Bharatiya Vidya Bhavan

BHAVAN'S VIVEKANANDA COLLEGE OF SCIENCE, HUMANITIES AND COMMERCE,
SAINIKPURI, SECUNDERABAD.
Autonomous College
Affiliated to OSMANIA UNIVERSITY, Hyderabad.
(Accredited with 'A' grade by NAAC)

CHEMISTRY SYLLABUS

(2016-2019)

CBCS SYSTEM

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BOS in Chemistry
Bhavan's Vivekananda College
Sainikpuri

CREDITS IN CHEMISTRY

SEM	PAPER	CODE	COURSE TITLE	COURSE TYPE	HPW	CREDITS
I	I	CT135	INORGANIC AND GENERAL CHEMISTRY-I	DSC-3A	4T+2P=6	4+1=5
II	II	CT235	PHYSICAL AND ORGANIC CHEMISTRY-I	DSC-3B	4T+2P=6	4+1=5
III	III	CT335	ORGANIC AND GENERAL CHEMISTRY PAPER-II	DSC-3C	4T+2P=6	4+1=5
IV	IV	CT435	INORGANIC AND PHYSICAL CHEMISTRY PAPER-II	DSC-3D	4T+2P=6	4+1=5
V	V	CT535	ORGANIC,PHYSICAL AND GENERAL CHEMISTRY-III	DSC-4E	3T+2P=5	3+1=4
V	VI	CT535A / 535B	PHYSICO-METHODS OF ANALYSIS,SPECTROSCOPY and CATALYSIS/ELECTRO ANALYTICAL TECHNIQUES	DSE-4F	3T+2P=5	3+1=4
VI	VII	CT635	ORGANIC,PHYSICAL AND GENERAL CHEMISTRY-IV	DSC-5E	3T+2P=5	3+1=4
VI	VIII	CT635A	DRUGS, PESTICIDES, MACROMOLECULES	DSE-5F	3T+2P=5	3+1=4
III*	I	SE 335	SAFETY IN CHEMISTRY LABORATORY AND PREPARING LAB REAGENTS	SEC-1	02	02*
IV*	II	SE 435	GREEN METHODS IN CHEMISTRY	SEC-2	02	02*
V*	III	SE 535	BASIC ANALYTICAL CHEMISTRY	SEC-3	02	02*
VI*	IV	SE 635	CHEMINFORMATICS	SEC-4	02	02*
V*	I	GE 535	ORGANIC FARMING	GE-1	02	02*
VI*	II	GE 635	CHEMISTRY OF COSMETICS &PERFUMES	GE-2	02	02*
			TOTAL			36+12*

DSC=DISCIPLINE SPECIFIC COURSE DSE=DISCIPLINE SPECIFIC ELECTIVE

*SEC=SKILL ENHANCEMENT COURSE * GE=GENERIC ELECTIVE

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Ch. Sarada Devi

CHEMISTRY SYLLABUS (2016-2019)

SEMESTER I AND II

PAPER	SEMESTER	CODE& TITLE	UNITS	CLASSES ALLOTED	TOTAL CLASSES	TOTAL MARKS
I	I	CT 135 (THEORY) INORGANIC CHEMISTRY-I AND GENERAL CHEMISTRY-I	UNIT I AND UNIT II: INORGANIC CHEMISTRY -I	02 HOURS/WEEK	30HOURS-15WEEKS	100
			UNIT III AND UNIT IV: GENERAL CHEMISTRY-I	02 HOURS/WEEK	30HOURS-15WEEKS	
I	I	CT 135 P PRACTICALS	INORGANIC CHEMISTRY (SEMI MICRO QUALITATIVE ANALYSIS)	02 HOURS/WEEK	30HOURS-15WEEKS	25
II	II	CT 235 (THEORY) PHYSICAL CHEMISTRY-I AND ORGANIC CHEMISTRY-I	UNIT I AND UNIT II: PHYSICAL CHEMISTRY-I	02 HOURS/WEEK	30HOURS-15WEEKS	100
			UNIT III AND UNIT IV: ORGANIC CHEMISTRY-I	02 HOURS/WEEK	30HOURS-15WEEKS	
II	II	CT 235 P PRACTICALS	INORGANIC CHEMISTRY (SEMI MICRO QUALITATIVE ANALYSIS)	02 HOURS/WEEK	30HOURS-15WEEKS	25

B Bhattacharyya

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SEMESTER III AND IV

PAPER	SEMESTER	CODE& TITLE	UNITS	CLASSES ALLOTED	TOTAL CLASSES	TOTAL MARKS
III	III	CT 335 (THEORY) ORGANIC CHEMISTRY-II AND GENERAL CHEMISTRY-II	UNIT I AND UNIT II: ORGANIC CHEMISTRY -II	02 HOURS/WEEK	30HOURS-15WEEKS	100
			UNIT III AND UNIT IV: GENERAL CHEMISTRY-II	02 HOURS/WEEK	30HOURS-15WEEKS	
III	III	CT 335 P PRACTICALS	INORGANIC CHEMISTRY (QUANTITATIVE ANALYSIS-TITRIMETIC ANALYSIS)	02 HOURS/WEEK	30HOURS-15WEEKS	25
IV	IV	CT 435 (THEORY) INORGANIC CHEMISTRY-II AND PHYSICAL CHEMISTRY-II	UNIT I AND UNIT II: INORGANIC CHEMISTRY-II	02 HOURS/WEEK	30HOURS-15WEEKS	100
			UNIT III AND UNIT IV: PHYSICAL CHEMISTRY-II	02 HOURS/WEEK	30HOURS-15WEEKS	
IV	IV	CT 435 P PRACTICALS	INORGANIC CHEMISTRY (QUANTITATIVE ANALYSIS-TITRIMETIC ANALYSIS)	02 HOURS/WEEK	30HOURS-15WEEKS	25

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SEMESTER V

SEMESTER	PAPER	CODE& TITLE	UNITS	CLASSES ALLOTED	TOTAL CLASSES	TOTAL MARKS
V	V	CT 535 (THEORY) ORGANIC CHEMISTRY-III , PHYSICAL CHEMISTRY-III AND INORGANIC CHEMISTRY-III	UNIT I :ORGANIC CHEMISTRY -III	01HOURS/WEEK	15HOURS-15WEEKS	100
			UNIT II: PHYSICAL CHEMISTRY-III	01 HOUR/WEEK	15HOURS-15WEEKS	
			UNIT III: INORGANIC CHEMISTRY-III	01HOURS/WEEK	15HOURS-15WEEKS	
V	VI	CT 535A (THEORY)	ELECTIVE-I PHYSICO CHEMICAL METHODS OF ANALYSIS,SPECTROSCOPY AND CATALYSIS	03 HOURS/WEEK	45 HOURS-15WEEKS	100
			ELECTIVE-II ELECTROANALYTICAL TECHNIQUES			
V	V	CT535P PRACTICALS	ORGANIC CHEMISTRY-I	02 HOURS/WEEK	30HOURS-15WEEKS	25
V	VI	CT 535AP PRACTICALS	PHYSICAL CHEMISTRY-I	02 HOURS/WEEK	30HOURS-15WEEKS	25

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SEMESTER VI

SEMESTER	PAPER	CODE& TITLE	UNITS	CLASSES ALLOTED	TOTAL CLASSES	TOTAL MARKS
VI	VII	CT 635 (THEORY) ORGANIC CHEMISTRY-IV , PHYSICAL CHEMISTRY-IV AND INORGANIC CHEMISTRY-IV	UNIT I :ORGANIC CHEMISTRY -IV	01 HOURS/WEEK	15HOURS-15WEEKS	100
			UNIT II: PHYSICAL CHEMISTRY-IV	01 HOUR/WEEK	15HOURS-15WEEKS	
			UNIT III: INORGANIC CHEMISTRY-IV	01 HOUR/WEEK	15HOURS-15WEEKS	
VI	VIII	CT 635A (THEORY)	ELECTIVE-I DRUGS, PESTICIDES, MACROMOLECULES	03 HOURS/WEEK	45 HOURS-15WEEKS	100
			ELECTIVE-II BIOMOLECULES			
VI	VII	CT635P PRACTICALS	ORGANIC CHEMISTRY-II	02 HOURS/WEEK	30HOURS-15WEEKS	25
VI	VIII	CT 635AP PRACTICALS	PHYSICAL CHEMISTRY-II	02 HOURS/WEEK	30HOURS-15WEEKS	25

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DEPARTMENT OF CHEMISTRY

B Sc CHEMISTRY COURSE SYLLABUS-CBCS
(To be effective from the batch of students admitted from the academic year 2016-17)

I SEMESTER / PAPER - I **(60 hrs / 15 weeks)**
(Inorganic chemistry-I and General chemistry-I)

