: Introduction to dipole moment, polarization of a bond, bond moment, molecular structure, .Rotational spectrum of a diatomic molecule, rigid rotor, moment of inertia, energy levels, conditions for obtaining pure rotational spectrum, selection rule, nature of spectrum, determination of internuclear distance and isotopic shift.<br>1.2 **Vibrational spectrum**: Vibrational motion, degrees of freedom, modes of vibration, vibrational spectrum of a diatomic molecule, simple harmonic oscillator, energy levels, zero point energy, conditions for obtaining vibrational spectrum, selection rule, nature of spectrum.<br>1.3 **Vibrational-Rotational spectrum of diatomic molecule**: energy levels, selection rule, nature of spectrum, P and R branch lines. Anharmonic oscillator - energy levels, selection rule, fundamental band, overtones. Application of vibrational-rotational spectrum in determination of force constant and its significance. Infrared spectra of simple molecules like $H_2O$ and $CO_2$.<br>1.4 **Raman Spectroscopy :** Scattering of electromagnetic radiation, Rayleigh scattering, Raman scattering, nature of Raman spectrum, Stoke's lines, anti-Stoke's lines, Raman shift, quantum theory of Raman spectrum, comparative study of IR and Raman spectra, rule of mutual exclusion- $CO_2$ molecule. | |
| UNIT II | 2.0 CHEMICAL THERMODYNAMICS | 10 L |
| | 2.1.1**Colligative properties:** Vapour pressure and relative lowering of vapour pressure.<br>Measurement of lowering of vapour pressure - Static and Dynamic method. | |
| | 2.1.2 **Solutions of Solid in Liquid:**<br>2.1.2.1 Elevation in boiling point of a solution, thermodynamic derivation relating elevation in boiling point of the solution and molar mass of non-volatile solute.<br>2.1.2.2 Depression in freezing point of a solution, thermodynamic | |

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| | derivation relating the depression in the freezing point of a solution and the molar mass of the non-volatile solute.<br>Beckmann Method and Rast Method. | |
| | 2.1.3 **Osmotic Pressure :** Introduction, thermodynamic derivation of Van't Hoff equation, Van't Hoff Factor. Measurement of Osmotic Pressure - Berkeley and Hartley's Method, Reverse Osmosis. | |
| | 2.2 CHEMICAL KINETICS | 5 L |
| | 2.2.1 **Collision theory of reaction rates** : Application of collision theory to 1. Unimolecular reaction Lindemann theory and<br>2. Bimolecular reaction.<br>(derivation expected for both)<br><br>2.2.2 Classification of reactions as slow, fast and ultra -fast. Study of kinetics of fast reactions by Stop flow method and Flash photolysis (No derivation expected). | |
| | | |
| UNIT III | 3.0 NUCLEAR CHEMISTRY | 15L |
| | 3.1. **Introduction**: **B**asic terms-radioactive constants (decay constant, half life and average life) and units of radioactivity | |
| | 3.2 **Detection and Measurement of Radioactivity:** Types and characteristics of nuclear radiations, behaviour of ion pairs in electric field, detection and measurement of nuclear radiations using G. M. Counter and Scintillation Counter. | |
| | 3.3 **Application of use of radioisotopes as Tracers :** chemical reaction mechanism, age determination - dating by $C^{14}$. | |
| | 3.4 **Nuclear reactions**: nuclear transmutation (one example for each projectile), artificial radioactivity, Q - value of nuclear reaction, threshold energy. | |
| | 3.5 **Fission Process :** Fissile and fertile material, nuclear fission, chain reaction, factor controlling fission process.<br>multiplication factor and critical size or mass of fissionable material, nuclear power reactor and breeder reactor. | |
| | 3.6 **Fusion Process :** Thermonuclear reactions occurring on stellar bodies and earth. | |
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| UNIT IV | 4.1 SURFACE CHEMISTRY | 6L |
| | 4.1.1 **Adsorption:** Physical and Chemical Adsorption, types of adsorption isotherms . Langmuir's adsorption isotherm (Postulates and derivation expected).<br>B.E.T. equation for multilayer adsorption, (derivation not expected). Determination of surface area of an adsorbent using B.E.T. equation. | |
| | 4.2 COLLOIDAL STATE | 9L |
| | 4.2.1 **Introduction to colloids** - Emulsions, Gels and Sols | |
| | 4.2.2 **Electrical Properties** : Origin of charges on colloidal particles, Concept of electrical double layer, zeta potential, Helmholtz and Stern model.<br>Electro-kinetic phenomena - Electrophoresis, Electro-osmosis, Streaming potential, Sedimentation potential; Donnan Membrane | |

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| | Equilibrium. | |
| | 4.2.3 **Colloidal electrolytes :** Introduction, micelle formation, | |
| | 4.2.4 **Surfactants:** Classification and applications of surfactants in detergents and food industry. | |

**Reference Books :**


1. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co.Ltd.

2. Physical Chemistry, P.C. Rakshit, 6th Edition, 2001, Sarat Book Distributors, Kolkota.

3. Physical Chemistry, R.J. Silbey, & R.A. Alberty, 3rd edition , John Wiley & Sons, Inc [part 1]

4. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.

5. Modern Electrochemistry, J.O.M Bockris & A.K.N. Reddy, Maria Gamboa – Aldeco 2nd Edition, 1st Indian reprint,2006 Springer

6. Fundamental of Molecular Spectroscopy, 4th Edn., Colin N Banwell and Elaine M McCash Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2008.

7. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.

8. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford Universtity Press Oxford.

9. Physical Chemistry, G.K. Vemullapallie, 1997, Prentice Hall of India, Pvt.Ltd. New Delhi.

10. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, VISHAL PUBLISHING Company, 2008.

11. Textbook of Polymer Science, Fred W Bilmeyer, John Wiley & Sons (Asia) Ple. Ltd., Singapore, 2007.

12. Polymer Science, V.R. Gowariker, N.V. Viswanathan, Jayadev Sreedhar, New Age International (P) Ltd., Publishers, 2005.

13. Essentials of Nuclear Chemistry, Arnikar, Hari Jeevan , New Age International (P) Ltd., Publishers, 2011..

14. Chemical Kinetics,K. Laidler, Pearson Education India, 1987.


# T.Y.B.Sc Physical Chemistry Practical

## SEMESTER V

## PHYSICAL CHEMISTRY

**COURSE CODE: USCHP01**

**CREDITS: 02**

## Non-Instrumental

### Colligative properties

To determine the molecular weight of compound by Rast Method

### Chemical Kinetics

To determine the order between $K_2S_2O_8$ and KI by fractional change method. **(six units and three units)**

### Surface phenomena

To investigate the adsorption of acetic acid on activated charcoal and test the validity of Freundlich adsorption isotherm.

**Instrumental**

### Potentiometry

To determine the solubility product and solubility of AgCl
potentiometrically using chemical cell.

### Conductometry

To determine the velocity constant of alkaline hydrolysis of ethyl acetate by conductometric method.

### pH-metry

To determine acidic and basic dissociation constants of amino acid and hence to calculate isoelectric point.

## Reference books

1. Practical Physical Chemistry 3rd edition
A.M.James and F.E. Prichard , Longman publication

2. Experiments in Physical Chemistry R.C. Das and
B. Behra, Tata Mc Graw Hill

3. Advanced Practical Physical Chemistry J.B.Yadav,
Goel Publishing House

4. Advanced Experimental Chemistry. Vol-I
J.N.Gurtu and R Kapoor, S.Chand and Co.

5. Experimental Physical Chemistry By V.D.Athawale.

6. Senior Practical Physical Chemistry By: B. D. Khosla, V. C. Garg and A. Gulati, R Chand and Co.. 2011

**SEMESTER VI**

**PHYSICAL CHEMISTRY**

**COURSE CODE: USCH601 CREDITS: 02**

**LECTURES: 60**

| | | |
|---|---|---|
| UNIT I | 1.1 ELECTROCHEMISTRY | 7L |
| | 1.1.1 **Activity and Activity Coefficient:** Lewis concept, ionic strength, Mean ionic activity and mean ionic activity coefficient of an electrolyte, expression for activities of electrolytes. Debye-Huckel limiting law (No derivation). | |
| | 1.1.2 **Classification of cells:** Chemical cells and Concentration cells.<br>Chemical cells with and without transference, Electrode Concentration cells, Electrolyte concentration cells with and without transference | |

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| | (derivations are expected), | |
| | 1.2 APPLIED ELECTROCHEMISTRY | 8L |
| | 1.2.1 **Polarization**: concentration polarization and it's elimination | |
| | 1.2.2 **Decomposition Potential and Overvoltage** : Introduction, experimental determination of decomposition potential, factors affecting decomposition potential. Tafel's equation for hydrogen overvoltage, experimental determination of over –voltage | |
| UNIT II | 2.0 POLYMERS | 15L |
| | 2.1 **Basic terms :** macromolecule, monomer, repeat unit, degree of polymerization. | |
| | 2.2. **Classification of polymers:** Classification based on source, structure, thermal response and physical properties. | |
| | 2.3. **Molar masses of polymers:** Number average, Weight average, Viscosity average molar mass, Monodispersity and Polydispersity | |
| | 2.4. **Method of determining molar masses of polymers :** Viscosity method using Ostwald Viscometer. (derivation expected) | |
| | 2.5. **Light Emitting Polymers :** Introduction, Characteristics, Method of preparation and applications. | |
| | 2.6. **Antioxidants and Stabilizers :** Antioxidants , Ultraviolet stabilizers, Colourants, Antistatic agents and Curing agents. | |
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| UNIT III | 3.1 BASICS OF QUANTUM CHEMISTRY | 10 L |
| | 3.1.1 **Classical mechanics**: Introduction, limitations of classical mechanics, Black body radiation, photoelectric effect, Compton effect. | |
| | 3.1.2 **Quantum mechanics :** Introduction, Planck's theory of quantization, wave particle duality, de –Broglie's equation, Heisenberg's uncertainty principle. | |
| | 3.1.3 **Progressive and standing waves-** Introduction, boundary conditions, Schrodinger's time independent wave equation (No derivation expected), interpretation and properties of wave function. | |
| | 3.1.4 **Quantum mechanics** : 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. | |
| | 3.2 RENEWABLE ENERGY RESOURCES | 5L |
| | 3.2.1. **Renewable energy resources** : Introduction. | |
| | 3.2.2 **Solar energy**: Solar cells, Photovoltaic effect, Differences between conductors,semiconductors ,insulators and its band gap, Semiconductors as solar energy converters, Silicon solar cell | |
| | 3.2.3. **Hydrogen :** Fuel of the future, production of hydrogen by direct electrolysis of water, advantages of hydrogen as a universal energy medium. | |

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| UNIT IV | 4.1 NMR -NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY | 7L |
| | **4.1.1. Principle** : Nuclear spin, magnetic moment, nuclear 'g' factor, energy levels, Larmor precession, Relaxation processes in NMR ( spin -spin relaxation and spin - lattice relaxation).<br>**4.1.2. Instrumentation**: NMR Spectrometer | |
| | 4.2 ELECTRON SPIN RESONANCE SPECTROSCOPY | |
| | **4.2.1. Principle**: fundamental equation, g-value -dimensionless constant or electron g-factor, hyperfine splitting.<br>**4.2.2. Instrumentation**: ESR spectrometer, ESR spectrum of hydrogen and deuterium. | 8L |

**Note : Numericals and Word Problems are Expected from All Units**

**Reference Books :**


1. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co.Ltd.

2. Physical Chemistry, P.C. Rakshit, 6th Edition, 2001, Sarat Book Distributors, Kolkota.

3. Physical Chemistry, R.J. Silbey, & R.A. Alberty, 3rd edition , John Wiley & Sons, Inc [part 1]

4. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.

5. Modern Electrochemistry, J.O.M Bockris & A.K.N. Reddy, Maria Gamboa – Aldeco 2nd Edition, 1st Indian reprint,2006 Springer

6. Fundamental of Molecular Spectroscopy, 4th Edn., Colin N Banwell and Elaine M McCash Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2008.

7. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.

8. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford Universtity Press Oxford.

