

**Discipline Specific Elective Chemistry**  
**(Choose any two)**  
**B.Sc.III (Semester V) (CBCS)**  
**USC DSE ChT 09**

Total marks: 50 Total Lectures: 48

Note: Figures to the right hand side indicate number of lectures

**Discipline Specific Elective Chemistry I (Organic Chemistry)**

**UNIT I**

**Spectroscopy**

Nuclear magnetic resonance (NMR) spectroscopy. Proton magnetic resonance (<sup>1</sup>H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1, 1, 1-tribromoethane, ethyl acetate, toluene and acetophenone. Problems pertaining to the structure elucidation of simple organic compounds using nmr data. (12L)

**UNIT III**

**Organic Synthesis via Enolates.**

Definition, Active methylene compounds, Preparation of Aceto acetic ester, (Claisen condensation with Mechanism), Acidity of alpha hydrogen, properties and reactions involving formation of mono, di and unsaturated carboxylic acids, also synthesis of ketone, diketone, 4-methyl uracil from acetoacetic ester, keto-enol tautomerism. Preparation of diethyl malonate, properties and reactions involved in alkylation, formation of mono, di and unsaturated carboxylic acids, and also synthesis of glycine and barbutric acids from diethyl malonate (12L)

**UNIT III**

**Polymers**

Introduction and classification including di-block, tri-block and amphiphilic polymers; (2L)

**Polymerization reactions -**

Introduction, Hydrolysis, Hydrogenation, Addition and Substitution reactions, Cross-linking

reactions, Cure reactions, Reactions of various aliphatic and aromatic pendent groups in polymers. applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene); (7L)

**Fabrics** – natural and synthetic (acrylic, polyamido, polyester); Rubbers – natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives; Introduction to liquid crystal polymers; Biodegradable and conducting polymers with examples. (3L)

## UNIT IV

### Green Chemistry and Technology for sustainable development

Green Chemistry from theory to practice The twelve principles of green chemistry Green Chemistry and sustainable Development Designing Products under the holistic approach “Cardle-to Cardle” Scientific areas for practical applications of green chemistry Use of alternative basic chemicals as feed stocs in chemical industry and research Green Chemistry and Reduction of solvent Toxicity ( Alternative Solvents or replacement) Applications of New Methodologies in the synthesis of chemical compounds- catalysis and green chemistry. Green Chemistry and Toxic organic solvents Green solvents and Alternative methods Green Chemistry, Green solvents – Alternative techniques in organic synthesis. (12L)

### USC DSE ChP 05(Organic)

#### Practicals

- A) Identification of organic compound on the basis of NMR data.
- B) 1. Estimation of hydroxyl number of a polymer using colorimetric method..  
2. Estimation of the amount of HCHO in the given solution by sodium sulphite method
- C) 1. Preparation of nylon 66  
2. Preparation of urea-formaldehyde resin.
- D) Green chemistry synthesis of organic compound by using micro wave technic.

## Reference Books

- 1) Chemistry for Degree Student, Dr. R. L. Madan, S. Chand and Co. New Delhi.
- 2) Organic Chemistry by R. T. Morrison and R. T. Boyd, 6th edition, PHI.
- 3) Organic Chemistry by Pine, 5th edition.
- 4) Inorganic Chemistry Vol. I, II and III by Mukharjee, Singh and Kapoor – Willey Eastern.
- 5) Organic Chemistry by S. K. Ghosh.
- 6) Reaction Mechanism in Organic Chemistry by S. M. Mukharjee and S. P. Singh.
- 7) Spectroscopy of Organic Compounds by P. S. Kalsi.
- 8) Stereochemistry and Mechanism through solved problems by P.S. Kalsi.
- 9) Organic Chemistry by TWG Solomons, 4th edition, John Wiley.
- 10) Hand book of Organic Analysis by H. J. Clarke, Arnold Heinmen.
- 11) Text book of Practical Organic Chemistry by A. I. Vogel.
- 12) Text book of Organic Chemistry by Jamode, Ganar, Makode, Waghmare, Mahaja, Toshinwal.
- 13) Text book of Organic Chemistry by P.S. Kalsi published by Macmillian India Ltd. 1999, Delhi.
- 14) Practical Organic Chemistry by F. G. Mann. B. C. saunders, Orient Longman.
- 15) Comparative Practical Organic Chemistry (Qualitative Analysis) by V. K. Ahluwalia and Sunita Dhingra, Orient Longman.
- 16) Comprehensiv Practical Organic Chemistry (Preparation and Qualitative Analysis) by V. K. Ahluwalia and Renu Agrawal. Orient Longman.