UNIT I-Inorganic Chemistry-I		**30 hrs (2 h / w)**
1. Structural inorganic chemistry	6 h	
2. Hydrogen bonding	2 h	
3. s-Block elements	3 h	
UNIT II-Inorganic Chemistry-I		
1. p-Block elements	15 h	
2. Organo metallic Chemistry	4 h	
UNIT III-General Chemistry-I		**30 hrs (2 h / w)**
1. Atomic structure and Elementary quantum mechanics	7 h	
2. Chemical Bonding	8 h	
UNIT IV- General Chemistry-I		
1. Structural theory in Organic Chemistry	9 h	
2. General principles of Inorganic qualitative analysis	6 h	

II SEMESTER / PAPER – II **(60 hrs / 15 weeks)**
(Physical chemistry-I & Organic chemistry-I)

UNIT I-Physical Chemistry-I		**30 hrs (2 h / w)**
1. Gaseous State	5 h	
2. Liquid State	4 h	
3. Solid State	9 h	
UNIT II-Physical Chemistry-I		
1. Solutions	6 h	
2. Colloids and Surface Chemistry	6 h	
UNIT III-Organic Chemistry-I		**30 hrs (2 h / w)**
1. Stereo chemistry of carbon compounds	10 h	
2. Acyclic hydrocarbons	8 h	
UNIT IV-Organic Chemistry-I		
1. Alicyclic hydrocarbons	4 h	
2. Benzene and its reactivity	6 h	
3. Poly nuclear hydrocarbons	2 h	

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I - SEMESTER (Theory)

PAPER – I **(60 h / 15 weeks)**
(Inorganic Chemistry-I & General Chemistry-I)

Unit I:

Structural Inorganic Chemistry: Atomic and ionic radii-covalent radius-single, double and triple bond, Van der Waal radius, radii of cations and anions. Ionization energy, electropositivity, basic nature, reducing behavior, electron affinity, concept of electronegativity- methods of determination and evaluation-Paulings approach. Mullikens approach, applications in predicting and explaining chemical nature of bond, bond length and bond angles, diagonal relationship. (6h)

Hydrogen bonding : Types of hydrogen, bonding, effect of hydrogen boding on physical properties of substances like--a) Physical State b) MP & BP c) Solubility d) Viscosity (2h)

s-block elements: General characteristics of groups I & II elements, diagonal relationship between Li & Mg, Be & Al. (3 h)

Unit II:

p-block elements: General characteristics of elements of groups 13, 14, 15, 16 and 17
Group – 13: Synthesis and structure of diborane and higher boranes (B_4H_{10} and B_5H_9), Boron-nitrogen compounds ($B_3N_3H_6$ and BN)
Group – 14: Preparation and applications of silanes and silicones, graphitic compounds.
Group – 15: Preparation and reactions of hydrazine, hydroxylamine, phosphazenes.
Group – 16: Classifications of oxides based on (i) Chemical behaviour and (ii) Oxygen content.
Group – 17: Inter halogen compounds and pseudo halogens (15h)

Organometallic Chemistry
Definition and classification of organometallic compounds, nomenclature, preparation, properties and applications of alkyls of 1, 2 and 13 group elements. (4 h)

Unit III:

Atomic Structure and elementary quantum mechanics; Blackbody radiation, Planck's radiation law, photoelectric effect, Compton effect, de Broglie's hypothesis, Heisenberg's uncertainty principle. Postulates of quantum mechanics. Schrodinger wave equation and a particle in a box, energy levels, wave functions and probability densities, Schrodinger wave equation for H-atom, Separation of variables, Radial and angular functions, hydrogen like wave functions, quantum numbers and their importance. (7 h)

Chemical Bonding : Valence bond theory, hybridization, VB theory as applied to ClF_3, BrF_5, Ni $(CO)_4$ and XeF_2, Dipole moment – orientation of dipoles in an electric field, dipole moment, induced dipole moment, dipole moment and structure of molecules. Molecular orbital theory – LCAO method, construction of M.O. diagrams for homo-nuclear and hetero-nuclear diatomic molecules (N_2, O_2, O_2^+, O_2^{--}, CO and NO). Comparison of VB and MO theories. (8 h)

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Unit IV:

Structural theory in Organic Chemistry: Types of bond fission and organic reagents (Electrophilic, Nucleophilic, and free radical reagents including neutral molecules like H_2O, NH_3 & $AlCl_3$).

Bond polarization: Factors influencing the polarization of covalent bonds, electro negativity – inductive effect. Application of inductive effect (a) Basicity of amines (b) Acidity of carboxylic acids (c) Stability of carbonium ions. Resonance or Mesomeric effect, application to (a) acidity of phenol and (b) acidity of carboxylic acids. Hyper conjugation and its application to stability of carbonium ions, Free radicals and alkenes, carbanions, carbenes and nitrenes.

Types of Organic reactions : Addition – electrophilic, nucleophilic and free radical. Substitution – electrophilic, nucleophilic and free radical, Elimination- Examples (mechanism not required). (9h)

General Principles of Inorganic qualitative analysis :

Anion analysis: Theory of sodium carbonate extract, classification and reactions of anions-CO_3^{2-}, Cl^-, Br^-, SO_4^{2-}, PO_4^{3-} ,BO_3^{3-} ,CH_3COO^-, NO_3^-

Cation Analysis: Principles involved - Solubility product, common ion effect, general discussion for the separation and identification of group I individual cations (Hg Ag+, Pb+) with flow chart and chemical equations. Principle involved in separation of group II & IV cations.

General discussion for the separation and identification of group II (Hg^{2+}, Pb^{2+}, Bi^{3+}, Cd^{2+}, Sb^{3+}, III (Al^{3+}, Fe^{3+}), IV ((Mn^{2+}, Zn^{2+}) individual cations with flow chart and chemical equations. Application of concept of hydrolysis in group V cation analysis.

General discussion for the separation and identification of group V individual cations (Ba^{2+}, Sr^{2+}, Ca^{2+}) with flow chart and chemical equations. Theory of flame test.

Identification of Group VI cations (Mg^{2+}, NH_4^+) (6h)

Laboratory Course : **30h (2h / week)**

Paper I

Qualitative Analysis - I

I. Preparations:

1.Tetrammine copper (II) sulphate,

2.Potash alum $KAl(SO_4)_2.\ 12H_2O$,

3. Bis (dimethylglyoximato) nickel(II)

II. Analysis of two anions and two cations in a mixture

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II - SEMESTER (Theory)

PAPER – II **(60 hrs / 15 weeks)**
(Physical Chemistry-I & Organic Chemistry-I)

UNIT I:

Gaseous state: Ideal gas equation, compression factors, deviation of real gases from ideal behavior. Van der Waal's equation of state. P-V Isotherms of real gases, Andrew's isotherms of carbon dioxide, continuity of state. Critical phenomena. The van der Waal's equation and the critical state. Relationship between critical constants and van der Waal's constants. The law of corresponding states and reduced equation of states. Joule Thomson effect. Liquefaction of gases: i) Linde's method and ii) Claude's method (5h)

Liquid State:

Intermolecular forces, structure of liquids (qualitative description). Structural differences between solids, liquids and gases. Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only). Liquid crystals, the mesomorphic state: Classification of liquid crystals in to Smectic and Nematic, differences between liquid crystal and solid / liquid. Application of liquid crystals as LCD devices. (4h)

Solid state Chemistry:

Laws of Crystallography – (i) Law of Constancy of interfacial angles (ii) Law of Symmetry, Symmetry elements in crystals (iii) Law of rationality of indices. Definition of space lattice, unit cell. Bravais Lattices and Seven Crystal systems (a brief review). Xray diffraction by crystals; Derivation of Bragg's equation, Determination of structure of NaCl, KCl & CsCl (Bragg's method and Powder method). Defects in crystals. Stoichiometric and non-stoichiometric defects. Band theory of semiconductors. Extrinsic and intrinsic semiconductors, n- and p-type semiconductors and their applications in photo electrochemical cells. (9h)

Unit II:

Solutions: Liquid-liquid - ideal solutions, Raoult's law. Ideally dilute solutions, Henry's law. Non-ideal solutions. Vapour pressure – composition and vapour pressure-temperature curves. Azeotropes-HCl-H_2O, ethanol-water systems and fractional distillation. Partially miscible liquids-phenol-water, trimethylamine-water, nicotine-water systems. Effect of impurity on consulate temperature. Immiscible liquids and steam distillation. Nernst distribution law. Calculation of the partition coefficient. Applications of distribution law. (6h)

Colloids and surface chemistry: Definition of colloids. Solids in liquids(sols), preparation, purification,properties -kinetic,optical,electrical. Stability of colloids, Hardy-Schulze law, protective colloid. Liquids in liquids (emulsions) preparation, properties, uses. Liquids in solids (gels) preparation, uses. Adsorption: Physical adsoption, chemisorption. Freundlich, Langmuir adsorption isotherms. Applications of adsorption (6 h)

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UNIT III:

Stereochemistry of carbon compounds: Three dimensional structures of organic molecules and Molecular representations- Wedge, Fischer, Newman and Saw-horse formulae. Homomers, Isomers, Constitutional isomers (chain, positional, functional), Stereoisomers, Enantiomers and Diastereomers, Configurational and Conformational stereoisomers – definitions and examples. Enantiomers: Optical activity- wave nature of light, plane polarised light, interaction with molecules, optical rotation and specific rotation. Racemic mixture- racemisation and resolution techniques. Chiral molecules- definition and symmetry criteria- classification to asymmetric and dissymmetric molecules –. Examples - Glyceraldehyde, Lactic acid, Alanine and trans -1,2-dichloro cyclopropane. Chiral centers: definition- molecules with similar and dissimilar chiral carbons – examples - tartaric acid and 2,3-dibromopentane - definition of mesomers - formulae for calculating the number of stereoisomers. D,L and R,S configuration in molecules with chiral centers - Cahn-Ingold-Prelog rules. Geometrical isomerism in alkenes- Cis, trans nomenclature and E,Z- configuration. (10 h)

Acyclic Hydrocarbons: Alkanes– IUPAC Nomenclature of Hydrocarbons. Methods of preparation: Hydrogenation of alkynes and alkenes, Wurtz reaction, Kolbe's electrolysis, Corey-House reaction. Chemical reactivity – inert nature, free radical substitution mechanism. Halogenation example- reactivity, selectivity and orientation; Alkenes – Preparation of alkenes by (a) dehydration of alcohols (b) dehydrohalogenation of alkyl halides (c) dehalogenation of 1,2 dihalides - mechanisms - Saytzev's rule. Properties: Addition of hydrogen – heat of hydrogenation and stability of alkenes. Addition of halogen and its mechanism. Addition of HX, Markonikov's rule, addition of H_2O, HOX, H_2SO_4 with mechanism and addition of HBr in the presence of peroxide (anti – Markonikov's addition). Oxidation – hydroxylation by $KMnO_4$, OsO_4, peracids (via epoxidation) hydroboration, Dienes – Types of dienes, reactions of conjugated dines – 1,2 and 1,4 addition of HBr to 1,3 – butadiene and Diel's – Alder reaction. Alkynes – Preparation by dehydrohalogenation of dihalides, dehalogenation of tetrahalides, Properties; Acidity of acetylenic hydrogen (formation of Metal acedtylides). Preperation of higher acetylenes, Metal ammonia reductions - Physical properties. Chemical reactivity – electrophilic addition of X_2, HX, H_2O (Tautomerism), Oxidation with $KMnO_4$, OsO_4, reduction and Polymerisation reaction of acetylene. (8 h)

Unit IV

Alicyclic hydrocarbons (Cycloalkanes): Nomenclature, Preparation by Freunds methods, heating dicarboxylic metal salts. Properties – reactivity of cyclopropane and cyclobutane by comparing with alkanes, Stability of cycloalkanes – Baeyer's strain theory, Sachse and Mohr predictions and Pitzer's strain theory. Conformational structures of cyclobutane, cyclopentane, cyclohexane. (4h)

Benzene and its reactivity: Concept of resonance, resonance energy. Heat of hydrogenation, heat of combustion of Benezene, mention of C-C bond lengths and orbital picture of Benzene. Concept of aromaticity – aromaticity (definition), Huckel's rule – application to Benzenoid (Benzene, Napthalene) and Non – Benzenoid compounds (cyclopropenyl cation, cyclopentadienyl anion and tropylium cation). Reactions – General mechanism of electrophilic substitution, mechanism of nitration. Friedel Craft's alkylation and acylation. Orientation of aromatic substitution – Definition of ortho, para and meta directing groups. Ring activating and

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deactivating groups with examples (Electronic interpretation of various groups like NO_2 and Phenolic). Orientation of (i). Amino, methoxy and methyl groups (ii). Carboxy, nitro, nitrile, carbonyl and Sulfonic acid groups. (iii). Halogens (Explanation by taking minimum of one example from each type). (6 h)

Polynuclear Hydrocarbons: Structure of naphthalene and anthracene (Molecular Orbital diagram and resonance energy) Any two methods of preparation of naphthalene and reactivity.Reactivity towards electrophilic substitution. Nitration and sulfonation as examples. (2 h)

Laboratory Course **30hrs (2 h / week)**

Paper II - Qualitative Analysis - II

I Semi micro analysis of mixtures

Analysis of two anions and two cations in the given mixture.(group separation for cations)

Anions: CO_3^{2-} Cl^-, Br^-, I^- CH_3COO^-, NO_3^- PO_4^{3-} SO_4^{2-}

Cations:, Pb^{2+}, Hg^{2+}

Pb^{2+}, Bi^{3+}, Cd^{2+}, Cu^{2+}, $Sb^{3+/5+}$, $Sn^{2+/4+}$

Al^{3+}, Fe^{3+},

Zn^{2+}, Mn^{2+}

Ca^{2+}, Sr^{2+}, Ba^{2+}

Mg^{2+}, NH_4^+

References: (SEM-I)

UNIT -I and II

1 .Principles of physical chemistry by Prutton and Marron.
2. Text Book of Physical Chemistry by Soni and Dharmahara.
3. Text Book of Physical Chemistry by Puri and Sharma
4. Text Book of Physical Chemistry by K. L. Kapoor
5. Physical Chemistry through problems by S.K. Dogra.
6. Elements of Physical Chemistry by Lewis and Glasstone.

UNIT -III and IV

1. Text book of organic chemistry by Morrison and Boyd.
2. Text book of organic chemistry by Graham Solomons.
3. Text book of organic chemistry by Bruice Yuranis Powla.
4. Text book of organic chemistry by Soni.
5. General Organic chemistry by Sachin Kumar Ghosh.

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References: (SEM-II)

Unit- I and II

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia ,Vishal Publications1996.
2. Concise Inorganic Chemistry by J.D. Lee 3rd edn.
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus ,3rd edn ,Wiley Publishers 2001. Chem.
4. Vogel's Qualitative Inorganic Analysis by Svehla
5. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey,E.A. Keiter and R.L. Keiter 4th edn.
6. Chemistry of the elements by N.N.Greenwood and A. Earnshaw Pergamon Press1989.
7. Inorganic Chemistry by Shriver and Atkins 3rd edn Oxford Press 1999.

Unit- III and IV

1. Analytical chemistry by G. L. David Krupadanam, D. Vijaya Prasad, K.Varaprasada Rao, K.L.N. Reddy and C. Sudhakar
2. Vogel's Text Book of Qualitative Analysis by G.H.Jeffery, J.Bassett,J.Mendham and R.C. Denney 5th edn Addison Wesley Longman Inc. 1999.
3. Principles of physical chemistry by Prutton and Marron.
4. Text Book of Physical Chemistry by Soni and Dharmahara.
5. Text Book of Physical Chemistry by Puri and Sharma

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SEMESTER I and II SYLLABUS

OBJECTIVES:

In-organic chemistry:

1. Structural inorganic chemistry has been introduced in the syllabus for basic understanding of inorganic chemistry.
2. Properties of s-block and p-block elements are taught in detail.
3. A chapter on Organo metallic chemistry has been introduced and their application as catalysts in preparation of various organic compounds.

General Chemistry:

1. Introduction to quantum mechanics and chemical bonding is covered - Schrodinger equation, particle in a 1D box and application of quantum numbers is taught to make the students understand the structure of the atom.
2. Students learn about different types of organic reactions which is the basic of organic chemistry.
3. Students are made aware of the basic principles of qualitative analysis to identify the ions.

Physical chemistry:

1. The fundamentals of gaseous state, liquid state and solid state is taught to students. This helps in understanding theoretical chemistry.
2. The fundamentals of gaseous state, liquid state and solid also help the students to understand the environmental processes around us.
3. Colloids & surface chemistry helps students to understand the importance of different types of solutions and mixtures - their solubilities, impurities, their separation techniques and their adsorption.
4. Applications of surface chemistry - separation of effluents, sewage treatment etc.

Organic chemistry:

1. Students learn about different organic mechanisms which help them analyse the reactions.
2. The mechanisms also have industrial applications.
3. Stereochemistry is the most important branch of modern chemistry which is based on visualization and conceptualization.

Laboratory Course:

1. The semi-micro analysis is the best tool to identify various cations and anions. This is applicable for soil analysis, food adulteration, industrial effluents, purification of water.