9. Physical Chemistry, G.K. Vemullapallie, 1997, Prentice Hall of India, Pvt.Ltd. New Delhi.

10. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, VISHAL PUBLISHING Company, 2008.

11. Textbook of Polymer Science, Fred W Bilmeyer, John Wiley & Sons (Asia) Ple. Ltd., Singapore, 2007.

12. Polymer Science, V.R. Gowariker, N.V. Viswanathan, Jayadev Sreedhar, New Age International (P) Ltd., Publishers, 2005.

13. Essentials of Nuclear Chemistry, Arnikar, Hari Jeevan , New Age International (P) Ltd., Publishers, 2011..

14. Chemical Kinetics,K. Laidler, Pearson Education India, 1987.


# T.Y.B.Sc Physical Chemistry Practical

**SEMESTER VI**

**PHYSICAL CHEMISTRY**

**COURSE CODE: USCHP02** **CREDITS: 02**

# Non-Instrumental

## Chemical Kinetics

To interpret the order of reaction graphically from the given experimental data and calculate the specific rate constant.

(No fractional order)

## Viscosity

To determine the molecular weight of high polymer polyvinyl alcohol (PVA) by viscosity measurement.

# Instrumental

## Potentiometry

To determine the amount of iodide, bromide and chloride in the mixture by potentiometric titration with silver nitrate.

To determine the number of electrons in the redox reaction between ferrous ammonium sulphate and cerric sulphate potentiometrically.

## Conductometry

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

## Colorimetry

To estimate the amount of Fe(III) in the complex formation with salicylic acid by Static Method.

## Reference books

1. Practical Physical Chemistry 3rd edition A.M.James and F.E. Prichard , Longman publication

2. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata Mc Graw Hill

3. Advanced Practical Physical Chemistry J.B.Yadav, Goel Publishing House

4. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S.Chand and Co.

5. Experimental Physical Chemistry By V.D.Athawale.

6. Senior Practical Physical Chemistry By: B. D. Khosla, V. C. Garg and A. Gulati, R Chand and Co.. 2011

**T.Y.B.Sc. CHEMISTRY (6 UNITS)**

Choice Based Semester and Grading System

**SEMESTER V**

**INORGANIC CHEMISTRY**

**COURSE CODE: USCH502** **CREDITS: 02** **LECTURES: 60**

| **UNIT-I** | **L/Week** |
|---|---|
| **1. Molecular Symmetry and Chemical Bonding** | |
| **1.1Molecular Symmetry (6L)** | |
| 1.1.1 Introduction and Importance of Symmetry in Chemistry. | |
| 1.1.2 Symmetry elements and Symmetry operations. | |
| 1.1.3 Concept of a Point Group with illustrations using the following point groups :(i)$C_{\infty V}$ (ii) $D_{\infty h}$ (iii) $C_{2V}$ (iv) $C_{3v}$ (v)$C_{2h}$ and (vi)$D_{3h}$ | |
| **1.2 Molecular Orbital Theory for heteronuclear diatomic molecules and polyatomic species (9L)** | |
| 1.2.1 Comparision between homonuclear and heteronuclear diatomic molecules. | |
| 1.2.2. Heteronuclear diatomic molecules like CO, NO and HCl, appreciation of modified MO diagram for CO. | |
| 1.2.3 Molecular orbital theory for $H_3$ and $H_3^+$ (correlation diagram expected). | |
| 1.2.4. Molecular shape to molecular orbital approach in $AB_2$ molecules. Application of symmetry concepts for linear and angular species considering σ- bonding only. (Examples like : i) $BeH_2$, ii) $H_2O$). | |
| **UNIT-II** | |
| **2 SOLID STATE CHEMISTRY** | |
| **2.1 Structures of Solids (11L)** | |
| 2.2.1 Explanation of terms viz.crystal lattice, lattice point, unit cell and lattice constants. | |
| 2.1.2 Closest packing of rigid spheres (hcp,ccp), packing density in simple cubic, bcc and fcc lattices. Relationship between density, radius of unit cell and lattice parameters. | |

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| 2.1.3 Stoichiometric Point defects in solids (discussion on Frenkel and Schottky defects expected). | |
| **2.2 Superconductivity (4L )** | |
| 2.2.1 Discovery of superconductivity. | |
| 2.2.2 Explanation of terms like superconductivity, transition temperature, Meissner effect. | |
| 2.2.3 Different types of super conductors viz.conventional superconductors, alkali metal fullerides, high temperature super conductors. | |
| 2.2.4 Brief application of superconductors. | |
| **UNIT-III** | |
| **3.0 CHEMISTRY OF INNER TRANSITION ELEMENTS (15L)** | |
| **3.1 Introduction:** Position in periodic table and electronic configuration of lanthanides and actinides. | |
| **3.2 Chemistry of Lanthanides with reference to** (i) lanthanide contraction and its consequences(ii) Oxidation states (iii) Ability to form complexes (iv) Magnetic and spectral properties | |
| **3.3 :**Occurrence, extraction and separation of lanthanides by (i) Ion Exchange method and (ii) Solvent extraction method (Principles and technique) | |
| **3.4** Applications of lanthanides | |
| UNIT-IV | |
| **4. SOME SELECTED TOPICS** | |
| **4.1 Chemistry of Non-aqueous Solvents (5 L)** | |
| 4.1.1Classification of solvents and importance of non-aqueous solvents. | |
| 4.1.2 Characteristics and study of liquid ammonia, dinitrogen tetra oxide as non-aqueous solvents with respect to : (i) acid-base reactions and (ii) redox reactions. | |
| **4.2 Comparative Chemistry of Group 16 (5L)** | |
| 4.2.1 Electronic configurations, trends in physical properties, allotropy | |
| 4.2.2 Manufacture of sulphuric acid by Contact process. | |
| **4.3 Comparative Chemistry of Group 17 (5L)** | |
| 4.3.1Electronic configuration , General characteristics, anamolous properties of fluorine, comparative study of acidity of oxyacids of chlorine w.r.t acidity, oxidising properties and structures(on the basis of VSEPR theory) | |
| 4.3.2 Chemistry of interhalogens with reference to preparations, properties and structures (on the basis of VSEPR theory) . | |

## REFERENCES

### SEM-V

**Unit-I**


1. Per Jensen and Philip R. Bunker , Fundamentals of Molecular Symmetry , Series in Chemical Physics, Taylor & Francis Group
2. J. S. Ogden, Introduction to Molecular Symmetry, Oxford University Press
3. Derek W. Smith, Molecular orbital theory in inorganic chemistry Publisher: Cambridge University Press
4. C. J. Ballhausen, Carl Johan Ballhausen, Harry B. Gray Molecular Orbital Theory: An Introductory Lecture Note and Reprint Volume Frontiers in chemistry Publisher W.A. Benjamin, 1965
5. Jack Barrett and Mounir A Malati, Fundamentals of Inorganic Chemistry, Affiliated East west Press Pvt. Ltd., New Delhi.
6. Satya Prakash, G.D.Tuli, R.D. Madan , , Advanced Inorganic Chemistry.S. Chand & Co Ltd


**Unit-II**


1. Lesley E. Smart, Elaine A. Moore Solid State Chemistry: An Introduction, 2nd Edition CRC Press,
2. C. N. R. Rao Advances in Solid State Chemistry
3. R.G. Sharma Superconductivity: Basics and Applications to Magnets
4. Michael Tinkham ,Introduction to Superconductivity: Vol I (Dover Books on Physics)
5. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.
6. Richard Harwood, Chemistry, Cambridge University Press,
7. Satya Prakash, G.D.Tuli, R.D. Madan , , Advanced Inorganic Chemistry.S. Chand & Co Ltd .


**Unit-III**


1. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
2. Greenwood, N.N. and Earnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.
3. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
4. G. Singh, Chemistry of Lanthanides and Actinides, Discovery Publishing House
5. Simon Cotton , Lanthanide and Actinide Chemistry Publisher: Wiley-Blackwell


**Unit-IV**


1. B. H. Mahan, University Chemistry, Narosa publishing.
2. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.

3. J. D. Lee, Concise Inorganic Chemistry, 4thEdn., ELBS,
4. D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd edition, Oxford University Press
5. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
6. Gary Wulfsberg, Inorganic chemistry, Viva Books Pvt,.Ltd. (2002).
7. Richard Harwood, Chemistry, chapter 10 Industrial inorganic chemistry
8. Greenwood, N.N. and Earnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.
9. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993
10. Satya Prakash, G.D.Tuli, R.D. Madan , Advanced Inorganic Chemistry.S. Chand & Co Ltd 2004

## Practicals

### SEMESTER V

### INORGANIC CHEMISTRY

**COURSE CODE: USCHP05** **CREDITS: 02**

### Course USCH502: Inorganic Practicals (60L)

### I. Inorganic preparations

1. Preparation of Potassium diaquobis- (oxalato)cuprate (II)
2. Preparation of Ferrous ethylene diammonium sulphate.
3. Preparation of bisacetylacetonatocopper(II)

### II. Determination of percentage purity of the given water soluble salt and qualitative detection w.r.t added cation and/or anion (qualitative analysis only by wet tests).

(Any three salts of transition metal ions)

**Reference Books (practicals)**

1. Vogel Textbook of Quantitative Chemical Analysis G.H. Jeffery, J. Basset.

2. Advanced experiments in Inorganic Chemistry., G. N. Mukherjee., 1st Edn., 2010., U.N.Dhur & Sons Pvt Ltd .
3. Vogel's. Textbook of. Macro and Semimicro qualitative inorganic analysis. Fifth edition.

**SEMESTER VI**

**INORGANIC CHEMISTRY**

**COURSE CODE: USCH602 CREDITS: 02 LECTURES: 60**

| **COURSE CODE** | **CREDITS** | |
|---|---|---|
| **USCH602** | **(60 Lectures)** | |
| (Numericals and word problems are expected) | | |
| **UNIT-I** | | **L/week** |
| **1.Theories of the metal-ligand bond (I) (15L)** | | |
| 1.1 Limitations of Valence Bond Theory. | | |
| 1.2 Crystal Field Theory and effect of crystal field on central metal valence orbitals in various geometries from linear to octahedral(from coordination number 2 to coordination number 6) | | |
| 1.3 Splitting of *d* orbitals in octahedral, square planar and tetrahedral crystal fields. | | |
| 1.4 Distortions from the octahedral geometry : (i) effect of ligand field and (ii) Jahn-Teller distortions. | | |
| 1.5 Crystal field splitting parameters Δ ; its calculation and factors affecting it in octahedral complexes, Spectrochemical series. | | |
| 1.6 Crystal field stabilization energy(CFSE), calculation of CFSE for octahedral complexes with $d^0$ to $d^{10}$ metal ion configurations. | | |
| 1.7 Consequences of crystal field splitting on various properties such as ionic radii, hydration energy and enthalpies of formation of metal complexes of the first transition series. | | |
| 1.8 Limitations of CFT : Evidences for covalence in metal complexes (i) intensities of d-d transitions, (ii) ESR spectrum of $[IrCl_6]^{2-}$ (iii) Nephelauxetic effect. | | |
| **UNIT-II** | | |
| **2.Theories of the metal-ligand bond (II)** | | |
| **2.1 Molecular orbital Theory for coordination compounds. (4L)** | | |