## USC DSE ChT10

### Discipline Specific Elective Chemistry II (Physical)

#### UNIT- I

##### Electrochemistry – I :

Electrical transport: Conductance in metals (electronic) & in electrolyte solutions (ionic conductance), conductivity of electrodes, specific, equivalent and molar conductance, measurement of equivalent conductance, variation of equivalent & specific conductance with dilution, mobility of ions & Kohlrausch's law, Application of Kohlrausch's law & conductance for the determination of degree of dissociation, dissociation constant of acids, solubility of sparingly soluble salt, conductometric titrations (Acid-base & precipitation titrations).

Arrhenius theory of electrolyte dissociation & its limitation, Debye-Huckel theory (elementary treatment). Relaxation effect, Electrophoretic effect and Onsager equation. (12 L)

#### UNIT-II

##### Electrochemistry – II:

(A) Galvanic cells, irreversible & reversible cells, emf of cells & its measurement, calculation of thermodynamic quantities of a cell reactions ( $\Delta G$ ,  $\Delta H$  &  $\Delta S$  & equilibrium constant) Types of processes, Working and counter electrodes, Faraday's laws (I and II) of electrolysis, Faradaic processes, Nonfaradaic processes, Ideally polarized electrodes (6L)

B) Migration of ions, velocity of ions & change in concentration around electrode, transport number: definition & determination by Hittorf's method & moving boundary method, factors affecting transport number of ions, relation between transport number & ionic conductance determination of activity coefficients and transference numbers. (6L)

#### UNIT- III

Types of reversible electrodes: gas electrode, metal-metal ion electrode, amalgam electrode, metal insoluble salt-anion, redox electrodes, Half cell reactions, Nernst equation, calculation of cell emf from single electrode potential, reference electrodes, standard electrode potential.

Concentration cells with & without transference, liquid-junction potential, salt bridge & its functions, Applications of emf measurements in : (i) pH- determination using hydrogen electrode, quinhydrone electrode & glass electrode (ii) potentiometric titration(Acid –Base and Redox titrations).(iii)Solubility product of sparingly soluble salt,Qualitative discussion of potentiometric titrations (acid-base, redox,precipitation). (12L)

#### **UNIT-IV**

##### **Quantum Mechanics**

A) Failure of classical mechanics: Explanation on the basis of Black body radiation, Photoelectric effect, heat capacity of solids and Bohr's model of Hydrogen atom (No derivation). Plank's quantum theory.De Broglie's hypothesis (Derivation and experimental proof). Heisenberg's uncertainty principle (Explanation and experimental proof).

B) Introduction to wave functions ( $\Psi$ ), well behaved wave functions. Interpretation of wave function ( $\Psi$ ) and its square ( $\Psi^2$ ). Schrodinger wave equation. Normalized and orthogonal wave functions (only qualitative idea no problems). Introduction to operators. Postulates of quantum mechanics, Derivation of Schrodinger wave equation from postulates of quantum mechanics. Particle in a one dimensional box: derivation of energy and normalized wave function. Graphical representation of  $\Psi$  and its square  $\Psi^2$ . Applications of particle in a one dimensional box. Numerical problems. (12 L)

#### **USC DSE ChP 06 (Physical Chemistry)**

##### **Practicals**

- 1) To determine the strength of strong acid and a weak acid in a given mixture conductometrically by titrating it with standard alkali solution.
- 2) To determine the solubility and solubility product of a sparingly soluble salt conductometrically.
- 3) To titrate potentiometrically ferrous ammonium sulphate solution using potassium

dichromate solution as titrate and calculate the redox potential of  $\text{Fe}^{2+}/\text{Fe}^{3+}$  system on hydrogen scale.

- 4) To determine the dissociation constant of weak acid potentiometrically by titrating it against alkali.
- 5) To study the saponification of ethyl acetate conductometrically.
- 6) To determine strength of strong acid with strong base potentiometrically.

### **Reference Books**

- 1) Physical Chemistry : Walter J. Moore, 5th edn. New Delhi.
- 2) Physical Chemistry : G. M. Barrow, McGraw Hill, Indian Edn.
- 3) Principle of Physical Chemistry : Maron and Prutton.
- 4) Principles of Physical Chemistry : Puri and Sharma
- 5) Physical Chemistry : P. W. Atkins, 4th Edn.
- 6) Text book of Physical Chemistry : P. L. Sony O. R. Dhurma.
- 7) Physical Chemistry : Levine
- 8) Practical Physical Chemistry : Palit and De.
- 9) Practical Physical Chemistry : Yadao
- 10) Practical Physical Chemical : Khosla.
- 11) An introduction to synthetic drugs, Himalaya publishing house by Sing and Rangnekar. 28) Spectroscopy, Goel Publishing house by B. K. Sharma.