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DEPARTMENT OF CHEMISTRY

B .Sc CHEMISTRY COURSE SYLLABUS-CBCS

III SEMESTER / PAPER - III (60 hrs/15 weeks)
(Organic Chemistry -II and General Chemistry -II)

UNIT I-Organic chemistry-II	**30 hrs (2h/w)**
1. Halogen compounds	4 h
2. Hydroxy compounds	6 h
3. Ethers and Epoxides	2h
UNIT II-Organic chemistry-II	
1. Carbonyl compounds	10h
2. Carboxylic acids and derivatives	5 h
3. Active methylene compounds and their reactivity	3 h
UNIT III-General chemistry-II	**30 hrs (2h/w)**
1. Evaluation of analytical data	5 h
2. Theory of quantitative analysis	5h
3. Molecular symmetry	5h
UNIT IV-General chemistry-II	
1. Nuclear chemistry	5 h
2. Stereo selectivity in Chemistry	5 h
3. Introduction to Pericyclic Reactions	5 h

IV SEMESTER / PAPER - IV (60 hrs/15 weeks)
(Inorganic Chemistry -II and Physical Chemistry -II)

UNIT I-Inorganic chemistry-II	**30 hrs (2h/w)**
1. Chemistry of d-block elements	9 h
2. Chemistry of f-block elements	8 h
UNIT II-Inorganic chemistry-II	
1. Theories of bonding in metals	6 h
2. Metal carbonyls and related compounds	7 h
UNIT III -Physical chemistry-II	**30 hrs (2h/w)**
1. Phase Rule	5 h
2. Dilute solutions	8 h
UNIT IV Physical chemistry-II	
1. Electro chemistry	17 h

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PAPER –III **(60h/15 weeks)**
(Organic Chemistry – II & General Chemistry–II)

UNIT I:

1.Halogen compounds:
Nomenclature and classification of alkyl (into primary, secondary, tertiary), aryl, aralkyl, allyl, vinyl, benzyl halides.
Chemical Reactivity, formation of RMgX
Nucleophilic aliphatic substitution reaction- classification into S_N1 and S_N2.
Energy profile diagram of S_N1 and S_N2 reactions. Stereochemistry of S_N2 (Walden Inversion) S_N1 (Racemisation). Explanation of both by taking the example of optically active alkyl halide – 2bromobutane. Ease of hydrolysis – comparision of alkyl, benzyl, alkyl, vinyl and aryl halides (4h)

2.Hydroxy compounds:
Nomenclature and classification of hydroxy compounds.
Alcohols: Preparation with hydroboration reaction, Grignard synthesis of alcohols.
Phenols: Preparation i) from diazonium salt, ii) from aryl sulphonates, iii) from cumene.
Physical properties- Hydrogen bonding (intermolecular and intramolecular). Effect of hydrogen bonding on boiling point and solubilitiy in water.
Chemical properties:
acidic nature of phenols.
formation of alkoxides/phenoxides and their reaction with RX.
replacement of OH by X using PCl_5, PCl_3, PBr_3, $SOCl_2$ and with $HX/ZnCl_2$.
esterification by acids (mechanism).
dehydration of alcohols.
oxidation of alcohols by CrO_3, $KMnO_4$.
special reaction of phenols: Bromination, Kolb-Schmidt reaction, Riemer-Tiemann reaction, Fries rearrangement, azocoupling.
Identification of alcohols by oxidation with $KMnO_4$, ceric ammonium nitrate, lucas reagent and phenols by reaction with $FeCl_3$.
Polyhydroxy compounds: Pinacol-Pinacolone rearrangement. (6 h)

3.Ethers and Epoxides:
Nomenclature,preparation by:
a)Williamsons synthesis b)from alkenes by the action of H_2SO_4
Physical properties –Absence of hydrogen bonding,Insoluble in water,low boiling point
Chemical properties-Inert nature, action of conc. H_2SO_4 and HI.Acid and base catalysed ring opening of epoxides-stereoselective and regioselective with examples.
(2h)

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UNIT II:

1.Carbonyl compounds:

Nomenclature of aliphatic and aromatic carbonyl compounds, structure of the carbonyl group.

Synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids.

Physical properties: absence of hydrogen bonding, keto-enol tautomerism, reactivity of carbonyl group in aldehydes and ketones.

Nucleophilic addition reaction with a) $NaHSO_3$ b) HCN c) RMgX d) NH_2OH e)$PhNHNH_2$ f) 2,4 DNP g) Alcohols-formation of hemiacetal and acetal.

Halogenation using PCl_5 with mechanism.

Base catalysed reactions: a) Aldol b) Cannizzaro reaction c) Perkin reaction d) Benzoin condensation e) Haloform reaction Oxidation of aldehydes-Baeyer-Villiger oxidation of ketones.

Reduction: Clemmensen reduction, Wolf-Kishner reduction, MPV reduction, reduction with $LiAlH_4$ and $NaBH_4$.

Analysis of aldehydes and ketones with a) 2,4-DNP test b) Tollen's test c) Fehling text d) Schiff test e) Haloform test (with equation). (10 h)

2. Carboxylic acids and derivatives:

Nomenclature, classification and structure of carboxylic acids.

Methods of preparation by a) hydrolysis of nitriles, amides and esters.
b) carbonation of Grignard reagents.

Special methods of preparation of aromatic acids by
a) oxidation of side chain.
b) hydrolysis by benzotrichlorides.
c) Kolbe reaction.

Physical properties: Hydrogen bonding, dimeric association, acidity- strength of acids with examples of trimethyl acetic acid and trichloroacetic acid. Relative differences in the acidities of aromatic and aliphatic acids.

Chemical properties: Reactions involving H, OH and COOH groups- salt formation, anhydride formation, acid chloride formation, amide formation and esterification (mechanism). Degradation of carboxylic acids by Huns-Diecker reaction, decarboxylation by Schimdt reaction, Arndt-Eistert synthesis, halogenation by Hell-Volhard- Zelinsky reaction.

Derivatives of carboxylic acids: Reaction of acid chlorides, acid anhydrides, acid amides, esters (mechanism of the hydrolysis of esters by acids and bases). (5 h)

3. Active methylene compounds and their reactivity:

Acetoacetic esters: preparation by Claisen condensation, keto-enol tautomerism. Acid hydrolysis and ketonic hydrolysis.

Preparation of a) monocarboxylic acids. and b) dicarboxylic acids.

Reaction with urea

Malonic ester: preparation from acetic acid.

Synthetic applications: Preparation of
a) monocarboxylic acids (propionic acid and n-butyric acid).
b) dicarboxylic acids (succinic acid and adipic acid).
c) α,ß-unsaturated carboxylic acids (crotonic acid).

Reaction with urea. (3 h)

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UNIT III:

1. Evaluation of analytical data:
Theory of errors, idea of significant figures and its importance, accuracy – methods of expressing accuracy, error analysis and minimization of errors, precision – methods of expressing precision, standard deviation and confidence limit (5 h)

2. Thoery of quantitative analysis:
Principles of volumetric analysis, Theories of acid-base, redox, complexometric, iodometric and precipitation titrations, choice of indicators for these titrations. Principles of gravimetric analysis: precipitation, coagulation, peptization, coprecipitation, post precipitation, digestion, filtration and washing of precipitate, drying and ignition, precipitation from homogenous solutions, requirements of gravimetric analysis. (5 h)

3. Molecular symmetry:
Concept of symmetry in chemistry-symmetry operations, symmetry elements. Rotational axis of symmetry and types of rotational axes. Planes of symmetry and types of planes. Improper rotational axis of symmetry. Inversion centre. Identity element. The symmetry operations of a molecule form a group. Flow chart for the identification of molecular point group. (5 h)

UNIT IV:

1. 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

2.Stereoselectivity in Chemistry:
Selectivity in chemistry – Definition and examples of Chemoselectivity, Regioselectivity and Stereoselectivity – Stereospecific reactions – Definition of enantiomeric and diastereomeric excess (e e and d e) –. Mechanism of Iodide catalysed dehalogenation of meso and active 2,3-dibromobutane
Brief introduction to Asymmetricsynthesis (5h)

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3. Introduction to Pericyclic Reactions:

Definition and Types of Pericyclic reactions - Electrocyclisation, Cycloaddition and Sigmatropic reactions – examples - Stereo specificity under thermal and photochemical conditions - selection rules of pericyclic reactions - Molecular orbital diagrams for ethylene, 1,3-butadiene and 1,3,5-hexatriene and their symmetry properties - definition of HOMO and LUMO – Mechanism of electrocyclisation and cycloaddition reactions by Frontier Molecular Orbital (FMO) theory. (5h)

Laboratory Course **30h (2h/week)**
Paper III
Quantitative Analysis-III
Titrimetric Analysis-

1.Estimation of Carbonate in Sodium Carbonate-(Acid-Base Titration)
2.Estimation of Bicarbonate in Sodium Bicarbonate-(Acid-Base Titration)
3.Estimation of Magnesium using EDTA(Complexometric Titration)
4.Determination of Fe(II) using Potassium dichromate(Red-Ox Titration)
5.Estimation of Cu(II) using Sodium thiosulphate with Potassium dichromate as primary standard(Iodometry Titration)

Gravimetric Analysis I

1.Determination of Barium as Barium sulphate
2.Determination of Lead as Lead chromate.

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PAPER –IV **(60h/15 weeks)**

Inorganic Chemistry–II & Physical Chemistry-II

UNIT I:

1.Chemistry of d-block elements:

Characteristics of d-block elements with special reference to electronic configuration, variable valence, magnetic properties, catalytic properties and ability to form complexes. Stability of various oxidation states and e.m.f. Comparative treatment of second and third transition series with their 3d analogues. Study of Ti, Cr and Cu triads in respect of electronic configuration and change of reactivity with different oxidation states, applications.