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| 2.1.1 Identification of the central metal orbitals and their symmetry suitable for formation of σ bonds with ligand orbitals. | |
| 2.1.2 Construction of ligand group orbitals. | |
| 2.1.3 Construction of σ-molecular orbitals for an $ML_6$ complex. | |
| 2.1.4 Effect of π-bonding on complexes . | |
| 2.1.5 Examples like $[FeF_6]^{-4}$, $[Fe(CN)_6]^{-4}$, $[FeF_6]^{-3}$, $[Fe(CN)_6]^{-3}$, $[CoF_6]^{-3}$, $[Co(NH_3)_6]^{+3}$ | |
| **2.2 Stability of Metal-Complexes (4L)** | |
| 2.2.1 Thermodynamic and kinetic perspectives of metal complexes with examples. | |
| 2.2.2 Stability constants: stepwise and overall stability constants and their interrelationship. | |
| 2.2.3 Factors affecting thermodynamic stability. | |
| **2.3 Reactivity of metal complexes. (4L)** | |
| 2.3.1 Comparison between Inorganic and organic reactions. | |
| 2.3.2 Types of reactions in metal complexes. | |
| 2.3.3 Inert and labile complexes : correlation between electronic configurations and lability of complexes. | |
| 2.3.4 Ligand substitution reactions : Associative and Dissociative mechanisms. | |
| 2.2.5 Acid hydrolysis, base hydrolysis and anation reactions. | |
| **2.4 Electronic Spectra. (3L)** | |
| 2.4.1Origin of electronic spectra | |
| 2.4.2 Types of electronic transitions in coordination compounds: intra- ligand,Charge transfer and intra-metal transitions. | |
| 2.4.3 Selection rules for electronic transitions. | |
| 2.4.4 Electronic configuration and electronic micro states, Terms and Term symbols for transition metal ions, rules for determination of ground state term. | |
| 2.4.5 Determination of Terms for $p^2$ and $d^1$ electronic configurations. | |
| **UNIT-III** | |
| **3 ORGANOMETALLIC CHEMISTRY (15L)** | |
| **3.1 Organometallic Compounds of main group metal (6L)** | |
| 3.1.1General characteristics of various types of organometallic compounds, viz.ionic, σ-bonded and electron deficient compounds. | |
| 3.1.2 General synthetic methods of organometallic compounds : (i) Oxidative-addition, (ii)Metal-metal exchange(transmetallation), (iii) Carbanion-halide exchange, (iv) Metal-hydrogen exchange(metallation) and (v) Methylene-insertion reactions. | |
| 3.1.3 Some chemical reactions of organometallic compounds: | |

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| (i) Reactions with oxygen and halogens, (ii) Alkylation and arylation reactions (iii) Reactions with protic reagents, (iv) Redistribution reactions and (v) Complex formation reactions. | |
| **3.2 Metallocenes (5L)** | |
| Introduction, Ferrocene : Synthesis, properties, structure and bonding on the basis of VBT. | |
| **3.3 Catalysis (4L)** | |
| 3.3.1 Comparison between homogeneous and heterogeneous catalysis | |
| 3.3.2 Basic steps involved in homogeneous catalysis | |
| 3.3.3 Mechanism of Wilkinson's catalyst in hydrogenation of alkenes. | |
| **UNIT-IV** | |
| **4 SOME SELECTED TOPICS (15L)** | |
| **4.1 Metallurgy ( 7L)** | |
| 4.1.1 Types of metallurgies, | |
| 4.1.2 General steps of metallurgy; Concentration of ore, calcinations, roasting,reduction and refining. | |
| 4.1.3 Metallurgy of copper: occurrence, physicochemical principles, Extraction of copper from pyrites& refining by electrolysis. | |
| **4.2 Chemistry of Group 18 (5L)** | |
| 4.2.1 Historical perspectives | |
| 4.2.2 General characteristics and trends in physical and chemical properties | |
| 4.2.3 Isolation of noble gases | |
| 4.2.4 Compounds of Xenon (oxides and fluorides) with respect to preparation and structure (VSEPR) | |
| 4.2.5 Uses of noble gases | |
| **4.3 Introduction to Bioinorganic Chemistry. (3L)** | |
| 4.3.1Essential and non essential elements in biological systems. | |
| 4.3.2 Biological importance of metal ions such as $Na^{+}$,$K^{+}$,$Fe^{+2}$/$Fe^{+3}$ and $Cu^{+2}$(Role of $Na^{+}$ and $K^{+}$ w.r.t ion pump) | |
| | |

**References.**

**SEM-VI**

**Unit-I:**


1. Geoffrey A. Lawrance Introduction to Coordination Chemistry John Wiley & Sons.
2. R. K. Sharma Text Book of Coordination Chemistry Discovery Publishing House
3. R. Gopalan , V. Ramalingam Concise Coordination Chemistry , Vikas Publishing House;
4. Shukla P R, Advance Coordination Chemistry , Himalaya Publishing House
5. Glen E. Rodgers, Descriptive Inorganic, Coordination, and Solid-State Chemistry Publisher: Thomson Brooks/Cole


**Unit-II:**


1. Ramesh Kapoor and R.S. Chopra, **Inorganic Chemistry**, R. Chand publishers,
2. Basolo, F, and Pearson, R.C., Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY,
3. Twigg ,Mechanisms of Inorganic and Organometallic Reactions Publisher: Springer
4 R.K. Sharma Inorganic Reaction Mechanisms Discovery Publishing House
5 M. L. Tobe Inorganic Reaction Mechanisms Publisher Nelson, 1972


**Unit-III:**


1 Cotton, Wilkinson, Murillo and Bochmann, Advanced **Inorganic Chemistry**, 6th Edition..
2 H.W. Porterfield, Inorganic Chemistry, Second Edition, Academic Press, 2005
3 Purecell, K.F. and Kotz, J.C., Inorganic Chemistry W.B. Saunders Co. 1977.
4 Robert H. Crabtree ,The Organometallic Chemistry of the Transition Metals, Publication by John Wiley & Sons
5 B D Gupta & Anil J Elias Basic Organometallic Chemistry: Concepts, Syntheses and Applications, University press
6 Ram Charan Mehrotra, Organometallic Chemistry: A Unified Approach, New Age International.


**Unit-IV**


1 R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.
2 D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd edition, Oxford University Press
3 Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
4 Jack Barrett and Mounir A Malati, Fundamentals of Inorganic Chemistry, Affiliated East west Press Pvt. Ltd., New Delhi.
5 R.Gopalan, Chemistry for undergraduates. Chapter 18. Principles of Metallurgy.(567-591)
6 Puri ,Sharma Kalia Inorganic chemistry. Chapter 10, Metals and metallurgy.(328-339)

7 Greenwood, N.N. and Earnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.
8 Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
9 Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing Company 1994.
10 Satya Prakash, G.D.Tuli, R.D. Madan , , Advanced Inorganic Chemistry.S. Chand & Co Ltd

## PRACTICALS

### SEMESTER VI

### INORGANIC CHEMISTRY

**COURSE CODE: USCHP06** **CREDITS: 02**

**I. Inorganic preparations**

1. Preparation of Tris(acetylacetonato) iron(III)
2. Green synthesis of bis(dimethylglyoximato) nickel(II) complex using nickel carbonate and sodium salt of dmg .
3. Preparation of potassium trioxalato aluminate (III)

**II. Determination of percentage purity of the given water soluble salt and qualitative detection w.r.t added cation and/or anion (qualitative analysis only by wet tests).**

(Any three salts of main group metal ions)

**Reference Books (practicals)**

4. Vogel Textbook of Quantitative Chemical Analysis G.H. Jeffery, J. Basset.
5. Advanced experiments in Inorganic Chemistry., G. N. Mukherjee., 1st Edn., 2010., U.N.Dhur & Sons Pvt Ltd .
6. Vogel's. Textbook of. Macro and Semimicro qualitative inorganic analysis. Fifth edition.

# T.Y.B.Sc, CHEMISTRY (Six Units)

**SEMESTER V**

**ORGANIC CHEMISTRY**

**COURSE CODE: USCH503** **CREDITS: 02** **LECTURES: 60**

## Unit I

### 1.1 Mechanism of organic reactions (10 L)

1.1.1 The basic terms & concepts: bond fission, reaction intermediates, electrophiles & nucleophiles, ligand, base, electrophilicity vs. acidity & nucleophilicity vs basicity.

1.1.2 Neighbouring group participation in nucleophilic substitution reactions**:** participation of lone pair of electrons, kinetics and stereochemical outcome.

1.1.3 Acyl nucleophilic substitution (Tetrahedral mechanism): Acid catalyzed esterification of carboxylic acids ( $A_{AC}2$) and base promoted hydrolysis of esters ( $B_{AC}2$).

1.1.4 Pericyclic reactions, classification and nomenclature

1.1.4.1 Electro cyclic reactions (ring opening and ring closing), cycloaddition, sigma tropic Rearrangement, group transfer reactions, cheletropic reaction (definition and one example of each type)

1.1.4.2 Pyrolytic elimination: Cope, Chugaev, pyrolysis of acetates

**References:**


1. A guidebook to mechanism in Organic Chemistry, 6th edition, Peter Sykes, Pearson education, New Delhi
2. Organic Reaction Mechanism, 4th edition, V. K. Ahluwalia, R. K. Parashar, Narosa Publication.
3. Organic reactions & their mechanisms,3rd revised edition, P.S. Kalsi, New Age International Publishers.
4. M.B.Smith and J. March, Advanced organic chemistry- reactions mechanism and structure, 5th edition.


### 1.2 Photochemistry (5 L)

1.2.1 Introduction: Difference between thermal and photochemical reactions. Jablonski diagram, singlet and triplet states, allowed and forbidden transitions, fate of excited molecules, photosensitization.

1.2.2 Photochemical reactions of olefins: photoisomerization, photochemical rearrangement of 1,4-dienes (di- π methane)

1.2.3 Photochemistry of carbonyl compounds: Norrish I, Norrish II cleavages. Photo reduction (e.g. benzophenone to benzpinacol)

**References:**


1. Organic Chemistry, 7th Edition, R.T. Morrison, R. N. Boyd & S. K. Bhattacharjee, Pearson.
2. Organic chemistry,8th edition, John Mc Murry


## Unit II

### 2.1 Stereochemistry I (5 L)

2.1.1 Molecular chirality and elements of symmetry: Mirror plane symmetry, inversion center, roation -reflection (alternating) axis.

2.1.2 Chirality of compounds without a stereo genic center: cummulenes and biphenyls.

**References:**


1. L. Eliel , stereochemistry of carbon compounds, Tata McGraw Hill
2. Stereochemistry P.S.Kalsi , New Age International Ltd.,4th Edition
3. Stereochemistry by Nassipuri.


**2.2 Agrochemicals (4 L)**

2.2.1 General introduction & scope, meaning & examples of insecticides, herbicides, fungicide, rodenticide, pesticides, plant growth regulators.

2.2.2 Advantages & disadvantages of agrochemicals

2.2.3 Synthesis & application of IAA ( Indole Acetic Acid) & Endosulphan,

2.2.4 Bio pesticides – Neem oil & Karanj oil.

**References:**


1. Insecticides & pesticides: Saxena A. B., Anmol publication.
2. Growth regulators in Agriculture & Horticulture: Amarjit Basra, CRC press 2000.
3. Agrochemicals and pesticides: A.Jadhav and T.V.Sathe.


**2.3 Heterocyclic chemistry: (6 L)**

2.3.1 Reactivity of pyridine-N-oxide, quinoline and iso-quionoline.

2.3.2 Preparation of pyridine-N-oxide, quinoline (Skraup synthesis) and iso-quinoline ( Bischler-Napieralski synthesis).

2.3.3 Reactions of pyridine-N-oxide: halogenation, nitration and reaction with $NaNH_2$/liq.$NH_3$, n-BuLi.

2.3.4 Reactions of quinoline and isoquinoline; oxidation,reduction,nitration,halogenation and reaction with $NaNH_2$/liq.$NH_3$,n-BuLi.

**References**


1. Name Reactions in Heterocyclic Chemistry, Jie-Jack Li, Wiley-Interscience publications, 2005.
2. Handbook of Heterocyclic Chemistry, 2nd Edition, Alan R. Katritzky and Alexander F. Pozharskii, Elsevier Science Ltd, 2000.
3. Heterocyclic Chemistry, 5th Edition, John A. Joule and Keith Mills, Wiley publication, 2010.
4. Heterocyclic chemistry, 3rd Edition, Thomas L. Gilchrist, Pearson Education, 2007.


**Unit III**

**3.1 IUPAC (5 L)**

IUPAC Systematic nomenclature of the following classes of compounds (including compounds upto two substituents / functional groups):

3.1.1 Bicyclic compounds – spiro, fused and bridged (upto 11 carbon atoms) – saturated and unsaturated compounds.

3.1.2 Biphenyls

3.1.3 Cummulenes with upto 3 double bonds

3.1.4 Quinolines and isoquinolines

**References**

1. Nomenclature of Organic Chemistry**:** IUPAC recommendations and preferred Names 2013, RSC publication.
2. IUPAC nomenclature by S.C.Pal.