## USC DSE ChT 11

### Discipline Specific Elective Chemistry III (Industrial Chemicals AND Environment)

#### Unit I

##### Industrial Gases and Inorganic Chemicals

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.(2L)

Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chromealum, potassium dichromate and potassium permanganate.(10 Lectures)

#### Unit II

##### Industrial Metallurgy

Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology. (4 L)

##### Environment and its segments

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur. (2L)

##### Biocatalysis

Introduction to biocatalysis: Importance in “Green Chemistry” and Chemical Industry.(6L)

#### Unit III

Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of airpollution.Pollution by SO<sub>2</sub>, CO<sub>2</sub>, CO, NO<sub>x</sub>, H<sub>2</sub>S and other foul smelling gases. Methods of estimation of CO, NO<sub>x</sub>, SO<sub>x</sub> and control procedures.

Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates. (12 L)

#### **Unit IV**

##### **Energy & Environment**

Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc.

Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

(12L)

#### **USC DSE ChP 07(Industrial Chemicals AND Environment)**

##### **Practicals**

1. Determination of dissolved oxygen in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO<sub>3</sub> and potassium chromate).
6. Estimation of total alkalinity of water samples (CO<sub>3</sub><sup>2-</sup>, HCO<sub>3</sub><sup>-</sup>) using double titration method.
7. Measurement of dissolved CO<sub>2</sub>.
8. Study of some of the common bio-indicators of pollution.
9. Estimation of SPM in air samples.
10. Preparation of borax/ boric acid.



## Reference Books

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

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

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

4 S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New Delhi.

5 K. De, Environmental Chemistry: New Age International Pvt., Ltd, New Delhi.

6 S. M. Khopkar, Environmental Pollution Analysis: Wiley Eastern Ltd, New Delhi.

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## USC DSE ChT 12

### Discipline Specific Elective Chemistry IV (Green Chemistry)

#### UNIT I

##### Introduction to Green Chemistry

What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry.

Principles of Green Chemistry and Designing a Chemical synthesis Twelve principles of Green Chemistry with their explanations and examples; Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products (Atom Economy); prevention/ minimization of hazardous/ toxic products; designing safer chemicals – different basic approaches to do so; selection of appropriate auxiliary substances (solvents, separation agents), green solvents, solventless processes, immobilized solvents and ionic liquids; (12 L)

#### UNIT II

##### Examples of Green Synthesis/ Reactions

Green Synthesis of the following compounds: adipic acid, catechol, BHT, methylmethacrylate, urethane, aromatic amines (4-aminodiphenylamine), benzyl bromide, acetaldehyde, disodium iminodiacetate (alternative to Strecker synthesis), citral, ibuprofen, paracetamol, furfural.

Microwave assisted reactions in water: Hofmann Elimination, Hydrolysis (of benzyl chloride, benzamide, n-phenyl benzamide, methylbenzoate to benzoic acid), Oxidation (of toluene, alcohols).

Microwave assisted reactions in organic solvents: Esterification, Fries rearrangement, Orthoester Claisen Rearrangement, Diels-Alder Reaction, Decarboxylation.

Microwave assisted solid state reactions: Deacetylation, Deprotection. Saponification of esters, Alkylation of reactive methylene compounds, reductions, synthesis of nitriles from aldehydes; anhydrides from dicarboxylic acid; (12L)

#### UNIT III

Ultrasound assisted reactions: Esterification, saponification, substitution reactions,

Alkylations, oxidation, reduction, coupling reaction, Cannizzaro reaction, Strecker synthesis,

Reformatsky reaction. Selective methylation of active methylene group using dimethylcarbonate; Solid-state polymerization of amorphous polymers using diphenylcarbonate; Use of “Clayan”, a nonmetallic oxidative reagent for various reactions; Free Radical Bromination; Role of Tellurium in organic syntheses; Biocatalysis in organic syntheses. (12L)

#### **UNIT IV**

Future Trends in Green Chemistry Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; oncovalent derivatization; Green chemistry in sustainable development. Energy requirements for reactions - use of microwaves, ultrasonic energy; selection of starting materials; avoidance of unnecessary derivatization – careful use of blocking/protecting groups; use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; designing of biodegradable products; prevention of chemical accidents; strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes. (12 L)

### **USC DSE ChP 08(Green Chemistry)**

#### **Practicals**

##### 1. Safer starting materials

The Vitamin C clock reaction using Vitamin C tablets, tincture of iodine, hydrogen peroxide and liquid laundry starch.