(9h)

2.Chemistry of f-block elements:

Chemistry of lanthanides – electronic structure, oxidation states, lanthanide contraction, Separation of lanthanides by ion exchange and solvent extraction methods. Chemistry of actinides – electronic configuration, oxidation states, actinide contraction, position of actinides in the periodic table, comparison with lanthanides in terms of magnetic properties. (8h)

UNIT II:

1.Theories of bonding in metals:

Valence bond theory, Explanation of metallic properties and its limitations, Free electron theory, thermal and electrical conductivity of metals, limitations, Band theory, formation of bands, explanation of conductors, semiconductors and insulators. (6h)

2.Metal carbonyls and related compounds:

EAN rule, classification of metal carbonyls, structures and shapes of metal carbonyls of V, Cr Mn, Fe, Co and Ni. Metal nitrosyls and metallocenes (only ferrocene). (7h)

UNIT III:

1.Phase rule:

Concept of phase, components, degree of freedom. Derivation of Gibbs phase rule. Phase equilibrium of one component – water system. Phase equilibrium of two-component system, solid-liquid equilibrium. Simple eutectic diagram of Pb-Ag system, desilverisation of lead. Solid solutions- compound with congruent melting point- (Mg-Zn) system, compound with incongruent melting point – NaCl- water system. Freezing mixtures. (5h)

2.Dilute solutions:

Colligative properties. Raoult's law, relative lowering of vapour pressure, its relation to molecular weight of non-volatile solute. Elevation of boiling point and depression of freezing point. Derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods of determination. Osmosis, osmotic pressure, experimental determination. Theory of dilute solutions.

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Abnormal Colligative properties. Van't Hoff factor, degree of dissociation and association. (8h)

UNIT IV:

1. Electrochemistry:

Specific conductance, equivalent conductance, measurement of equivalent conductance. Variation of equivalent conductance with dilution. Migration of ions, Kohlrausch's law. Arrhenius theory of electrolyte dissociation and its limitations. Ostwald's dilution law. Debye-Huckel-Onsagar's equation for strong electrolytes (elementary treatment only). Definition of transport number, determination by Hittorf's method. Application of conductivity measurements-determination of dissociation constant (K_a) of an acid, determination of solubility product of sparingly soluble salt, conductometric titrations.

Types of reversible electrodes- the gas electrode, metal-metal ion, metal-insoluble salt and redox electrodes. Electrode reactions, Nernst equation, single electrode potential, standard Hydrogen electrode, reference electrodes, standard electrode potential, sign convention, electrochemical series and its significance. Reversible and irreversible cells, conventional representation of electrochemical cells. EMF of a cell and its measurements. Computation of cell EMF. Applications of EMF measurements, Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Determination of pH using quinhydrone electrode, Solubility product of AgCl. Potentiometric titrations. (17h)

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Laboratory Course **30h (2h/week)**
Paper IV
Quantitative Analysis-IV
Titrimetric Analysis-

1.Estimation of Carbonate and Bicarbonate in a mixture - (Acid-Base Titration)
2.Estimation of Bicarbonate in Baking soda- (Acid-Base Titration)
3.Estimation of total hardness of water using EDTA (Complexometric Titration)
4.Determination of Fe(II) using Potassium permanganate with oxalic acid as primary standard (Redox Titration)
5.Estimation of Potassium dichromate using dichromate as primary standard (Iodometry Titration).
6. Estimation of Zinc by ferrocyanide (precipitation titration)

Gravimetric Analysis

1.Determination of nickel as Ni-DMG complex
2.Determination of magnesium as magnesium pyrophosphate.

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REFERENCES SEM III

UNIT I AND UNIT II

1. Organic Chemistry by R.T.Morrison and R.N .Boyd
2. Organic chemistry by John Mc Murrys.
3. Problems and their solutions in organic chemistry by I.L Finar
4. Reaction mechanisms in organic chemistry by S.M.Mukherji and S.Singh

UNIT III AND UNIT IV

1. A text book of Quantitative analysis by A.I Vogel.
2. Symmetry by Veera Reddy
3. Stereochemistry by P.S Kalsi
4. Principles of nuclear chemistry by H.J.Arnikar

REFERENCES SEM IV

UNIT I AND UNIT II

1. Concise Inorganic Chemistry by J.D.Lee
2. Basic Inorganic Chemistry by Cotton and Wilkinson
3. Advanced Inorganic Chemistry Vol-I by Satyaprakash,Tuli,Basu and Madan
4. Inorganic Chemistry by J.E.Huheey.
5. Inorganic Chemistry by Chopra and Kapoor.
6. Inorganic chemistry by R. R Heslop and P. L Rohinson.
7. Inorganic chemistry by D.F Shriver, P.W Atkins and C.H Langford.

UNIT III AND UNIT IV

1. Principles of Physical chemistry by Puri, Sharma and Pathania
2. Physical Chemistry by D.F Shriver, P.W.Atkinson and C.H. Langford
3. An Introduction to Electrochemistry by S Glasstone.

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SEMESTER III and IV SYLLABUS

OBJECTIVES:

Organic chemistry:

1. Students will gain an understanding of
   i) Fundamental electronic structure and bonding in organic molecules.
   ii) Correlate the physical properties of organic compounds with the structure of the molecules.
   iii) The reactivity of different compounds.
2. Students will be able to discuss the reactions involved in the preparation of Hydroxyl, halogen, carbonyl compounds, etc.
3. To predict the outcome and mechanism of some simple organic reactions, using a basic understanding of the relative reactivity of functional groups.

Physical chemistry:

1. Students will gain an understanding of: States of matter and how they depend on temperature and pressure as well as how they co-exist in phase equilibria.
2. Calculate standard cell potentials for any redox reaction and combine this information with concentration data to determine the effect concentration will have on the cell potential.
3. Draw a redox cell diagram given cell notation.
4. The aim of this module will be to provide a general introduction to the enormous positive impact chemistry has on our lives. In addition to lectures, students will work in groups to prepare and deliver an oral presentation on an assigned topic in an area covered by the course.

General Chemistry:

1. To become familiar with the scope, methodology, and application of modern chemistry.
2. to learn problem solving and learning to interpret the data, to employ valid and efficient methods of analysis, and to assess whether or not the results of calculations are reasonable.
3. Determine the symmetry operations that can be applied to several molecules, and hence the molecular point group.
4. Promote logical, independent and critical thinking
5. Motivate students to take responsibility for their own learning process.

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In-organic chemistry:

1. To understand the trends in properties and reactivity of the periodic elements.
2. Provide students with the opportunity to apply and integrate concepts and principles to ascertain molecular properties

Laboratory Course:

1. Titrimetric analysis- is a method of quantitative analysis used to determine unknown concentration of known substance.
2. A review of classic methods of analysis, which includes stoichiometry, solution, equilibrium and acid/bases; classical analytical method of gravimetric and volumetric analyses.

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Bharatiya Vidya Bhavan

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Autonomous College
Affiliated to OSMANIA UNIVERSITY, Hyderabad.
(Accredited with 'A' grade by NAAC)

DEPARTMENT OF CHEMISTRY

B. Sc CHEMISTRY COURSE SYLLABUS-CBCS

V SEMESTER / PAPER - V **(45 hrs / 15 weeks)**

ORGANIC, PHYSICAL AND GENERAL CHEMISTRY III

ORGANIC CHEMISTRY III

UNIT I

1.Nitrogen compounds 11 h

INORGANIC CHEMISTRY- III

UNIT II

1.Co-ordination chemistry 11 h

ORGANIC CMISTRY & INORGANIC CHEMISTRY-III

UNIT III

1.Hetero cyclic compounds 6 h

2.Spectral and magnetic properties of metal complexes 5 h

PHYSICAL CHEMISTRY III

UNIT IV

1.Thermodynamics 12 h

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V SEMESTER / PAPER – VI Elective-I **(45 hrs / 15 weeks)**

PHYSICO-CHEMICAL METHODS OF ANALYSIS, MOLECULAR SPECTROSCOPY AND CATALYSIS

UNIT I

1.Separation techniques 11 h

UNIT II

1.Spectrophotometry 5 h

2.Mass Spectrometry 6 h

UNIT III

1.Molecular spectroscopy 12 h

UNIT IV

1.Catalysis 11 h

V SEMESTER / PAPER – VI Elective- II I **(45 hrs / 15 weeks)**

ELECTROANALYTICAL TECHNIQUES & MOLECULAR SPECTROSCOPY

UNIT I

1.Conductometric methods-1 11 h

UNIT II

1.Conductometric methods-2 5 h

2.Potentiometric titrations 6 h

UNIT III

1.pH measurements & applications 5 h

2.Mass Spectrometry 6 h

UNIT IV

1.Molecular spectroscopy 12 h

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VI SEMESTER / PAPER - VII **(45 hrs / 15 weeks)**