**3.2 Synthesis of organic compounds (10L)**

3.2.1 Introduction: Linear and convergent synthesis, criteria for an ideal synthesis, concept of chemo selectivity and regioselectivity with examples, calculation of yields.

3.2.2 Multicomponent Synthesis: Mannich reaction and Biginelli reaction. Synthesis with examples (no mechanism)

3.2.3 Green chemistry and synthesis:

Introduction: Twelve principles of green chemistry, concept of atom economy and E-factor, calculations and their significance, numerical examples.

i) Green reagents: dimethyl carbonate.
ii) Green starting materials : D-glucose
iii) Green solvents : supercritical $CO_2$
iv) Green catalysts: Bio catalysts.

3.2.4 Planning of organic synthesis

i) synthesis of nitroanilines. (*o&p*)
ii) synthesis of halobenzoic acid.(*o&p*)
iii) Alcohols (primary / secondary / tertiary) using Grignard reagents.
iv) Alkanes (using organo lithium compounds)

**Reference:**


1. Green chemistry an introductory text : Mike Lancaster.
2. Green chemistry: V. K. Ahluwalia (Narosa publishing house pvt. ltd.)
3. Green chemistry an introductory text : RSC publishing.
4. New trends in green chemistry V. K. Ahluwalia , M. Kidwai, Klumer Academic publisher
5. Green chemistry by V. Kumar.
6. Organic chemistry: Francis Carey
7. Organic chemistry: Carey and Sundberg.


**Unit IV**

**4.1 Spectroscopy I (5 L)**

4.1.1 Introduction: Electromagnetic spectrum, units of wavelength and frequency

4.1.2 UV – Visible spectroscopy: Basic theory, solvents, nature of UV-Visible spectrum, concept of chromophore, auxochrome, bathochromic and hypsochromic shifts, hyperchromic and hypochromic effects, chromophore-chromophore and chromophore-auxochrome interactions.

4.1.3 Mass spectrometry: Basic theory. Nature of mass spectrum. General rules of fragmentation. Importance of molecular ion peak, isotopic peaks, base peak, nitrogen rule, rule of 13 for determination of empirical formula and molecular formula. Fragmentation of alkanes and aliphatic carbonyl compounds.

**References:**


1. Organic spectroscopy (Second edition),Jag Mohan ,Narosa publication
2. Spectroscopy, Pavia, Lampman, Kriz,Vyvyan.

3. Elementary organic spectroscopy (Third edition), Y.R.Sharma, S.Chand publication..
4. Introduction to spectroscopy (third edition), Pavia ,Lampman,Kriz,john vondeling,Emily Barrosse.
5. Organic chemistry Paula Y. Bruice, Pearson education.
6. Spectral identification of organic molecules by Silverstein.
7. Absorption spectroscopy of organic molecules by V.M.Parikh.

**4.2 Natural Products: (10L)**

4.2.1. Terpenoids: Introduction, Isoprene rule, special isoprene rule and the gem-dialkyl rule.

4.2.2 Citral:

a) Structural determination of citral.
b) Synthesis of citral from methyl heptenone
c) Isomerism in citral. (cis and trans form).

4.2.3. Alkaloids Introduction and occurrence.

Hofmann's exhaustive methylation and degradation in**:** simple open chain and N – substituted monocyclic amines.

4.2.4 Nicotine:

a) Structural determination of nicotine. (Pinner's work included )
b) Synthesis of nicotine from nicotinic acid
c) Harmful effects of nicotine.

4.2.5 Hormones:

Introduction, structure of adrenaline (epinephrine), physiological action of adrenaline.
Synthesis of adrenaline from

a) Catechol
b) p-hydroxybenzaldehyde( Ott's synthesis)

**References:**

1. Chemistry of natural products by Chatwal Anand – Vol I and Vol II
2. Chemistry of natural products by O.P. Agarwal
3. Chemistry of natural products by Meenakshi Sivakumar and Sujata Bhat.
4. Organic chemistry by Morrision and Boyd,7th edition.
5. I.L.Finar,Vol-I and Vol-II, 5th edition.

**PRACTICALS**

**SEMESTER V**

**ORGANIC CHEMISTRY**

**COURSE CODE: USCHP09** **CREDITS: 02**

**A) SEMESTER V**: Separation of Binary solid-solid mixture (2.0 gms mixture to be given).

1. Minimum Six mixtures to be completed by the students.
2. Components of the mixture should include water soluble and water insoluble acids (carboxylic acid), water insoluble phenols( 2-naphthol, 1-naphthol), water insoluble bases

(nitroanilines) , water soluble neutral (thiourea) and water insoluble neutral compounds (anilides , amides, m-DNB, hydrocarbons)

After correct determination of chemical type, the separating reagent should be decided by the student for separation.

4. Follow separation scheme with the bulk sample of binary mixture.

5. After separation into component A and component B, one component (decided by the examiner) is to be analyzed and identified with m.p..

**References:**


1. Practical organic chemistry – A. I. Vogel
2. Practical organic chemistry – H.Middleton.
3. Practical organic chemistry – O.P.Aggarwal.


**SEMESTER VI**

**ORGANIC CHEMISTRY**

**COURSE CODE: USCH603** **CREDITS: 02** **LECTURES: 60**

## Unit I

### 1.1 Stereochemistry II (10 L)

1.1.1 Stereoselectivity and stereospecificity: Idea of enantioselectivity (ee) and diastereoselectivity (de) , Topicity : enantiotopic and diasterotopic atoms, groups and faces.

1.1.2 Stereochemistry of –

i) Substitution reactions : $S_{Ni}$ (reaction of alcohol with thionyl chloride)

ii) Elimination reactions: $E_2$–Base induced dehydrohalogenation of 1-bromo-1,2-diphenylpropane.

iii) Addition reactions to olefins:

a) bromination (electrophilic anti addition)

b) syn hydroxylation with $O_sO_4$ and $KMnO_4$

c) epoxidation followed by hydrolysis.

**References:**

Refer Stereochemistry –I (Sem-V, Unit-II)

### 1.2 Amino acids & Proteins (5 L)

**1.2.1** α-Amino acids: General Structure, configuration, and classification based on structure and nutrition. Properties: pH dependency of ionic structure, isoelectric point and zwitter ion. Methods of preparations: Strecker synthesis, Gabriel phthalamide synthesis.

**1.2.2** Polypeptides and Proteins: nature of peptide bond. Nomenclature and representation of polypeptides (di-and tri-peptides) with examples Merrifield solid phase polypeptide synthesis. .Protiens:general idea of primary,secondary,tertiary & quaternary structure

**References:**


1. Biochemistry, 8th Ed., Jeremy Berg, Lubert Stryer, John L. Tymoczko, Gregory J. Gatto Pub. W. H. Freeman Publishers
2. Lehninger Principles of Biochemistry 7th Ed., David Nelson and Michael Cox, Publisher W. H. Freeman
3. Name Reactions – Jie Jack Li, 4th Edition, Springer Pub.


## Unit II

### 2.1 Molecular Rearrangements (5 L)

Mechanism of the following rearrangements with examples and stereochemistry wherever applicable.

2.1.1 Migration to the electron deficient carbon: Pinacol-pinacolone rearrangement.

2.1.2 Migration to the electron deficient nitrogen: Beckmann rearrangement.

2.1.3 Migration involving a carbanion : Favorski rearrangement.

2.1.4 Name reactions: Michael addition, Wittig reaction.

**References:**

Refer Mechanism of organic reaction (Sem-V, Unit-I)

### 2.2 Carbohydrates (10 L)

2.2.1 Introduction: classification, reducing and non-reducing sugars, DL notation

2.2.2 Structures of monosaccharides: Fischer projection (4-6 carbon monosaccharides) and Haworth formula (furanose and pyranose forms of pentoses and hexoses)
Interconversion: open chain and Haworth forms of monosaccharides with 5 and 6 carbons. Chair conformation with stereochemistry of D-glucose, Stability of chair form of D-glucose

2.2.3 Stereoisomers of D-glucose: enantiomer, diastereomers, anomers, epimers.

2.2.4 Mutarotation in D-glucose with mechanism

2.2.5 Chain lengthening & shortening reactions: Modified Kiliani-Fischer synthesis (D-arabinose to D-glucose and D-mannose), Wohl method (D-glucose to D-arabinose)

2.2.6 Reactions of D-glucose and D-fructose:
(a) Osazone formation (b) reduction: Hi/Ni, $NaBH_4$ (c) oxidation: bromine water, $HNO_3$, $HIO_4$ (d) acetylation (e) methylation:(d) and (e) with cyclic pyranose forms

2.2.7 Glycosides: general structure

**References:**


1. Organic chemistry (fourth edition),G,Marc Loudon,Oxford University press.
2. Introduction to Organic Chemistry (Third edition), Andrew Streitwieser, Jr. Clayton H. Heathcock, Macmilan publishing.
3. Organic chemistry fourth edition, Morrision and Boyd.
4. Introduction to Organic chemistry,John McMurry.
5. Organic chemistry volume-1&2 (fifth and sixth edition) IL Finar.


## Unit III

### 3.1 Spectroscopy II (10 L)

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

**3.1.2** PMR Spectroscopy: Basic theory of PMR, nature of PMR spectrum, chemical shift (δ unit), standard for PMR, solvents used. Factors affecting chemical shift: (1) inductive effect (2) anisotropic effect (with reference to C=C, C≡C, C=O and benzene ring). Spin- spin coupling and

coupling constant. application of deuterium exchange technique. application of PMR in structure determination.

**3.1.3** Spectral characteristics of following classes of organic compounds, including benzene and monosubstituted benzenes, with respect to IR and PMR: (1) alkanes (2) alkenes (3) alkynes (4) haloalkanes (5) alcohols (6) carbonyl compounds (7) ethers (8) amines (broad regions characteristic of different groups are expected).

Problems of structure elucidation of simple organic compounds using individual or combined use of UV-Vis, IR, Mass and NMR spectroscopic technique are expected. (Index of hydrogen deficiency should be the first step in solving the problems).

**References:**

Refer spectroscopy –I, (Sem-V, Unit-IV)

**3.2 Nucleic Acids** **(5 L)**

Controlled hydrolysis of nucleic acids. sugars and bases in nucleic acids. Structures of nucleosides and nucleotides in DNA and RNA. Structures of nucleic acids (DNA and RNA) including base pairing.

**References:**


1. Organic chemistry R.T.Morrison and R.N.Boyd, 6th edition, pearson education
2. S.H.Pine, organic chemistry 4th edition. McGraw Hill


**Unit IV**

**4.1 Polymer** **(8 L)**

4.1.1 Introduction: terms monomer, polymer, homopolymer, copolymer, thermo plastics and thermosets.

4.1.2 Addition polymers: polyethylene, polypropylene, teflon, polystyrene, PVC, Uses.

4.1.3 Condensation polymers: polyesters, polyamides, polyurethanes, polycarbonates, phenol formaldehyde resins.Uses

4.1.4 Stereochemistry of polymers: Tacticity, mechanism of stereochemical control of polymerization using Ziegler Natta catalysts.

4.1.5 Natural and synthetic rubbers: Polymerisation of isoprene: 1,2 and 1,4 addition (cis and trans), Styrene butadiene copolymer.

4.1.6 Additives to polymers: Plasticisers, stabilizers and fillers.

4.1.7 Biodegradable polymers: Classification and uses. polylactic acid structure, properties and use for packaging and medical purposes.

(Note : Identification of monomer in a given polymer & structure of polymer for a given monomer is expected. condition for polymerization is not expected)

**References:**


1. Polymer chemistry by M.G.Arora, K.Singh.
2. Polymer science – a text book by Ahluwalia and Mishra
3. Introduction to polymer chemistry - R.Seymour, Wiley Interscience.