1) Effect of concentration on clock reaction

2) Effect of temperature on clock reaction. (if possible)

##### 2. Using renewable resources

Preparation of biodiesel from vegetable oil.

##### 3. Avoiding waste

Principle of atom economy.

Use of molecular model kit to simulate the reaction to investigate how the atom economy can illustrate Green Chemistry.

Preparation of propene by two methods can be studied

(I) Triethylamine ion + OH<sup>-</sup> → propene + trimethylpropene + water

(II) 1-propanol H<sub>2</sub>SO<sub>4</sub>/□ → propene + water

The other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy.

4. Use of enzymes as catalysts

Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide

Alternative Green solvents

5. Diels Alder reaction in water

Reaction between furan and maleic acid in water and at room temperature rather than in benzene and reflux.

6. Extraction of D-limonene from orange peel using liquid CO<sub>2</sub> prepared from dry ice.

7. Mechanochemical solvent free synthesis of azomethines

8. Co-crystal controlled solid state synthesis (C2S3) of N-organophthalimide using phthalic anhydride and 3-aminobenzoic acid.

### Reference Books

1 Anastas, P.T & Warner, J.C. Green Chemistry: Theory and Practice, Oxford University Press (1998).

2 Kirchoff, M. & Ryan, M.A. Greener approaches to undergraduate chemistry experiment. American Chemical Society, Washington DC (2002).

3 Ryan, M.A. Introduction to Green Chemistry, Tinnesand; (Ed), American Chemical Society, Washington DC (2002).

4 Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. I.K. Green Chemistry Experiment: A monograph International Publishing House Pvt Ltd. New Delhi. Bangalore CISBN 978-93-81141-55-7 (2013).

5 Cann, M.C. & Connelly, M. E. Real world cases in Green Chemistry, American Chemical Society (2008).

6 Cann, M. C. & Thomas, P. Real world cases in Green Chemistry, American Chemical Society (2008).

7 Pavia, D. L. Lamponan, G. H. &Kriz, G.S. W B Introduction to organic laboratory

### Distribution Of Marks For Practical Examination

#### Time 4-5 hours (One Day Examination) Marks 30

USC DSE ChP 05 (Experiment) (In examination Experiment A is compulsory (4M)+ any one from B or C or D (8M) ..... 12

USC DSE ChP 06 (Experiment) (In examination any one) ..... 12

USC DSE ChP 07(Experiment) (In examination any two) ..... 12

USC DSE ChP 08 (Experiment) (In examination any one) ..... 12

#### ANY TWO FROM ABOVE FOUR

TOTAL MARKS	12+12=	24
Viva-Voce	.....	03
Record	.....	03
<b>Total :</b>		<b>30 marks</b>

## **Skill Enhancement Course (SEC)**

**(Choose one)**

### **SEC I**

#### **1. Pharmaceutical Chemistry**

##### Drugs & Pharmaceuticals

Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, Ibuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).

##### Fermentation

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

#### **Practicals**

1. Preparation of Aspirin and its analysis.
2. Preparation of magnesium bisilicate (Antacid).
3. Preparation of Paracetamol and its analysis.
4. To perform analytical method validation of Paracetamol in pure and tablet form by using UV spectrophotometric method.

#### **Reference Books:**

- 1 G.L. Patrick: Introduction to Medicinal Chemistry, Oxford University Press, UK.
- 2Hakishan, V.K. Kapoor: Medicinal and Pharmaceutical Chemistry, Vallabh

Prakashan, Pitampura, New Delhi.

3 William O. Foye, Thomas L., Lemke , David A. William: Principles of Medicinal Chemistry, B.I. Waverly Pvt. Ltd. New Delhi

## **SEC II**

### **Chemistry of Cosmetics& Perfumes**

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

### **Practicals**

1. Preparation of talcum powder.
2. Preparation of shampoo.
3. Preparation of enamels.
4. Preparation of hair remover.
5. Preparation of face cream.
6. Preparation of nail polish and nail polish remover.

### **Reference Books:**

- 1 E. Stocchi: Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.
- 2 P.C. Jain, M. Jain: Engineering Chemistry, DhanpatRai& Sons, Delhi.
- 3 B.K. Sharma: Industrial Chemistry, Goel Publishing House, Meerut.

**Distribution Of Marks**  
**Skill Enhancement course**

**Theory -15Marks**  
**Practical -35 Marks**

**For theory examination**

15 marks multiple choice question paper is to be set by the college and evaluation is done by college.