ORGANIC, PHYSICAL AND GENERAL CHEMISTRY IV

ORGANIC CHEMISTRY IV

UNIT I

1.Carbohydrates	6 h
2.Amino acids and proteins	5 h

UNIT II

INORGANIC CHEMISTRY IV

1. Reactivity of metal complexes	4 h
2.Stability of complexes	4 h
3. Hard and soft bases	4 h

UNIT III

ORGANIC CHEMISTRY & INORGANIC CHEMISTRY IV

1. Synthetic strategies	6h
2 .Bioinorganic chemistry	5h

UNIT IV

PHYSICAL CHEMISTRY-IV

1.Chemical kinetics	9 h
2.Photochemistry	2 h

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VI SEMESTER / PAPER – VIII Elective-I **(45 hrs / 15 weeks)**

DRUGS, PESTICIDES, MACROMOLECULES

UNIT I

1.Pharmaceutical drugs 12 h

UNIT II

1.HIV and AIDS 5 h

2.Formulations 3 h

3.Pestiscides - I 3 h

UNIT III

1.Pesticides - II 3 h

2.Material Science 8 h

UNIT IV

1.Macromolecules 11 h

VI SEMESTER / PAPER – VIII Elective-II **(45 hrs / 15 weeks)**

BIOMOLECULES

UNIT I

1.Alkaloids 11 h

UNIT II

1.Terpenoids 11 h

UNIT III

1.Steroids 6 h

2.Vitamins 5 h

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UNIT IV

1.Carbohydrates 4 h

2.Proteins and Nucleic acids 8 h

LABORATORY COURSE **(30h/15weeks)2h/w**

SEM-V

Practical Paper – V (Organic Chemistry)

1. Synthesis of Organic Compounds

a) Aromatic electrophilic substitution Nitration: Preparation of nitro salicylic acid and p-nitro acetanilide,

b) Halogenation: Preparation of p-bromo acetanilide

c) Diazotization and coupling: Preparation of phenyl azo β-napthol

d)Oxidation: Preparation of benzoic acid from toluene

e) Reduction: Preparation of m-nitro aniline from m-dinitro benzene

f) Esterfication: Preparation of methyl p-nitro benzoate from p-nitro benzoic acid.

g) Methylation: Preparation of β-napthyl methyl ether

h) Condensation: Preparation of benzylidine aniline

2. Thin layer Chromatography & Column Chromatography

a) Preparation of the TLC plates. Checking the purity of the compounds by TLC:

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

b) Microwave assisted Green synthesis, one example: 1. Hydrolysis of Benzamide

LABORATORY COURSE **(30h/15weeks)2h/w**

SEM-VII

Practical Paper – VII (Organic Chemistry)

1. Organic Qualitative Analysis:

a) Identification of an organic compound through the functional group analysis, determination

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of melting point and preparation of suitable derivatives.

b) Separation of two component mixtures

c) Aniline + Naphthalene 2) Benzoic acid + Benzophenone 3) p-Cresol + Chlorobenzene.

LABORATORY COURSE **(30h/15weeks)2h/w**

SEM-V

Practical Paper – VI (Physical Chemistry)

1. Electrochemistry

a) Determination of concentration of HCl conductometrically using standard NaOH solution.

b) Determination of concentration of acetic acid conductometrically using standard NaOH solution.

c) Determination of dissociation constant (K_a) of acetic acid by conductivity measurements.

d)Determination of solubility and solubility product of $BaSO_4$.

2. pH metry

a) pH metric titration of weak acid, acetic acid with strong base NaOH and calculation of dissociation constant.

3. Colorimetry

a) Verification of Beer-Lambert law for $KMnO_4$, $K_2Cr_2O_7$ and determination of concentration of the given solution.

4. Properties of liquids

a) Surface tension of liquids b) Viscosity of liquids.

LABORATORY COURSE – VI **(30h/15weeks)2h/w**

SEM-VI

Practical Paper – VIII (Physical Chemistry)

1. Chemical kinetics

a) Determination of specific reaction rate of the hydrolysis of methyl acetate catalyzed by hydrogen ion at room temperature.

b) Determination of rate of decomposition of hydrogen peroxide.

c) Determination of overall order of saponification of ethyl acetate

2. Distribution law

a) Determination of distribution coefficient of acetic acid between water and butanol.

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b) Determination of molecular status and partition coefficient of benzoic acid in Toluene and water.

3.Colorometry

a) Composition of complex of Cu^{2+} - EDTA disodium salt

4. Project Work

Collection of spectral data of a minimum of four compounds belonging to different functional groups (other than those included in the syllabus) and submission of the report.

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V SEMESTER / PAPER-V **(45 hrs / 15 weeks)**

Organic Chemistry – III **(3 h / w)**

UNIT-I

1.Nitrogen compounds **11 h**

Nitro hydrocarbons: Nomenclature and classification – nitro hydrocarbons – structure. Tautomerism of nitroalkanes leading to aci and keto form. Preparation of Nitroalkanes. Reactivity – halogenation, reaction with HONO (Nitrous acid), Nef reaction, Mannich reaction leading to Michael addition and reduction.

Amines (Aliphatic and Aromatic)

Nomenclature, Classification into 1^0, 2^0, 3^0 amines and quarternary ammonium compounds. Preparative methods -1. Ammonolysis of alkyl halides 2. Gabriel synthesis 3. Hoffman's bromamide reaction (mechanism). 4. Reduction of Amides and Schmidt reaction. Physical properties and basic character – Comparative basic strength of Ammonia, methyl amine, dimethyl amine, trimethyl amine and aniline – comparative basic strength of aniline, N-methylaniline and N, N-dimethyl aniline (in aqueous and non-aqueous medium), steric effects and substituent effects. Use of amine salts as phase transfer catalysts. Chemical properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation e) Reaction with Nitrous acid of 1^0, 2^0, 3^0 (Aliphatic and aromatic amines). Electrophilic substitutions of Aromatic amines – Bromination and Nitration. oxidation of aryl and 3^0 Amines. Diazotization

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

Inorganic Chemistry-III

UNIT-II

1. Coordination Chemistry **11h**

IUPAC nomenclature, bonding theories – review of Werner's theory and Sidgwick's concept of coordination, Valence bond theory, geometries of coordination numbers 4-tetrahedral and square planar and 6-octahedral and its limitations, crystal filed theory, splitting of d-orbitals in octahedral, tetrahedral and square-planar complexes – low spin and high spin complexes – factors affecting crystal-field splitting energy, merits and demerits of crystal-field theory. Isomerism in coordination compounds – structural isomerism and stereo isomerism, stereochemistry of complexes with 4 and 6 coordination numbers.

Organic Chemistry & Inorganic Chemistry-III

UNITIII

1.Heterocyclic Compounds **6 h**

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

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

2. Spectral and magnetic properties of metal complexes **5 h**

Electronic absorption spectrum of $[Ti(H_2O)_6]^{3+}$ ion.(Jahn-Teller effect). Types of magnetic behavior, spin-only formula, calculation of magnetic moments, experimental determination of magnetic susceptibility – Gouy method.

Physical Chemistry – III

UNIT-IV

1.Thermodynamics **12 h**

The first law of thermodynamics-statement, definition of internal energy and enthalpy. Heat capacities and their relationship. Joule's Law-Joule-Thomson coefficient. Calculation of w, q, dU and dH for the expansion of perfect gas under isothermal and adiabatic conditions for reversible processes. State function.

Temperature dependence of enthalpy of formation-Kirchoff's equation.

Second law of thermodynamics. Different Statements of the law. Carnot cycle and its efficiency. Carnot theorem. Thermodynamic scale of temperature. Concept of entropy, entropy as a state function, entropy changes in cyclic, reversible, and irreversible processes and reversible phase change. Calculation of entropy changes with changes in V & T and P&T. Entropy of mixing inert perfect gases. Entropy changes in spontaneous and equilibrium processes.

The Gibbs (G) and Helmholtz (A) energies. A & Gas criteria for thermodynamic equilibrium and spontaneity-advantage over entropy change. Gibbs equations and the Maxwell relations. Variation of G with P, V and T.

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V SEMESTER / PAPER-VI (Elective-1) **(45 hrs / 15 weeks)**

Physico–chemical Methods of Analysis, Spectroscopy and catalysis **(3h/w)**

UNIT-I

1. Separation techniques **12 h**

Solvent extraction: Principle and process, Batch extraction, continuous extraction and counter current extraction. Application – Determination of Iron (III)

Chromatography: Classification of chromatography methods, principles of differential migration adsorption phenomenon, Nature of adsorbents, solvent systems, R_f values, factors effecting R_f values.

Paper Chromatography: Principles, Rf values, experimental procedures, choice of paper and solvent systems, developments of chromatogram – ascending, descending and radial. Two dimensional chromatography, applications in analysis of free amino acids in rats,analysis of alkaloids.

Thin layer Chromatography (TLC): Advantages. Principles, factors effecting R_f values. Experimental procedures. Adsorbents and solvents. Preparation of plates. Development of the chromatogram. Detection of the spots. Applications in the drug industry.

Column Chromatography: Principles, experimental procedures, Stationary and mobile Phases, Separation technique.

High Performance Liquid Chromatography (HPLC): Principles and Applications in pharmaceutical and food industry.