**4.2 Catalysts and Reagents** **(7 L)**

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

**4.2.1** Catalysts: Catalysts for hydrogenation:

a. Raney Nickel

b. Pt and $PtO_2$ ( C=C, CN, $NO_2$, aromatic ring)
c. Pd/C : C=C, COCl→CHO (Rosenmund)
d. Lindlar catalyst: alkynes

**d.2.2** Reagents**:**

a. $LiAlH_4$ (reduction of CO, COOR, CN,$NO_2$)
b. $NaBH_4$ (reduction of CO)
c. $SeO_2$ (Oxidation of $CH_2$ alpha to CO)
d. mCPBA (epoxidation of C=C)
e. NBS (allylic and benzylic bromination)

**References:**


1. Organic chemistry by Francis Carey – McGrawHill .
2. Oranic chemistry by Carey and Sundberg, Part A & B


**PRACTICALS**

**SEMESTER VI**

**ORGANIC CHEMISTRY**

**COURSE CODE: USCHP10** **CREDITS: 02**

**A) SEMESTER VI:** Separation of Binary liquid-liquid and liquid- solid mixture.

1. Minimum Six mixtures to be completed by the students.
2. Components of the liq-liq mixture should include volatile liquids like acetone, methylacetate, ethylacetate, isopropylalcohol, ethyl alcohol, EMK and non volatile liquids like chlorobenzene , bromobenzene, aniline, N,N dimethylaniline, acetophenone, nitrobenzene, ethyl benzoate.
3. Components of the liq- solid mixture should include volatile liquids like acetone, methylacetate, ethylacetate, ethyl alcohol, IPA, EMK and solids such as water insoluble acids, phenols, bases, neutral.
4. A sample of the mixture one ml to be given to the student for detection of the physical type of the mixture.
5. After correct determination of physical type, separation of the binary mixture to be carried out by distillation method using microscale technique.
6. After separation into component A and component B, the compound to be identified can be decided by examiner.

**References:**


4. Practical organic chemistry – A. I. Vogel
5. Practical organic chemistry – H.Middleton.
6. Practical organic chemistry – O.P.Aggarwal.


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# T.Y.B.Sc. CHEMISTRY (6 UNITS)

Choice Based Credit System

**SEMESTER V**

**ANALYTICAL CHEMISTRY**

**COURSE CODE: USCH504 CREDITS: 02 LECTURES: 60**

| | | | |
|---|---|---|---|
| **UNIT I :INTRODUCTION TO QUALITY CONCEPTS,CHEMICAL CALCULATIONS AND SAMPLING (3 & 6 UNITS)** | | | |
| **1.1** | **Quality in Analytical Chemistry** | | **05 L** |
| | 1.1.1 | Concepts of Quality, Quality Control and Quality Assurance | |
| | 1.1.2 | Importance of Quality concepts in Industry | |
| | 1.1.3 | Chemical Standards and Certified Reference Materials; Importance in chemical analysis<br>Quality of material: Various grades of laboratory reagents | |
| **1.2** | **Chemical Calculations (Numericals and word problems are expected)** | | **04 L** |
| | 1.2.1 | Inter conversion of various concentration units.<br>(Conversion of concentration from one unit to another unit with examples) | |
| | 1.2.2 | Percent composition of elements in chemical compounds | |
| **1.3** | **Sampling** | | **06 L** |
| | 1.3.1 | Purpose, significance and difficulties encountered in sampling | |
| | 1.3.2 | Sampling of solids: Sample size – bulk ratio, size to weight ratio, multistage and sequential sampling, size reduction methods, sampling of compact solids, equipments and methods of sampling of compact solids, sampling of particulate solids, methods and equipments used for sampling of particulate solids. | |
| | 1.3.3 | Sampling of liquids: Homogeneous and heterogeneous, Static and flowing liquids. | |
| | 1.3.4 | Sampling of gases: Ambient and stack sampling: Apparatus and | |

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|---|---|---|---|
| | | methods for sampling of gases. | |
| | 1.3.5 | Collection, preservation and dissolution of the sample. | |
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| **UNIT II : CLASSICAL METHODS OF ANALYSIS (TITRIMETRY) (3 & 6 UNITS)** | | | |
| **2.1** | **Redox Titrations (Numerical and word Problems are expected)** | | **08 L** |
| | | | |
| | 2.1.1 | Introduction | |
| | 2.1.2 | Construction of the titration curves and calculation of $E_{system}$ in aqueous medium in case of:<br>(1) One electron system<br>(2) Multielectron system | |
| | 2.1.3 | Theory of redox indicators, Criteria for selection of an indicator<br>Use of diphenyl amine and ferroin as redox indicators | |
| | | | |
| **2.2** | **Complexometric Titrations** | | **07 L** |
| | | | |
| | 2.2.1 | Introduction, construction of titration curve | |
| | 2.2.2 | Use of EDTA as titrant and its standardisation, absolute and conditional formation constants of metal EDTA complexes,<br>Selectivity of EDTA as a titrant.<br>Factors enhancing selectivity with examples.<br>Advantages and limitations of EDTA as a titrant. | |
| | 2.2.3 | Types of EDTA titrations. | |
| | 2.2.4 | Metallochromic indicators, theory, examples and applications | |
| | | | |
| **UNIT III: OPTICAL METHODS(6 UNITS)** | | | |
| **3.1** | **Atomic Spectroscopy: Flame Emission spectroscopy(FES) and Atomic Absorption Spectroscopy(AAS)** | | **07 L** |
| | 3.1.1 | Introduction, Energy level diagrams, Atomic spectra, Absorption and Emission Spectra | |
| | 3.1.2 | Flame Photometry – Principle, Instrumentation (Flame atomizers, types of Burners, Wavelength selectors, Detectors) | |
| | 3.1.3 | Atomic Absorption Spectroscopy – Principle, Instrumentation (Source, Chopper, Flame and Electrothermal Atomiser) | |
| | 3.1.4 | Quantification methods of FES and AAS – Calibration curve method, Standard addition method and Internal standard method. | |

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|---|---|---|---|
| | 3.1.5 | Comparison between FES and AAS | |
| | 3.1.6 | Applications, Advantages and Limitations | |
| | | | |
| **3.2** | **Molecular Fluorescence and Phosphorescence Spectroscopy** | | **04L** |
| | 3.2.1 | Introduction and Principle | |
| | 3.2.2 | Relationship of Fluorescence intensity with concentration | |
| | 3.2.3 | Factors affecting Fluorescence and Phosphorescence | |
| | 3.2.4 | Instrumentation and applications | |
| | 3.2.5 | Comparison of Fluorimetry and Phosphorimetry | |
| | 3.2.6 | Comparison with Absorption methods | |
| **3.3** | **Turbidimetry and Nephelometry** | | **04 L** |
| | 3.3.1 | Introduction and Principle | |
| | 3.3.2 | Factors affecting scattering of Radiation:<br>Concentration, particle size, wavelength, refractive index | |
| | 3.3.3 | Instrumentation and Applications | |
| | | | |
| **UNIT IV: METHODS OF SEPARATION – I (6 UNITS)** | | | |
| **4.1** | **Solvent Extraction** | | **06 L** |
| | 4.1.1 | Factors affecting extraction: Chelation, Ion pair formation and Solvation | |
| | 4.1.2 | Graph of percent extraction versus pH.<br>Concept of $[pH]_{1/2}$ and its significance (derivation not expected) | |
| | 4.1.3 | Craig's counter current extraction: Principle, apparatus and applications | |
| | 4.1.4 | Solid phase extraction: Principle, process and applications with special reference to water and industrial effluent analysis. | |
| | 4.1.5 | Comparison of solid phase extraction and solvent extraction. | |
| | | | |
| **4.2** | **High Performance Liquid chromatography (HPLC)** | | **06L** |
| | 4.2.1 | Introduction and Principle<br>Instrumentation- components with their significance: Solvent Reservoir, Degassing system, Pumps-(reciprocating pumps, screw driven- syringe type pumps, pneumatic pumps, advantages and disadvantages of each pump), Precolumn, Sample injection system, HPLC Columns, Detectors(UV – Visible detector, Refractive index detector) | |
| | 4.2.2 | Qualitative and Quantitative Applications of HPLC | |

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| **4.3** | **High Performance Thin Layer Chromatography (HPTLC)** | | **03 L** |
| | 4.3.1 | Introduction and Principle<br>Stationary phase, Sample application and mobile phase | |
| | 4.3.2 | Detectors<br>a) Scanning densitometer- Components.<br>Types of densitometer- Single beam and Double beam<br>b) Fluorometric Detector | |
| | 4.3.3 | Advantages, disadvantages and applications | |
| | 4.3.4 | Comparison of TLC and HPTLC | |

## REFERENCES


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|---|---|---|
| 1. | 3000 solved problems in Chemistry, David E. Goldberg,PhD.,Schaums Outline | Unit/s: (1.2) |
| 2. | A guide to Quality in Analytical Chemistry: An aid to accreditation, CITAC and EURACHEM, (2002), | Unit/s (1.1) |
| 3. | A premier sampling solids, liquids and gases, Smith Patricia I, American statistical association and the society for industrial and applied mathematics, (2001) | Unit/s (1.3) |
| 4. | Analytical Chemistry, Gary.D Christan, 5th edition | Unit/s (4.1,4.2,4.3) |
| 5. | Analytical Chemistry Skoog, West ,Holler,7th Edition: | Unit/s (2.1) |
| 6. | Analytical Chromatography, Gurdeep R Chatwal, Himalaya publication | Unit/s (4.1,4.2,4.3) |
| 7. | Basic Concepts of Analytical Chemistry, by S M Khopkar, new Age International (p) Limited | Unit/s (4.1,4.2,4.3) |
| 8. | Chemical methods of separation, J A Dean, Van Nostrand Reinhold, 1969 | Unit/s (4.1,4.2,4.3) |
| 9. | Fundamentals of Analytical Chemistry by Skoog and West , 8th Edition | Unit/s (4.1,4.2,4.3) |
| 10. | Handbook of quality assurance for the analytical chemistry laboratory, 2ndEdn., James P. DuxVanNostr and Reinhold, 1990 | Unit/s (1.1) |
| 11. | High Performance Thin Layer Chromatography by Dr P.D. Sethi, CBS Publisher and Distribution | Unit/s(4.1,4.2,4.3) |

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| 12. | High Performance Thin Layer Chromatography in Food analysis, by Prem kumar, CBS Publisher and distributer | Unit/s (4.1,4.2,4.3) |
| 13. | Instrumental methods of Analysis, by Dr Supriya S Mahajan, Popular Prakashan Ltd | Unit/s (4.1,4.2,4.3) |
| 14. | Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd | Unit/s (3.1,3.2,3.3) |
| 15. | Instrumental Methods of Chemical Analysis by B.K. Sharma Goel Publishing House | Unit/s (4.1,4.2,4.3) |
| 16. | Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman | Unit/s (4.1,4.2,4.3)(3.1,3.2,3.3) |
| 17. | Quality control and Quality assurance in Analytical Chemical Laboratory, Piotr Konieczka and Jacek Namiesnik, CRC press (2018) | Unit/s (1.1) |
| 18. | Quality in the Analytical Chemistry Laboratory, Elizabeth Prichard, Neil T. Crosby, Florence Elizabeth Prichard, John Wiley and Sons, 1995 | Unit/s (1.1) |
| 19. | Solvent extraction and ion exchange, J Marcus and A. S. Kertes Wiley INC 1969 | Unit/s (4.1,4.2,4.3) |
| 20. . | Thin Layer Chromatography, A LAB. Handbook, Egon Stahl, Springer International Student Edition | Unit/s (4.1,4.2,4.3) |

**PRACTICALS**

**SEMESTER V**

**ANALYTICAL CHEMISTRY**

**COURSE CODE: USCHP13** **CREDITS: 02**

1. Spectrophotometric estimation of fluoride
2. Estimation of magnesium content in Talcum powder by complexometry, using standardized solution of EDTA
3. Determination of COD of water sample.
4. To determine potassium content of a Fertilizer by Flame Photometry (Calibration curve method).
5. To determine the amount of persulphate in the given sample solution by back titration with standard Fe (II) ammonium sulphate solution.
6. To determine the amount of sulphate in given water sample turbidimetrically.