**For practical Examination:**

- 1) One practical of 10 marks
- 2) One survey based project report 20 marks
- 3) Viva 5 marks

**Total marks =15+35=50**



**Discipline Specific Elective Chemistry**  
(Choose any two)  
**B.Sc.III (Semester VI) (CBCS)**  
**USC DSE ChT 13**

**Discipline Specific Elective Chemistry V (Inorganic)**

**UNIT-I**

**A) Qualitative and quantitative aspects of analysis:**

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals. (6 L)

**B) Flame Photometry:**

Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Effect of solvent in flame photometry. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Limitations of flame photometry. Application of Flame photometry. Experimental procedure for quantitative analysis (6L)

**UNIT-II:**

**A) Separation Techniques:**

a) Chromatography: Classification, Principle, Technique and Application of Paper and Column Chromatography.

b) Ion- Exchange: Types of ion exchange resins, Equilibria and ion exchange capacity, Application in separation of binary mixtures.

c) Solvent Extraction: Principle and Classification, Factors influencing extraction and Application in chemistry. (6L)

**B) Fertilizer:**

Classification, Chemical fertilizer with example, advantages and disadvantages of chemical fertilizer, manures and compost and their advantages over chemical fertilizers. (3L)

**C) Basic Principal of Soil Chemistry:-**

Introduction of soil and its type, Chemical Analysis of soil, Collection of soil Sample, Method of analysis, Soil pH, Soil Salinity, Organic carbon, available phosphorous and potassium. Lime requirements. (3 L)

### **UNIT-III:**

#### **A) Organometallic Chemistry:-**

Definition, Nomenclature and Classification of Organometallic compounds. Preparation properties and application of Alkyl and Aryls of Al, Hg and Sn. A brief account of metal ethylenic complexes (Structure only). Homogeneous Hydrogenation (Wilkinson's Catalyst reaction). (6 L)

**B) Nanomaterials:** Basic Concepts in nanomaterials, classifications, preparation of gold and silver nanomaterial. Carbon nanotubes and inorganic nanowires. Bioinorganic nanomaterial. (6L)

### **UNIT-IV:**

#### **Water Pollution:**

**A)** Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems.

**B)** Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc. Sludge disposal.

**C)** Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water.

(12L)

### **USC DSE ChP 09(Inorganic)**

#### **Practicals:**

- 1) Ion Exchange Method, separation and estimation of Mg(II) and Zn(II)
- 2) Chromatographic Separation of Binary Mixtures (at least two) containing Cu(II), CO(II) and Ni(II) ions by paper chromatography and determination of R<sub>f</sub> Values.
- 3) verification of F, Q, and T test and rejection of data for acid base titration..
- 4) Analysis of soil:
  - 1) Determination of pH of soil. 2) Total soluble salt 3) Estimation of calcium, magnesium, phosphate, nitrate.

5) Measurement of chloride, sulphate and salinity of water samples by simple titration method ( $\text{AgNO}_3$  and potassium chromate).

6) Estimation of total alkalinity of water samples ( $\text{CO}_3^{2-}$ ,  $\text{HCO}_3^-$ ) using double titration method.

### Reference Books

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia – S. Naginchand & Co. Delhi.
2. Text book of Inorganic Chemistry by A. K. De. Wiley East Ltd.,
3. Selected Topics in Inorganic Chemistry by Malik, Tuli and Madan – S. Chand and Co.
4. Modern Inorganic Chemistry by R. c. Agrawal, Kitab Mahal.
5. Instrumental Methods of analysis by Chatwal and Anand, Himalaya Publishing House.
6. Concise Inorganic Chemistry by J. D. Lee, ELBS.
7. Inorganic Chemistry by J. E. Hoheey – Harper and Row.
8. Fundamental concepts of Inorganic Chemistry by E. S. Gilreath, McGraw Hill book Co.
9. Modern Inorganic Chemistry by W. L. McGraw Hill Int.
10. Chemistry Facts, Patterns and Principles by Kneen, Rogers and Simpson, ELBS.
11. Theoretical Principles of Inorganic Chemistry by G.S. Manku, Tata McGraw Hill.
12. Inorganic complex compounds by Murmann, Chapman and Hall.
13. Text book of Inorganic Chemistry by K. N. Upadhyaya, Vikas Publishing House, Delhi.
14. Advanced Practical Inorganic Chemistry by Gurdeep Raj. Goel Publishing House, Meerut.
15. Co-Ordination Chemistry by D. Banerjee, TMH Publication.
16. Text book of Inorganic Chemistry by Marathe, Bhadange, Mopari and Kubade.
17. Physico Chemical Techniques of Analysis – P.B. Janarthanam Vol – I & II- Asian Publication