Gas Liquid Chromatography (GLC): Principles and Applications in qualitative analysis.

UNIT-II

1. Spectrophotometry **5 h**

General features of absorption – spectroscopy, Beer-Lambert's law and its limitations, transmittance, Absorbance, and molar absorptivity. Single and double beam spectrophotometers. Application of Beer-Lambert law for quantitative analysis of

1. Chromium in $K_2Cr_2O_7$
2. Manganese in Manganous sulphate
3. Iron (III) with thiocyanate.

2.Mass spectrometry **6 h**

Basic principles of Mass spectrometry – Instrumentation – Ionization techniques - Molecular ion and fragment ions ions. Isotopic peaks and their importance in the determination of Molecular peaks and

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number and nature of hetero atoms in the molecule - General fragmentation patterns - Mass spectra of ethylbenzene, acetophenone, n-butyl amine and 1- proponal.

UNIT-III

1.Molecular spectroscopy **12 h**

(i) Electronic spectroscopy:

Interaction of electromagnetic radiation with molecules and types of molecular spectra. Potential energy curves for bonding and antibonding molecular orbitals. Energy levels of molecules (σ, π, n). Selection rules for electronic spectra. Types of electronic transitions in molecules effect of conjugation. Concept of chromophore.

(ii) Infra-Red spectroscopy

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

(iii) Raman spectroscopy,Concept of polarizability, selection rules and principles of Raman spectroscopy

(iv) Proton magnetic resonance spectroscopy (^{1}H-NMR)

Principles of nuclear magnetic resonance – shielding and de-shielding - equivalent and non-equivalent protons, position of signals. Chemical shift and splitting of signals – spin-spin coupling, coupling constants. Applications of NMR with suitable examples – ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate, toluene and acetophenone.

Spectral interpretation

Interpretation of IR, UV-Visible, ^{1}H-NMR and mass spectral data of the following compounds

1. Phenyl acetylene 2. Acetophenone 3. Cinnamic Acid 4. para-nitro aniline.

UNIT-IV

1.Catalysis **11 h**

Homogeneous and heterogeneous catalysis, comparision with examples. Kinetics of specific acid catalyzed reactions, inversion of cane sugar. Kinetics of specific base catalyzed reactions, base catalyzed conversion of acetone to diacetone alcohol. Acid and base catalyzed reactions- hydrolysis of esters, mutarotation of glucose. Catalytic activity at surfaces. Mechanisms of heterogeneous catalysis. Langmuir-Hinshelwood mechanism.

Enzyme catalysis: Classification, characteristics of enzyme catalysis. Kinetics of enzyme catalyzed reactions-Michaelis Menton law, significance of Michaelis constant (K_m) and maximum velocity

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(V_{max}).Significance of different plots. Factors affecting enzyme catalysis- effect of temperature, pH, concentration and inhibitor.

Catalytic efficiency. Mechanism of oxidation of ethanol by alcohol dehydrogenase.

V SEMESTER / PAPER-VI (Elective-2) **(45 hrs / 15 weeks)**

(3h/w)

1.Electro-Analytical Techniques:

UNIT-I

Conductometric methods-1: **11 h**

Introduction, conductance, applications of conductivity

1. Purity of Water 2. Measurement of salinity of sea water. 3. Analysis of fuming HNO3

4. Determination of specific ion in presence of others, 5. Determination of small amounts of ammonia in biological materials.

Conductometric Titrations:

(1). Strong acid with a strong base. (2) Weak acid with a strong base.

(3) Moderately strong acid with strong base (4) Strong acid with weak base

(5) Weak acid with Weak base (6) Mixture of acids with a base.

UNIT-II

1.Conductometric methods-2: **5 h**

(1) Redox titrations (2) Precipitation titrations

(3) Complexometric titrations.

Applications-Determination of atmospheric sulphur dioxide. Advantages and disadvantages of conductometric titrations

2.Potentiometric titrations: **6 h**

Introduction, Instrumentation-Types of potentiometric titrations.

(1) Acid –base titrations. (2) Complexometric titrations (3) Redox titrations (4) Precipitation titrations (5) Non-aqueous solvents. Advantages of potentiometric titrations.

UNIT-III

1.pH measurements: **5 h**

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Determination of pH (1) Potentiometric method using Quinhydrone electrode and Glass electrode

Instrumentation:(i) Potentiometric type (ii) Direct Reading type, Applications of pH measurements

2. Mass spectrometry **6 h**

Basic principles of Mass spectrometry – Instrumentation – Ionization techniques - Molecular ion and fragment ions. Isotopic peaks and their importance in the determination of Molecular peaks and number and nature of hetero atoms in the molecule - General fragmentation patterns - Mass spectra of ethylbenzene, acetophenone, n-butyl amine and 1- proponal.

Spectral interpretation

Interpretation of IR, UV-Visible, ^{1}H-NMR and mass spectral data of the following compounds

1. Phenyl acetylene 2. Acetophenone 3. Cinnamic Acid 4. para-nitro aniline

UNIT-IV

1.Molecular spectroscopy **12 h**

(i) Electronic spectroscopy:

Interaction of electromagnetic radiation with molecules and types of molecular spectra. Potential energy curves for bonding and antibonding molecular orbitals. Energy levels of molecules (σ,π, n) . Selection rules for electronic spectra. Types of electronic transitions in molecules effect of conjugation. Concept of chromophore.

(ii) Infra-Red spectroscopy

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

(iii) Raman spectroscopy

Concept of polarizability, selection rules and principles of Raman spectroscopy

(iv) Proton magnetic resonance spectroscopy (^{1}H-NMR)

Principles of nuclear magnetic resonance – shielding and de-shielding - equivalent and non-equivalent protons, position of signals. Chemical shift and splitting of signals – spin-spin coupling, coupling constants. Applications of NMR with suitable examples – ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate, toluene and acetophenone.

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VI SEMESTER / PAPER-VII **(45 hrs / 15 weeks)**

Organic Chemistry – IV

(3 h / w)

UNIT-I

1.Carbohydrates **6 h**

Monosaccharides: All discussion to be confined to (+) glucose as an example of aldo hexoses and

(-) fructose as example of ketohexoses. Chemical properties and structureal elucidation: Evidences for straight chain pentahydroxy aldehyde structure (Acetylation, reduction to n-hexane, cyanohydrin formation, reduction of Tollen's and Fehling's reagents and oxidation to gluconic and saccharic acid). Number of optically active isomers possible for the structure, configuration of glucose based on D-glyceraldehyde as primary standard (no proof for configuration is required). Evidence for cyclic structure of glucose (some negative aldehydes tests and mutarotation). Cyclic structure of glucose. Decomposition of cyclic structure (Pyranose structure, anomeric Carbon and anomers). Proof for the ring size (methylation, hydrolysis and oxidation reactions). Different ways of writing pyranose structure (Haworth formula and chair conformationa formula). Structure of fructose: Evidence of 2 – ketohexose structure (formation of penta acetate, formation of cyanohydrin its hydrolysis and reduction by HI to give 2-Carboxy-n-hexane). Same osazone formation from glucose and fructose, Hydrogen bonding in osazones, cyclic structure for fructose (Furanose structure and Haworth formula).

Interconversion of Monosaccharides: Aldopentose to aldo hexose – eg: Arabinose to D-Glucose, D-Mannose (Kiliani - Fischer method). Epimers, Epimerisation – Lobry de bruyn van Ekenstein rearrangement. Aldohexose to Aldopentose eg: D-glucose to D-arabinose by Ruff'f degradation. Aldohexose (+) (glucose) to ketohexose (-) (Fructose) and Ketohexose (fructose) to aldohexose (Glucose)

2.Amino acids and proteins **5 h**

Introduction: Definition of Amino acids, classification of Amino acids into alpha, beta, and gamma amino acids. Natural and essential amino acids – definition and examples, classification of alpha amino acids into acidic, basic and neutral amino acids with examples. Methods of synthesis: General methods of synthesis of alpha amino acids (specific examples – Glycine, Alanine, valine and leucene) by following methods: a) from halogenated carboxylic acid b) Malonic ester synthesis c) strecker's synthesis.

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Physical properties: Optical activity of naturally occurring amino acids: L-configuration, irrespective of sign rotation, Zwitter ion structure – salt like character - solubility, melting points, amphoteric character, definition of isoelectric point.

Chemical properties: General reactions due to amino and carboxyl groups – lactams from gamma and delta amino acids by heating peptide bond (amide linkage). Structure and nomenclature of peptides and proteins - introductory treatment.

Inorganic Chemistry-IV

UNIT-II

1.Reactivity of metal complexes **4 h**

Labile and inert complexes, ligand substitution reactions – S_N1 and S_N2, substitution reactions of square planar complexes – Trans effect and applications of trans effect.

2.Stability of metal complexes **4 h**

Thermodynamic stability and kinetic stability, factors affecting the stability of metal complexes, chelate effect, determination of composition of complex by Job's method.