**Note: Calculation of percent error is expected for all the experiments.**

# REFERENCES


| | |
|---|---|
| 1. | Vogel's Textbook of Quantitative Chemical Analysis, 5thEdn., G. H. Jeffery, J Bassett, J Memdham and R C Denney, ELBS with Longmann (1989). |
| 2. | Vogel's Textbook of Quantitative Chemical analysis, Sixth edition, J.Mendham et.al |


**SEMESTER VI**

**ANALYTICAL CHEMISTRY**

**COURSE CODE: USCH604 CREDITS: 02 LECTURES: 60**

| | | | |
|---|---|---|---|
| **UNIT I: ELECTRO ANALYTICAL TECHNIQUES(3 & 6 UNITS)** | | | |
| **1.1** | **Polarography** (**Numerical and word problems are expected)** | | **11L** |
| | 1.1.1 | Difference between potentiometry and voltammetry, Polarizable and non-polarizable electrodes | |
| | 1.1.2 | Basic principle of polarography<br>H shaped polarographic cell, DME (construction, working, advantages and limitations) | |
| | 1.1.3 | DC polarogram: Terms involved - Residual current, Diffusion current, Limiting current, Half-Wave Potential<br>Role and selection of supporting electrolyte, Interference of oxygen and its removal, polarographic Maxima and Maxima Suppressors<br>Qualitative aspects of Polarography: Half wave potential $E_{1/2}$,<br>Factors affecting $E_{1/2}$<br>Quantitative aspects of polarography: Ilkovic equations: various terms involved in it (No derivation) | |
| | 1.1.4 | Quantification<br>1) Wave height – Concentration plots (working plots/calibration)<br>2) Internal standard (pilot ion) method<br>3) Standard addition method | |
| | 1.1.5 | Applications advantages and limitations | |
| | | | |
| **1.2** | **Amperometric Titrations** | | **04L** |
| | 1.2.1 | Principle, Rotating Platinum Electrode(Construction, advantages and limitations) | |
| | 1.2.2 | Titration curves with example | |
| | 1.2.3 | Advantages and limitations | |

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| **UNIT II: METHODS OF SEPARATION - II (3 & 6 UNITS)** | | | |
| **2.1** | **Gas Chromatography** (**Numerical and word problems are expected**) | | **09 L** |
| | 2.1.1 | Introduction, Principle, Theory and terms involved | |
| | 2.1.2 | Instrumentation: Block diagram and components,types of columns, stationary phases in GSC and GLC, Detectors: TCD, FID, ECD | |
| | 2.1.3 | Qualitative, Quantitative analysis and applications | |
| | 2.1.4 | Comparison between GSC and GLC | |
| **2.2** | **Ion Exchange Chromatography** | | **06 L** |
| | 2.2.1 | Introduction, Principle. | |
| | 2.2.2 | Types of Ion Exchangers , Ideal properties of resin | |
| | 2.2.3 | Ion Exchange equilibria and mechanism, selectivity coefficient and separation factor<br>Factors affecting separation of ions | |
| | 2.2.4 | Ion exchange capacity and its determination for cation and anion exchangers. | |
| | 2.2.5 | Applications of Ion Exchange Chromatography with reference to Preparation of demineralised water, Separation of amino acids | |
| | | | |
| **UNIT III:FOOD AND COSMETICS ANALYSIS(6 UNITS)** | | | |
| **3.1** | **Introduction to food chemistry** | | **10 L** |
| | 3.1.1 | Food processing and preservation:<br>Introduction, need, chemical methods, action of chemicals(sulphur dioxide, boric acid, sodium benzoate, acetic acid, sodium chloride and sugar) and pH control<br>Physical methods (Pasteurization and Irradiation) | |
| | 3.1.2 | Determination of boric acid by titrimetry and sodium benzoate by HPLC. | |
| | 3.1.3 | Study and analysis of food products and detection of adulterants<br>**1)** Milk:<br>Composition & nutrients, types of milk (fat free, organic and lactose milk)<br>Analysis of milk for lactose by Lane Eynon's Method | |

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| | | **2)** Honey:<br><br>Composition<br>Analysis of reducing sugars in honey by Coles Ferricyanide method<br><br>**3)** Tea:<br><br>Composition, types (green tea and mixed tea)<br>Analysis of Tannin by Lowenthal's method<br><br>**4)** Coffee:<br><br>Constituents and composition, Role of Chicory<br>Analysis of caffeine by Bailey Andrew method | |
| **3.2** | **Cosmetics** | | **05 L** |
| | 3.2.1 | Introduction and sensory properties | |
| | 3.2.2 | Study of cosmetic products –<br><br>**1)** Face powder:<br><br>Composition<br>Estimation of calcium and magnesium by complexometric titration<br><br>**2)** Lipstick:<br><br>Constituents<br>Ash analysis for water soluble salts: borates, carbonates and zinc oxide<br><br>**3)** Deodorants and Antiperspirants:<br><br>Constituents, properties<br>Estimation of zinc by gravimetry | |
| | | | |
| **UNIT IV:THERMAL METHODS AND ANALYTICAL METHOD VALIDATION (6 UNITS)** | | | |
| **4.1** | **Thermal Methods** | | **12 L** |
| | 4.1.1 | Introduction to various thermal methods<br><br>(TGA, DTA and Thermometric titration) | |

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| | 4.1.2 | **Thermogravimetric Analysis(TGA)**<br>Instrumentation-block diagram,thermobalance (Basic components: balance, furnace, temperature measurement and control, recorder)<br>Thermogram (TG curve)for$CaC_2O_4.H_2O$ and $CuSO_4.5H_2O$<br>Factors affecting thermogram-Instrumental factors and Sample characteristics<br>Applications:<br>Determination of drying and ignition temperature range<br>Determination of percent composition of binary mixtures (Estimation of Calcium and Magnesium oxalate) | |
| | 4.1.3 | **Differential Thermal Analysis (DTA):**<br>Principle**,** Instrumentation, and Reference material used | |
| | | Differential thermogram ( DTA curve) $CaC_2O_4.H_2O$ and $CuSO_4.5H_2O$ | |
| | | Applications<br>Comparison between TGA and DTA. | |
| | 4.1.4 | **Thermometric Titrations –** Principle and Instrumentation<br>Thermometric titrations of :<br>1) HCl v/s NaOH<br>2) Boric acid v/s NaOH<br>3) Mixture of $Ca^{+2}$ and $Mg^{+2}$ v/s EDTA<br>4) $Zn^{+2}$ with Disodium Tartarate**.** | |
| **4.2** | **Analytical Method Validation** | | **03L** |
| | 4.2.1 | Introduction and need for validation of a method | |
| | 4.2.2 | Validation Parameters: Specificity, Selectivity, Precision, Linearity, Accuracy and Robustness | |

**Note: Concept of sensitivity is to be discussed for all techniques and instruments mentioned in the syllabus.**

**REFERENCES**


| | | |
|---|---|---|
| 1. | An Advance Dairy chemistry, V 3, P. F. Fox, P. L. H. McSweeney Springer | Unit/s (3.1,3.2) |

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| 2. | Analysis of food and Beverages, George Charalanbous, Academic press 1978 | Unit/s (3.1,3.2) |
| 3. | Analytical Chemistry of Open Learning(ACOL),James W. Dodd & Kenneth H. Tonge | Unit/s (4.1,4.2) |
| 4. | Analytical chemistry David Harvey The ,McGraw Hill Companies, Inc. | Unit/s (4.1,4.2) |
| 5. | Analytical Chemistry, Gary.D Christan, 5th edition | Unit/s (2.1,2.2) |
| 6. | Analytical chemistry, R. K. Dave. | Unit/s (2.1,2.2) |
| 7. | Chemical methods of separation, J A Dean, Van Nostrand Reinhold, 1969 | Unit/s (2.1,2.2) |
| 8. | Egyankosh.ac.in/bitstream/123456789/43329/1/Unit-8 | Unit/s (1.1,1.2,1.3) |
| 9. | Food Analysis, Edited by S. Suzanne Nielsen, Springer | Unit/s (3.1,3.2) |
| 10. | Food Analysis: Theory and practice, YeshajahuPomeranz, Clifton E. Meloan, Springer | Unit/s (3.1,3.2) |
| 11. | Formulation and Function of cosmetics, Sa Jellineck | Unit/s (3.1,3.2) |
| 12. | Fundamentals of Analytical Chemistry, D .A. Skoog and D. M. West and F. J. Holler Holt., Saunders 6th Edition (1992) | Unit/s (2.1,2.2) |
| 13. | Government of India publications of food drug cosmetic act and rules. | Unit/s (3.1,3.2) |
| 14. | Harry's Cosmetology, Longman scientific co. | Unit/s (3.1,3.2) |
| 15. | High Performance Thin Layer Chromatography in Food analysis, by Prem kumar, CBS Publisher and distributer | Unit/s (3.1,3.2) |
| 16. | Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd | Unit/s (1.1,1.2,1.3) (4.1,4.2,4.3) |
| 17. | Introduction to Polarography and Allied Techniques, By Kamala Zutshi, New Age International, 2006. | Unit/s (1.1,1.2,1.3) |
| 18. | Modern cosmetics, E. Thomessen Wiley Inter science | Unit/s (3.1,3.2) |

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| 19. | Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman | Unit/s (4.1,4.2,4.3) |
| 20. | Principles of Polarography by Jaroslav Heyrovský , Jaroslav Kůta, 1st Edition, Academic Press, eBook ISBN: 978148326478 | Unit/s (1.1,1.2,1.3) |
| 21. | Solvent extraction and ion exchange, J Marcus and A. S. Kertes Wiley INC 1969 | Unit/s (2.1,2.2,) |

**PRACTICALS**

**SEMESTER VI**

**ANALYTICAL CHEMISTRY**

**COURSE CODE: USCHP14** **CREDITS: 02**

1 Estimation of Chromium in water sample spectrophotometrically by using Diphenyl carbazide.

2 Estimation of reducing sugar in honey by Willstatter method.

3 Estimation o $Mg^{+2}$ & $Zn^{+2}$ by anion exchange resin.
using an anion exchange resin

4 Estimation of acetic acid in Vinegar sample by using Quinhydrone electrode potentiometrically.

5 Determination of phosphoric acid in cola sample pH metrically.

**Note: Calculation of percent error is expected for all the experiments.**

## References:


| | |
|---|---|
| 1. | Vogel's Textbook of Quantitative Chemical Analysis, 5thEdn., G. H. Jeffery, J Bassett, J Memdham and R C Denney, ELBS with Longmann (1989). |

| | |
|---|---|
| 2. | Vogel's Textbook of Quantitative Chemical analysis, Sixth edition, J.Mendham et.al |
| 3. | The chemical analysis of food and food products III edition Morris Jacob |
| 4. | The chemical analysis of food by David Pearson and Henry Edward |

**T Y B Sc Chemistry**

Choice Based Credit System

**SEMESTER V**

**Applied Component**

**(Drugs and Dyes)**

**COURSE CODE: USACDD501 CREDITS: 02 LECTURES: 60**

| Unit | | | Topics | |
|---|---|---|---|---|
| **I** | **1.1** | | **General Introduction to Drugs** | **(8L)** |
| | | 1.1.1 | Definition of a drug, sources of drugs, requirements 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, Pharmacology, Pharmacophore, Prodrug, Half – life efficiency, $LD_{50}$, $ED_{50}$,$GI_{50}$ Therapeutic Index. | |
| | | 1.1.4 | Brief idea of the following terms: Receptors, Agonists, Antagonists, 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** | **(3L)** |
| | | 1.2.1 | Oral and Parenteral routes with advantages and disadvantages. | |
| | | 1.2.2 | Formulations & combination formulation, Different dosage forms (including Patches & Adhesives, emphasis on sustained release formulations and enteric coated tablets). | |
| | | | | |
| | **1.3** | | **Pharmacodynamic agents:** A brief introduction of the following pharmacodynamic agents and the study with respect to their chemical structure, chemical class, therapeutic uses, and side effects. | |
| | | **1.3.1** | **CNS Drugs:**<br>Classification based on pharmacological actions: CNS Depressants & CNS Stimulants. Concept of sedation and hypnosis, anaesthesia.<br>• Phenytoin (Hydantoin)<br>• Trimethadione (Oxazolidinediones) (**Synthesis from acetone)**<br>• Alprazolam (Benzodiazepines)<br>• Levetiracetam (Pyrrolidines)<br>• Amphetamine (Phenethylamine) (**Asymmetric synthesis from phenyl acetic acid)**<br>• Chlorpromazine (Phenothiazines) | **(4L)** |
| | | | | |