## **Discipline Specific Elective Chemistry VI (Physical)**

### **UNIT I**

#### **A) Photochemistry :-**

Interaction of radiation with matter, difference between thermal and photochemical process, Beer-Lamberts, laws of photochemistry :Grothus-Draper law, Stark-Einstein law, Jablonski diagram depicting various processes (nonradiative and radiative) fluorescence, phosphorescence, chemiluminescence, quantum yield, determination of quantum yield of reactions, causes for low and high quantum yields. Some examples of photochemical reactions (e.g. Photochemical decomposition of Hydrogen iodide, Photosynthesis of HBr from H<sub>2</sub> and Br<sub>2</sub> and photosynthesis of HCl from H<sub>2</sub> and Cl<sub>2</sub> Photosensitized reactions. Energy transfer processes. (8 L)

#### **B) Dipole Moment :-**

Electrical dipole moment, polarizability of molecules (Clausius-Mosotti equation), orientation of dipoles in an electric field. Determination of dipole moment. Bond moments. Group moments for benzene derivatives. Application of dipole moment to (i) % ionic character (ii) Shape of molecules, (iii) study of geometrical isomers and (iv) substituted benzene molecules. (4 L)

### **UNIT-II**

#### **Spectroscopy**

##### **A) Rotational Spectroscopy:**

Introduction to spectroscopy, Dipole moment and Rotational Spectra. Rotational spectra of diatomic molecules, Energy levels of rigid rotor. Selection rule for transition between energy levels. Expression for wave number (cm<sup>-1</sup>) of spectral lines in terms of rotational constant (B) and rotational quantum number (J). Intensity of spectral lines. Application of rotational spectra for determination of bond length of diatomic molecules. Introduction to non-rigid rotor.[6 L]

## **B) Vibrational Spectroscopy:**

Energy levels of simple harmonic oscillator, Energy level diagram, relative populations of energy levels. Selection rule for pure vibrational spectra (harmonic oscillations), Force constant. Anharmonic oscillator, Morse equation, selection rules, idea of overtones. Degrees of freedom and normal modes of vibration for polyatomic molecules. Idea of vibrational frequencies of different functional groups. (6 L)

## **UNIT-III**

### **A) Surface Chemistry:-**

Adsorption, Chemisorptions, Application of adsorption, adsorption of gases by solid, freundlich adsorption isotherm , Langmuirs theory of adsorption, Adsorption from solution , Adsorption chromatography. (6 L)

### **B) Colloidal Chemistry:-**

Type of colloidal system , its classification, lyophilic and lyophobic sol, partical size range, preparation of colloidal solution by condensation method , ultra filtration, properties of colloidal system, charge on colloidal particles, gold number, electrical properties: electrophoresis and electro Osmosis, Surfactant definition, types , miscelle concentration, effect of temperature on CMC. ( 6 L)

## **UNIT IV**

### **Nuclear Chemistry**

The atom, nucleus and outer sphere, classification of nuclides, nuclear stability and binding energy. Discovery of radioactivity, types of radioactivity, general characteristics of radioactive decay and decay kinetics, Measurements radioactivity, gaseous ion collection method, proportional and G.M. counter.

Applications of radioactivity Radiochemical principles in the use of tracers,

Typical applications of radioisotopes as a tracer i) Chemical investigations- reaction mechanism,

ii) Structure determination- phosphorus pentachloride and thiosulphate ion

iii) Age determination- by Carbon-14 dating and Uranium-Lead/ Thorium-Lead Ratio

iv) Medical applications-Assess the volume of blood in patients body, Goiter (12L)

### USC DSE ChP10(Physical)

#### Practicals

- 1) To verify Beer – Lambert Law for  $\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$  and determining the concentration of the given solution of the substance from absorption.
- 2) To verify the Freundlich adsorption isotherm by acetic acid on activated charcoal
- 3) Determination of polarizability of given molecule by Abbe's refractometer.
- 4) To determine CMC of soap solution.
- 5) To study effect of temperature on CMC on soap solution.

#### Reference Books

1. Physical Chemistry: Walter, J. Moore, 5th edn., New Delhi.
2. Physical Chemistry: G.M. Barrow, McGraw Hill, Indian Edn.
3. Principles of Physical Chemistry: Maron and Prutton
4. Principles of Physical Chemistry: Puri, Sharma and Pathaniya.
5. Text book of Physical Chemistry: P.L. Sony, O.P. Dharma.
6. Physical Chemistry: Levine.
- 7 Practical Physical Chemistry: Palit and De.
8. Practical Physical Chemistry: Yadao.
9. Practical Physical Chemistry: Khosla.
- 10 Laboratory Manual of Physical Chemistry W.J. Popiel.
11. Principles of Soil Science : M. M. Rai (4th addition) McMillan publication.
- 12 Advance physical chemistry : J. N. Gurtu & A. Gurtu, Pragati prakashan, Meeru

## USC DSE ChT 15

### Discipline Specific Elective Chemistry VII

#### (Inorganic Materials of Industrial Importance)

#### UNIT I

##### **Silicate Industries**

Glass: Glassy state and its properties, classification (silicate and non-silicate glasses).

Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass,

**Ceramics:** Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre.

**Cements:** Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements. (12 Lectures)

#### UNIT II

##### **Fertilizers:**

Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; mixed fertilizers, potassium chloride, potassium sulphate. (4 L)

##### **Surface Coatings:**

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings (electrolytic and electroless), (8 L)

### **UNIT III**

#### **Batteries:**

Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solar cell and polymer cell.

(4 L)

#### **Alloys:**

Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization, dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). (8 L)

### **UNIT IV**

**Catalysis:** General principles and properties of catalysts, Deactivation or regeneration of catalysts, enzyme as nature's catalyst, Compare the activity and reactivity of man-made catalyst and enzyme, factors which affect enzyme activity, some industrially important catalytic processes - Haber's, Ostwald's process, Phase transfer catalysts, application of zeolites as catalysts. (8 L)

#### **Chemical explosives:**

Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants. (4 L)

### **USC DSE ChP11(Inorganic Materials of Industrial Importance)**

#### **Practicals**

1. Determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of Calcium in Calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.
4. Electroless metallic coatings on ceramic and plastic material.



5. Determination of composition of dolomite (by complexometric titration).
6. Analysis of (Cu, Ni); (Cu, Zn ) in alloy or synthetic samples.
7. Analysis of Cement.
8. Preparation of pigment (zinc oxide).

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### **Reference Books**

- 1 E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
- 2 R. M. Felder, R. W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
- 3 W. D. Kingery, H. K. Bowen, D. R. Uhlmann: Introduction to Ceramics, Wiley Publishers, New Delhi.
- 4 J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
- 5 P. C. Jain, M. Jain: Engineering Chemistry, DhanpatRai& Sons, Delhi.
- 5R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.
- 6 B. K. Sharma: Engineering Chemistry, Goel Publishing House, Meerut

## **USC DSE ChT 16**

### **Discipline Specific Elective Chemistry VIII (Polymer Chemistry)**

#### **Unit I**

Introduction and history of polymeric materials: Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers. (4L)Functionality and its importance:

Criteria for synthetic polymer formation, classification of polymerization processes,

Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems. (8 L)

## **Unit II**

Kinetics of Polymerization:

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques. (6L)

Polymer Additives

Fillers & Reinforcement, Plasticizers, Antioxidants & Thermal Stabilizers (Heat Stabilizers), Ultraviolet stabilizers, Fire retardants, Colourants, Antistatic agents & Curing agents (6 L)

## **UNIT III**

Determination of molecular weight of polymers ( $M_n$ ,  $M_w$ , etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance.(4 L)

Polymer Solution – Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.(8 L)

## **UNIT IV**

Nature and structure of polymers-Structure Property relationships.(2 L)

Properties of Polymers (Physical, thermal, Flow & Mechanical Properties).

Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac),

polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylenesulphidepolypyrrole, polythiophene)].(10 L)

## USC DSE ChP 12(Polymer Chemistry)

### Practicals

#### 1. Polymer synthesis

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).

a. Purification of monomer

b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bis-isobutyronitrile (AIBN)

2 Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein

a. Preparation of IPC

b. Purification of IPC

c. Interfacial polymerization

3. Redox polymerization of acrylamide

4. Precipitation polymerization of acrylonitrile

5. Preparations of novalac resin/resold resin.

6. Microscale Emulsion Polymerization of Poly(methylacrylate).

Polymer characterization

1. Determination of molecular weight by viscometry:

(a) Polyacrylamide-aq.NaNO<sub>2</sub> solution

(b) (Poly vinyl propylidene (PVP) in water

2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol)

(PVOH) and the fraction of “head-to-head” monomer linkages in the polymer.

3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).

4. Testing of mechanical properties of polymers.

### **Reference Books**

- Seymour’s Polymer Chemistry, Marcel Dekker, Inc.
- G. Odian: Principles of Polymerization, John Wiley.
- F.W. Billmeyer: Text Book of Polymer Science, John Wiley.
- P. Ghosh: Polymer Science & Technology, Tata Mcgraw-Hill.
- R.W. Lenz: Organic Chemistry of Synthetic High Polymers.