**UNIT-II (Drugs)**

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| **2** | **2.1** | | **Analgesics, Antipyretics and Anti-inflammatory Drugs.** | **(4L)** |

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| | | 2.1.1 | **Analgesics and Antipyretics**<br>• Morphine (Phenanthrene alkaloids)<br>• Tramadol (Cyclohexanols) (**Synthesis from salicylic acid)**<br>• Aspirin (Salicylates)<br>• Paracetamol (p-Amino phenols) | |

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| | | 2.1.2 | **Anti-inflammatory Drugs**<br>Mechanism of inflammation and various inflammatory conditions.<br>• Steroids: Prednisolone, Betamethasone<br>• Sodium Diclofenac, Aceclofenac (N- Aryl anthranilic acids) **(Synthesis from 2,6-dichlorodiphenyl amine)** | |
| | | | | |
| | **2.2** | | **Antihistaminic Drugs** | **(2L)** |
| | | | • Diphenhydramine (Ethanol amines)<br>• Cetrizene (Piperazine) (**Synthesis from 4-Chlorobenzhydryl chloride)**<br>• Chlorpheniramine maleate (Ethyl amines)<br>• Pantoprazole (Benzimidazoles) | |
| | | | | |
| | **2.3** | | **Cardiovascular drugs** | **(3L)** |
| | | | Classification based on pharmacological action<br>• Isosorbide dinitrate (Nitrates)<br>• Valsartan (Amino acids) (structure not expected)<br>• Atenolol (Aryloxy propanol amines) (**Synthesis from 3-Hydroxy phenyl acetamide)**<br>• Amlodipine (Pyridines)<br>• Frusemide /Furosemide (Sulfamoyl benzoic acid)<br>• Rosuvastatin (Pyrimidine) | |
| | | | | |
| | **2.4** | | **Antidiabetic Agents** | **(2L)** |
| | | | General idea and types of diabetes; Insulin therapy<br>• Glibenclamide (Sulphonyl ureas)<br>• Metformin (Biguanides)<br>• Dapagliflozin (Pyranose)<br>• Pioglitazone (Thiazolidinediones) (**Synthesis from 2-(5-ethylpyridin-2-yl) ethanol)** | |
| | | | | |
| | **2.5** | | **Antiparkinsonism Drugs** | **(2L)** |
| | | | Idea of Parkinson's disease.<br>• Procyclidine hydrochloride (Pyrrolidines)<br>• Ethopropazine hydrochloride (Phenothiiazines)<br>• Levodopa (Amino acids) (**Synthesis from Vanillin)** | |
| | | | | |
| | **2.6** | | **Drugs for Respiratory System**<br>General idea of: Expectorants; Mucolytes; Bronchodilators; Decongestants; Antitussives<br>• Ambroxol (Cyclohexanol) (**Synthesis from paracetamol)**<br>• Salbutamol (Phenyl ethyl amines)<br>• Oxymetazoline (Imidazolines) | **(2L)** |

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| | | | • Codeine Phosphate (Opiates) | |

**Reference Books: (For units I & II)**


1. Foye's principles of medicinal chemistry. 6th Edition, Edited by Davis William & Thomas Lemke, Indian edition by B I Publication Pvt Ltd, Lippmcolt Williams & Wilkins.
2. Text book of organic medicinal & pharmaceutical chemistry. Wilson &Gisovolds, 11th Edition by John H Block, John M Beale Jr.
3. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition.
4. Burger's Medicinal Chemistry, Drug Discovery and Development. Abraham and Rotella. Wiley
5. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition.
6. Medicinal chemistry. V.K. Ahluwalia and Madhu Chopra, CRC Press.
7. Principle of medicinal chemistry. Vol 1 &2 S. S. Kadam, K. R. Mahadik, K. G. Bothara
8. The Art of Drug synthesis. Johnson and Li. Wiley, 2007.
9. The organic chemistry of drug design & drug action. 2nd ed. By Richard B Silvermann, Academic Press.
10. The Organic Chemistry of Drug Synthesis. Lednicer and Mitsher, Wliey.

## Unit III (Dyes)

| | | | | |
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| **3** | **3.1** | | Introduction to the dye-stuff Industry | **(5L)** |
| | | 3.1.1 | Dyes | |
| | | | Definition of dyes, requirements of a good dye i.e. Colour, Chromophore and Auxochrome, Solubility, Linearity, Coplanarity, Fastness, Substantivity, Economic viability.<br><br>Definition of fastness and its properties and Mordants with examples<br><br>Explanation of nomenclature or abbreviations of commercial dyes with at least one example suffixes – G, O, R, B, K, L, C, S H, 6B, GK, 6GK,<br><br>Naming of dyes by colour index (two examples) used in dye industries. | |
| | | | | |
| | | 3.1.2 | Natural and Synthetic Dyes | |
| | | | Natural Dyes: Definition and limitations of natural dyes.<br>Examples and uses of natural dyes w.r.t Heena, Turmeric, Saffron, Indigo, Madder, Chlorophyll –**names** of the chief dyeing material/s in each natural dye **[structures not expected]**,<br><br>Synthetic dyes: Definition of synthetic dyes, primaries and intermediates. Important milestones in the development of synthetic dyes – Emphasis on Name of the Scientist, dyes and the year of the discovery is required. (structure is not expected) | |
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| | **3.2** | | Substrates for Dyes : Types of fibres | **(3L)** |
| | | 3.2.1 | Natural: cellulosic and proteinaceous fibres, examples – wool, silk and cotton structures and names of dyes applied on each of them. | |
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| | | 3.2.2 | Semi – synthetic: definition and examples [structures not expected] | |
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| | | 3.2.3 | Synthetic: Nylon, Polyesters and Polyamides structures and names of dyes applied on each of them | |
| | | | | |
| | | 3.2.4 | Blended fabrics: definition and examples [structures not expected] | |
| | | | | |
| | | 3.2.5 | Binding forces of dyes on substrate: ionic forces, covalent linkages, hydrogen bonding, vander-walls forces | |
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| | **3.3** | | Classification of dyes based on applications and dyeing methods | **(7L)** |
| | | 3.3.1 | Dyeing methods | |
| | | | Basic Operations involved in dyeing process:<br>i. Preparation of fibres ii. Preparation of dyebath<br>iii. Application of dyes iv. Finishing | |
| | | | Dyeing Method of Cotton Fibres:<br>(i) Direct dyeing (ii) Vat dyeing<br>(iii) Mordant dyeing (iv) Disperse dyeing | |

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| | | 3.3.2 | Classification of dyes based on applicability on substrates (examples with structures)<br>(a) Acid Dyes- Orange II,<br>(b) Basic Dyes-methyl violet,<br>(c) Direct cotton Dyes- Benzofast Yellow 5GL<br>(d) Azoic Dyes – Diazo components; Fast yellow G, Fast orange R. Coupling components. Naphthol AS, Naphthol ASG<br>(e) Mordant Dyes-Eriochrome Black A, Alizarin.<br>(f) Vat Dyes- Indanthrene brown RRD,<br>(g) Sulphur Dyes- Sulphur Black T (no structure)<br>(h) Disperse Dyes-Celliton Fast brown 3R,<br>(i) Reactive Dyes- Cibacron Brilliant Red B, | |
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| | | 3.3.3 | Optical Brighteners: General idea, important characteristics of optical brighteners and their classes [Stilbene, Coumarin, Heterocyclic vinylene derivatives, Diaryl pyrazolines, Naphthylamide derivatives] general structure of each class. | |
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## Unit – IV (Dyes)

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| **4** | **4.1** | | **Colour and Chemical Constitution of Dyes** | **(4L)** |
| | | 4.1.1 | Absorption of visible light, Colour of wavelength absorbed, Complementary colour. | |
| | | 4.1.2 | Relation between colour and chemical constitution. | |
| | | | (i) Armstrong theory (quinonoid theory) and its limitations.<br>(ii) Witt's Theory: Chromophore, Auxochrome, Bathochromic & Hypsochromic Shift, Hypochromic & Hyperchromic effect<br>(iii) Valence Bond theory, comparative study and relation of colour in the following classes of compounds/dyes: Benzene, Nitrobenzene, Nitroanilines, Nitrophenols, Benzoquinones, Azo, Triphenyl methane, Anthraquinones.<br>(iv) Molecular Orbital Theory. | |
| | | | | |
| | **4.2** | | **Unit process and Dye Intermediates** | |
| | | 4.2.1 | **A brief idea of Unit Processes** | **(3L)** |
| | | | Introduction to primaries and intermediates | |
| | | | Unit processes: definition and brief ideas of below unit processes:<br>(a) Nitration (b) Sulphonation (c) Halogenation<br>(d) Diazotization: (3 different methods & its importance)<br>(e) Ammonolysis (f) Oxidation<br>NB: Definition, Reagents, Examples of each unit processes mentioned above with reaction conditions (mechanism is not expected) | |
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| | | 4.2.2 | **Preparation of the Following Intermediates** | **(8L)** |
| | | | Benzene derivatives: Benzenesulphonic acid; 1,3-Benzenedisulphonic acid; sulphanilic acid; o-, m-, p-chloronitrobenzenes; o-, m-, p-nitroanilines; o-, m-, p-phenylene diamines; Naphthol ASG | |
| | | | Naphthalene Derivative: Schaeffer acid; Tobias acid; Naphthionic acid; N.W. acid; cleve-6-acid; H-acid; Naphthol AS | |
| | | | Anthracene Derivative: 1-Nitroanthraquinone; 1-Aminoanthraquinone Anthraquinone-2-sulphonic acid; Benzanthrone. | |
| | | | | |

**References (For Units III & IV):**


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


## I] Practicals

## SEMESTER V

## (Drugs and Dyes)

**COURSE CODE: USACDD5P1** **CREDITS: 02**

1. Estimation of Ibuprofen (back titration method)
2. Estimation of Acid neutralizing capacity of a drug
3. Preparation of Aspirin from salicylic acid.
4. Separation of components of natural pigments by paper chromatography (eg: chlorophyll)

**II] Project:**
**Preparation of Orange II dye (semi-microscale1.0gms) and its use for dyeing different fabrics**

**SEMESTER VI**

**(Drugs and Dyes)**

**COURSE CODE: USACDD601** **CREDITS: 02** **LECTURES: 60**

**UNIT – I (Drugs)**

| | | | | |
|---|---|---|---|---|
| **1** | **1.1** | | **Drug Discovery, Design and Development** | **(6L)** |
| | | | | |
| | | 1.1.1 | Discovery of a Lead compound: Screening, drug metabolism studies and clinical observation, Lipinski's rule of 5 | |
| | | 1.1.2 | Medicinal properties of compounds from Natural Sources: Anti-infective and anticancer properties of Turmeric (Curcumin) | |
| | | 1.1.3 | Development of drug: The Pharmacophore identification, modification of structure or functional group, Structure activity relationship (Sulphonamides). | |
| | | 1.1.4 | Structure modification to increase potency: Homologation, Chain branching and Extension of the structure. | |
| | | 1.1.5 | Computer assisted drug design. | |
| | | | | |
| | **1.2** | | **Drug Metabolism:** Introduction, Absorption, Distribution, Bio-transformation, Excretion Different types of chemical transformation of drugs with specific examples. | **(3L)** |
| | | | | |
| | **1.3** | | **Chemotherapeutic Agents:** Study of the following chemotherapeutic agents with respect to their chemical structure, chemical class, therapeutic uses, side effects and introduction to MDR wherever applicable. | |
| | | | | |
| | | 1.3.1 | **Antibiotics and antivirals:** Definition,<br>• Amoxicillin (β- lactum antibiotics)<br>• Cefpodoxime (Cephalosporins)<br>• Doxycycline (Tetracyclines)<br>• Levofloxacin (Quinolones) (**Synthesis from 2,3,4 – Trifluro -1-nitrobenzene)**<br>• Aciclovir/Acyclovir (Purines) | **(2L)** |
| | | | | |
| | | 5.3.2 | **Antimalarials:** Types of malaria; Symptoms; Pathological detection during window period (Life cycle of the parasites not to be discussed)<br>• Chloroquine (3-Amino quinolones)<br>• Artemether(Benzodioxepins)<br>**Following combination to be discussed:**Atremether-Lumefantrine (no structure) | **(2L)** |
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| | | 1.3.3 | **Anthelmintics and AntiFungal agents**<br>Drugs effective in the treatment of Nematodes and Cestodes infestations. | **(2L)** |

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|---|---|---|---|---|
| | | | • Diethyl carbamazine (Piperazines)<br>• Albendazole (Benzimidazoles) (**Synthesis from 2- Nitroaniline)**<br>• Clotrimazole (Imidazole)<br>• Fluconazole (Triazole) (**Synthesis from 1- Bromo – 2,4-difluorobenzene)** | |

**UNIT – II(Drugs)**
**Chemotherapeutic Agents continued.**

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| **2** | **2.1** | | **Antiamoebic Drugs**<br>Types of Amoebiasis<br>• Metronidazole, Ornidazole, Tinidazole (Imidazole)<br>Synthesis of Metronidazole from glyoxal by Debus-Radziszewski imidazole synthesis route<br><br>**Following combination therapy to be discussed:** Ciprofloxacin-Tinidazole | **(1L)** |
| | **2.2** | | **Antitubercular and Antileprotic Drugs**<br>Types of Tuberculosis; Symptoms and diagnosis of Tuberculosis.<br>Types of Leprosy.<br>General idea of Antibiotics used in their treatment.<br>• PAS (Amino salicylates)<br>• Isoniazide (Hydrazides)<br>• Pyrazinamide (Pyrazines)<br>• (+) Ethambutol (Aliphatic diamines) (**Synthesis from 1- Nitropropane)**<br>• Dapsone(Sulphonamides) (**Synthesis from 4- Chloronitrobenzene)**<br>• Clofazimine (Phenazines)<br>• Bedaquiline (Quinoline)<br>**Following combination therapy to be discussed:**<br>(i) Rifampin + Ethambutol + Pyrazinamide<br>(ii) Rifampin + Isoniazide + Pyrazinamide | **(3L)** |
| | **2.3** | | **Anti-Neoplastic Drugs**<br>Idea of malignancy; Causes of cancer<br>Brief idea of Immuno Stimulants &Immuno depressants<br>• Lomoustine (Nitrosoureas)<br>• Anastrozole(Triazoles) (**Synthesis from 3,5-bis (bromo methyl) toluene)**<br>• Cisplatin (Chloro Platinum)<br>• Vincristine, Vinblastine, Vindesine) (Vinca alkaloids) (structure not expected) | **(2L)** |
| | **2.4** | | **Anti-HIV Drugs**<br>Idea of HIV pathogenicity, Symptoms of AIDS<br>• AZT/Zidovudine, Lamivudine,DDI (Purines) | **(1L)** |
| | **2.5** | | **Drug Intermediates:** Synthesis and uses<br>1. 2,3,6-Triamino-6- hydroxypyrimidine from Guanidine<br>2. p-[2'-(5-Chloro-2-methoxy benzamido) ethyl]-benzenesulphonamide from Methyl-5-chloro-2- methoxybenzene<br>3. 3-(p-Chlorophenyl)-3- hydroxypiperidine from 3-Chloroacetophenone | **(2L)** |

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|---|---|---|---|---|
| | | | 4. p-Acetyl amino benzenesulphonyl chloride from Aniline<br>5. Epichlorohydrine from propene | |
| | **2.6** | | **Nano particles in Medicinal Chemistry**<br>Introduction; Carbon nano particles (structures) and Carbon nano tubes:<br>• Functionalization for Pharmaceutical applications<br>• Targeted drug delivery<br>• In vaccine (Foot and mouth disease)<br>• Use in Bio-physical treatment.<br>Gold nano particles in treatment of: Cancer; Parkinsonism; Alzheimer.<br>Silver nano particles: Antimicrobial activity. | **(4L)** |
| | **2.7** | | **Drugs and Environmental Aspects**<br>• Impact of Pharma-industry on environment,<br>• International regulation for human experimentation with reference to: "The Nuremberg Code" and "The Helsinki Declaration". | **(2L)** |

**Reference Books (For Units I & II):**


1. Foye's principles of medicinal chemistry. 6th Edition, Edited by Davis William & Thomas Lemke, Indian edition by B I Publication Pvt Ltd, Lippmcolt Williams & Wilkins.
2. Text book of organic medicinal & pharmaceutical chemistry. Wilson &Gisovolds, 11th Edition by John H Block, John M Beale Jr.
3. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition.
4. Burger's Medicinal Chemistry, Drug Discovery & Development. Abraham & Rotella. Wiley
5. Medicinal chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition.
6. Medicinal chemistry. V.K. Ahluwalia and Madhu Chopra, CRC Press.
7. Principle of medicinal chemistry. Vol 1 & 2 S. S. Kadam, K. R. Mahadik, K. G. Bothara
8. The Art of Drug synthesis. Johnson and Li. Wiley, 2007.
9. The organic chemistry of drug design & drug action. 2nd ed. By Richard B Silvermann, Academic Press.
10. The Organic Chemistry of Drug Synthesis. Lednicer and Mitsher, Wliey.
11. Text book of drug design and discovery. Povl-Krog-Sgaard-Larsen, Tommy Liljefors and ULF Madsen, 3rd Edition Taylor & Francis.
12. Bio-applications of nanoparticles. Edited by Warren C.W. Chan, Springer Publication.
13. Nanoparticle and technology for drug delivery (Drugs and pharmaceutical sciences). Ram B.Gupta& Uday B.Kompella Pub. Informa Healthcare.
14. Nano forms of carbon and its applications. Edited by Maheshwar Sharon and Madhuri Sharon.MonadNanotechPvt. Ltd.
15. Environmental Chemistry. A. K. De
16. Text Book on Law and Medicine. Chokhani and Ghormade. 2nd Edition. Hind Law House,Pune.
17. Essentials of Medical Pharmacology. K D Tripathi, Jaypee Brothers Medical publishers Pvt. ltd.

Practical organic chemistry, Vogel.

**SEMESTER VI**

**Unit – III (Dyes)**

| | | | | |
|---|---|---|---|---|
| **3** | **3.1** | | **Classification of Dyes based on Chemical Constitution and Synthesis of Selected Dyes** (Synthesis of the dyes marked with * is expected) | **(12L)** |
| | | | **i)Nitro Dye**: Naphthol Yellow S | |
| | | | **ii) Nitroso Dye**: Gambine Y | |
| | | | **iii)Azo dyes:**<br>a) Monoazo dyes: Orange IV *(from sulphanilic acid) & Eriochrome Black T* (from β- naphthol)<br>b) Bisazo dyes: Congo Red* (from nitrobenzene)<br>c) Trisazo Dye: Direct Deep Black EW* (from benzidine) | |
| | | | **iv)Diphenylmethane dye**: Auramine O* (from N,N-dimethyl aniline) | |
| | | | **v)Triphenylmethane dye**:<br>a) Diamine series: Malachite Green* (from benzaldehyde)<br>b) Triamine series: Acid Magenta<br>c) Phenol series: Rosolic acid | |
| | | | **vi)Heterocyclic Dyes**:<br>a) Thiazine dyes: Methylene Blue<br>b) Azine dyes: Safranin T* (from o-toluidine)<br>c) Xanthene Dyes: Eosin* (from phthalic anhydride)<br>d) Oxazine Dyes: Capri Blue<br>e) Acridine Dyes: Acriflavine | |
| | | | **vii)Quinone Dyes**:<br>a) Naphthaquinone: Naphthazarin<br>b) Anthraquinone Dyes: Indanthrene Blue* (from anthraquinone) | |
| | | | **viii) Indigoid Dyes**: Indigo* (from aniline + monochloroacetic acid) | |
| | | | **ix) Phthalocyanine Dyes**: Monastral Fast Blue B | |
| | | | | |
| | **3.2** | | **Health and Environmental Hazards of Synthetic Dyes and their Remediation Processes** | **(3L)** |
| | | 3.2.1 | **Impact of the textile and leather dye Industry on the environment** with special emphasis on water pollution | |
| | | 3.2.2 | **Health Hazards:** Toxicity of dyes w.r.t food colours. | |
| | | 3.2.3 | **Effluent Treatment Strategies**:<br>Brief introduction to effluent treatment plants (ETP)<br>Primary Remediation processes:(Physical Processes) Sedimentation, Aeration, Sorption (activated charcoal, fly ashetc.)<br><br>Secondary Remediation processes: Biological Remediation – Biosorption, bioremediation and biodegradation<br><br>Chemical Remediation: Oxidation Processes (chlorination), Coagulation-flocculation-Precipitation | |

## Unit – IV (Dyes)

| | | | | |
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| **4** | **4.1** | | **Non-textile uses of dyes:** | **(8L)** |
| | | 4.1.1 | **Biomedical uses of dyes**<br>i) Dyes used in formulations (Tablets, capsules, syrups etc)<br>Indigo carmine, Sunset yellow, Tartrazine<br>ii) Biological staining agents<br>Methylene blue, Crystal violet and Safranine T<br>iii) DNA markers<br>Bromophenol blue, Orange G, Cresol red<br>iv) Dyes as therapeutics<br>Mercurochrome, Acriflavine, Crystal Violet, Prontosil | |
| | | | | |
| | | 4.1.2 | **Dyes used in food and cosmetics:**<br>i) Properties of dyes used in food and cosmetics<br>ii) Introduction to FDA and FSSAI<br>iii) Commonly used food colours and their limits | |
| | | | | |
| | | 4.1.3 | **Paper and leather dyes**<br>i) Structural features of paper and leather<br>ii) Dyes applicable to paper and leather | |
| | | | | |
| | | 4.1.4 | **Miscellaneous dyes**<br>i) Hair dyes<br>ii) Laser dyes<br>iii) Indicators<br>iv) Security inks<br>iv) Coloured smokes and camouflage colours | |
| | | | | |
| | **4.2** | | **Pigments** | **(3L)** |
| | | | Definition of pigments, examples, properties of pigments, difference between dyes and pigments.<br>Definition of Lakes and Toners | |
| | | | | |
| | **4.3** | | **Dyestuff Industry - Indian Perspective** | **(4L)** |
| | | 4.3.1 | Growth and development of the Indian Dyestuff Industry | |
| | | 4.3.2 | Strengths, Weaknesses, Opportunities and Challenges of the Dyestuff industry in India | |
| | | 4.3.3 | Make in India - Future Prospects of the Dye Industry | |

**References (For Units III & IV)**


1. Chemistry of Synthetic Dyes, Vol I – IV, Venkatraman K., Academic Press 1972
2. The Chemistry of Synthetic Dyes and Pigments, Lubs H.A., Robert E Krieger Publishing Company, NY ,1995
3. Chemistry of Dyes and Principles of Dyeing, Shenai V.A., Sevak Publications, 1973
4. Environmental Studies, Joseph Benny, Tata McGraw Hill Education, 2005
5. Fundamental Concepts of Environmental Chemistry,Sodhi. G. S**.,** Alpha Science International, 2009
6. Planning Commission, Niti Aayog, FSSAI and FDA websites
7. Green Chemistry for Dyes Removal from Waste Water- Research Trends and Applications, Ed. Sharma S.K., Wiley, 2015
8. Environmental Pollution- Monitoring and Control, Khopkar S.M., New Age International (P) Ltd, New Delhi, 1982


## Practicals

### SEMESTER V

### (Drugs and Dyes)

**COURSE CODE: USACDD6P1** **CREDITS: 02**

1. O-Methylation of β-naphthol.
2. Preparation of Paracetamol form p-aminophenol.
3. Preparation of Fluorescein
4. TLC of a mixture of dyes (safranine-T, Indigo carmine, methylene blue)

**II] Preparation of monograph of any one drug from syllabus by I.P. method.**

**OR**

**Industrial visit Report.**

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