### **Distribution Of Marks For Practical Examination**

#### **Time 4-5 hours (One Day Examination) Marks 30**

USC DSE ChP 09 (any two experiment)	.....	12
USC DSE ChP 10 (any one experiment)	.....	12
USC DSE ChP 11 (any one experiment)	.....	12
USC DSE ChP 12 (any one experiment)	.....	12

**ANY TWO FROM ABOVE FOUR**

TOTAL MARKS	12+12=	24
Viva-Voce	.....	03
Record	.....	03
<b>Total :</b>		<b>30 marks</b>

**Skill Enhancement Course (SEC)**

**B.Sc. III Semester VI**

**(Choose one)**

**SEC-III**

**PESTICIDE CHEMISTRY**

General introduction to pesticides (natural and synthetic), benefits and adverse

effects, changing concepts of pesticides, structure activity relationship, purpose of formulations of pesticides, different types of formulations synthesis and technical manufacture and uses of representative pesticides in the following classes:

Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion );

Carbamates (Carbofuran and carbaryl); Quinones ( Chloranil), Anilides (Alachlor and Butachlor).

### **Practicals**

1 To calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications.

2 Preparation of simple organophosphates, phosphonates and thiophosphates

### **Reference Book:**

1 R. Cremlyn: Pesticides, John Wiley.

## **SEC-IV**

### **ANALYTICAL CLINICAL BIOCHEMISTRY**

Basic understanding of the structures, properties and functions of carbohydrates, lipids and proteins:

Review of concepts studied in the core course

Carbohydrates: Biological importance of carbohydrates, Metabolism, Cellular currency of energy (ATP), Glycolysis, Alcoholic and Lactic acid fermentations, Krebs cycle.

Isolation and characterization of polysachharides.

Proteins: Classification, biological importance; Primary and secondary and tertiary structures of proteins:  $\alpha$ -helix and  $\beta$ -pleated sheets, Isolation, characterization, denaturation of proteins.

Enzymes: Nomenclature, Characteristics (mention of Ribozymes), Classification; Active site, Mechanism of enzyme action, Stereospecificity of enzymes, Coenzymes and cofactors, Enzyme inhibitors, Introduction to Biocatalysis: Importance in "Green Chemistry" and Chemical Industry.

Lipids: Classification. Biological importance of triglycerides and phosphoglycerides and cholesterol; Lipid membrane, Liposomes and their biological functions and underlying applications.

Lipoproteins.

Properties, functions and biochemical functions of steroid hormones.

Biochemistry of peptide hormones.

Structure of DNA (Watson-Crick model) and RNA, Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation, Introduction to Gene therapy.

Enzymes: Nomenclature, classification, effect of pH, temperature on enzyme activity, enzyme inhibition.

Biochemistry of disease: A diagnostic approach by blood/ urine analysis.

Blood: Composition and functions of blood, blood coagulation. Blood collection and preservation of samples. Anaemia, Regulation, estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin.

Urine: Collection and preservation of samples. 6. Formation of urine. Composition and estimation of constituents of normal and pathological urine.

## **Practicals**

Identification and estimation of the following:

1. Carbohydrates – qualitative and quantitative.
2. Lipids – qualitative.
3. Determination of the iodine number of oil.
4. Determination of the saponification number of oil.
5. Determination of cholesterol using Liebermann- Burchard reaction.
6. Proteins – qualitative.
7. Isolation of protein.
8. Determination of protein by the Biuret reaction.
9. Determination of nucleic acids

**Reference Books:**

1. T.G. Cooper: Tool of Biochemistry.
2. Keith Wilson and John Walker: Practical Biochemistry.
3. Alan H Gowenlock: Varley's Practical Clinical Biochemistry.
4. Thomas M. Devlin: Textbook of Biochemistry.
5. Jeremy M. Berg, John L Tymoczko, Lubert Stryer: Biochemistry.
6. G. P. Talwar and M Srivastava: Textbook of Biochemistry and Human Biology.
7. A.L. Lehninger: Biochemistry.
5. Dean, J. A. Analytical Chemistry Notebook, McGraw Hill.
6. Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India.
7. Freifelder, D. Physical Biochemistry 2nd Ed., W.H. Freeman and Co., N.Y. USA (1982).
8. Cooper, T.G. The Tools of Biochemistry, John Wiley and Sons, N.Y. USA.16 (1977).
9. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall.



10. Vogel, A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Prentice Hall.
11. Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).

### **Distribution Of Marks**

#### **Skill Enhancement course**

**Theory -15Marks**

**Practical -35 Marks**

**For theory examination**

15 marks multiple choice question paper is to be set by the college and evaluation is done by college.

**For practical Examination:**

- 1) One practical of 10 marks
- 2) One survey based project report 20 marks
- 3) Viva 5 marks

**Total marks =15+35=50**