3.Hard and soft acids bases (HSAB) **4 h**

Classification, Pearson's concept of hardness and softness, application of HSAB principles – Stability of compounds / complexes, predicting the feasibility of a reaction.

Organic Chemistry & Inorganic Chemistry-IV

UNIT III

1.Synthetic strategies **6 h**

Terminology-Disconnection(dix), Symbol (), Synthon, Synthetic equivalent(SE), Functional group interconversion (FGI). Linear, Convergent and Combinatorial syntheses, Target molecule (TM). Retrosynthesis of the following molecules-Acetophenone, Cyclohexene, Phenyl ethyl bromide

2.Bioinorganic chemistry **5 h**

Essential elements, biological significance of Na, K, Mg, Ca, Fe, Co, Ni, Cu, Zn and chloride (Cl^-). Metalloporphyrins – hemoglobin, structure and function, Chlorophyll, structure and role in photosynthesis.

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Physical Chemistry – IV

UNIT-IV

1.Chemical kinetics **9 h**

Rate of reaction, factors influencing the rate of a reaction-concentration, temperature, pressure, solvent, light, catalyst. Experimental methods to determine the rate of reaction. Definition of order and molecularity. Derivation of rate constants for first, second, third and zero order reactions and examples. Derivation for time half change. Methods to determine the order of reactions. Kinetics of complex reactions (first order only): opposing reactions, parallel reactions, consecutive reactions and chain reactions. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy. Theories of reaction rates- collision theory-derivation of rate constant for bimolecular reaction. The transition state theory (elementary treatment).

2.Photochemistry **2 h**

Difference between thermal and photochemical processes. Laws of photochemistry-Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence. Quantum yield. Ferrioxalate actinometry. Photochemical hydrogen- chlorine, hydrogen-bromine reaction. Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing). Photosensitized reactions- energy transfer processes (simple example)

VI SEMESTER / PAPER-VIII (Elective -1) **(45 hrs 15 weeks)**

(3h/w)

Drugs, Pesticides, Macromolecules

UNIT-I

1. Pharmaceutical Drugs **12 h**

Introduction to Medicinal Chemistry – Historical evolution: Definition of a Drug and a Medicines – therapeutic index – good drugs and bad drugs.

Sources of drugs – folklore medicines, natural sources, synthetic origin – one example each.

Nomenclature: Chemical name, Generic name and Trade names of drugs with examples.

Classification: Classification of drugs based on therapeutic activity with one example each.

Pencillin : Isolation , structural features and activity - semi-synthetic pencillins

Synthesis: Synthesis and therapeutic activity of the following drugs: L-Dopa, Chloroquin, Omeprazole, Albuterol and ciprofloxacin.

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UNIT-II

1. HIV and AIDS: **5 h**

Immunity – CD-4 cells, CD-8 cells Retrovirus, replication in human body – detection of AIDS. Drugs available for curing AIDS – Names and structure only: Indinavir (Crixivan), Nelfinavir (Viracept), Abacavir (Ziagen), Lamivudine (Epivir, 3TC), Zidovudine (Retravir, AZT, ZDV)

2. Formulations **3 h**

Introduction to formulations – basis, classifications and types of formulations - Additives in formulations and their role (brief account only)

3. Pestiscides - I **3 h**

Introduction to Insecticides, Fungicides, Herbicides, Weedicides, Rodenticides, Plant Growth Regulators, Pheromones and Hormones. Brief discussion with examples and structure.

UNIT-III

1. Pesticides - II **3 h**

Synthesis of the following pesticides:

DDT, BHC, Malathion, Parathion, Endrin, Baygon, 2,4-D and Endo-sulphan

Natural products like Tobacco, Neem and Garlic.

Environmental problems in pesticide industry.

2. Material science **8 h**

Superconductivity, characteristics of superconductors, Meissner effect, types of superconductors and applications.

Nanomaterials- synthetic techniques, bottom-up-sol-gel method, top-down- electro deposition method.

Properties and applications of nano-materials in electronics, medicine, industry (textile, cosmetics) and agriculture.

Composites-definition, general characteristics, particle reinforce and fiber reinforce composites and their applications.

UNIT III

1. Macromolecules **11 h**

Polymers - Classification and Chemistry of polymerization, chain polymerization, step polymerization, coordination polymerization – tacticity. Molecular weight of polymers-number average and weight average molecular weight, degree of polymerization, determination of molecular weight of polymers by viscometry, Osmometry and light scattering methods. Kinetics of free radical polymerization, derivation of rate law. Preparation and industrial application of polyethylene, PVC, Teflon, polyacrylonitrile, terelene and Nylon6,6. Introduction to biodegradability.

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VI SEMESTER / PAPER-VIII (Elective -2) **(45 hrs 15 weeks)**

(3h/w)

UNIT-I

BIOMOLECULES

1. Alkaloids: **11 h**

Definition of an alkaloid – Extraction of alkaloids – General properties and methods of determining structure –functional nature of Oxygen (if present) and Nitrogen – Hofmann's exhaustive methylation method – Emde degradation and Von Braun,s method for opening nitrogen heterocyclic rings. Structures of Ephedrine, Nicotine, Quinine. Structure and synthesis of Papaverine.

UNIT-II

1.Terpenoids: **11 h**

Introduction to terpenes – Isoprene and special Isoprene rules – Isolation of mono and sequi terpenoids – Colour tests - General methods of determining the structure. Structures of Citral (monoterpenoid), α-Terpineol, Menthol and Camphor (monocyclic monoterpenoid), β-Bisabolene (monocyclic sesquiterpenoid). Synthesis of Geraniol.

UNIT-III

1. Steroids: **6 h**

Introduction,cholesterol and ergosterol, sex hormones, adrenal steroids, anabolic steroids and Oestrone.

2. Vitamins: **5 h**

Introduction to vitamins, Structure and source of vitamins A, B_1, B_2, pantothenic acid, vitaminB_6, vitamin D_2 ,α-Tocopherol,β-Biotin, vitamin K_1.

UNIT-IV

1. Carbohydrates: **5 h**

Definitions of Disccharides – Conformational structures of (+)-Maltose, (+)-Cellobiose, (+)-Lactose and (+)- Sucrose. Hydrolysis - Polysaccharides – Structure of Starch, Amylose, Cyclodextrins and Cellulose.

2. Proteins and Nucleic Acids: **7 h**

Peptides: Geometry of the peptide linkage. Determination of structure of peptides – Terminal residue analysis – Partial hydrolysis. Synthesis of peptides. Proteins: Classification and Function. – Structure of Proteins – Secondary structure of Proteins.

Nucleic acids: Structure of Nucleic acids – Pyrimidine and Purine bases – Sugars – Structure of nucleosides and nucleotides – RNA and DNA. Biosynthesis of proteins (introductory treatment only)

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PAPER V and VII OBJECTIVES:

PHYSICAL CHEMISTRY:

Students will gain an understanding of:

1. Concepts in thermodynamics, different thermodynamic quantities such as heat and work and how they are measured related or transformed from one to the other.
2. Chemical equilibrium and its relationship with thermodynamic quantities.
3. The transport of ions and thermodynamic functions with applications to electron transfer in biological systems.
4. Chemical kinetics; how reaction rates are measured and represented in rate laws, and applications of chemical kinetics in studying enzyme mechanisms.

ORGANIC CHEMISTRY:

Students will gain an understanding of

1. Fundamental electronic structure and bonding in organic molecules.
2. Correlate the physical properties of organic compounds with the structure of the molecules.
3. The reactivity of different compounds.
4. Students will be able to discuss the reactions involved in the preparation of nitrogen compounds, heterocyclic and biochemistry.
5. To predict the outcome and mechanism of some simple organic reactions, using a basic understanding of the relative reactivity of functional groups.

IN-ORGANIC CHEMISTRY:

1. Student gain in depth knowledge of orbital picture and their energy levels
2. They predict reaction mechanism and the connection between isomerism and reaction mechanism of complex compounds.
3. They understand spectra of complexes and various properties like color, magnetic properties of complex compounds.
4. Students learn biological importance of transition metals and their applications in the form of a complex compound.
5. They get knowledge 0f complex compounds in the nature like chlorophyll and predict mechanism 0f photosynthesis etc.., role of hemoglobin in oxygen transportation

LABORATORY COURSE:

1. The planning and implementation of advanced organic reactions.
2. Detailed organic structure analysis how to calculate a limiting reagent, yield, and percent yield.
3. How to critically evaluate data collected to determine the identity, purity, and yield of products.
4. How to summarize findings in writing in a clear and concise manner.
5. How to use the scientific method to create, test, and evaluate a hypothesis?
6. How to engage in safe laboratory practices handling laboratory glassware, equipment, and chemical reagents.
7. How to perform common laboratory techniques, including reflux, distillation, steam distillation, recrystallization, vacuum filtration, aqueous extraction, thin layer chromatography, column chromatography.

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PAPER VI OBJECTIVES:

Unit I - separation techniques are the basic tool to separate impurities in organic as well as inorganic compounds. Chromatography is introduced in detail

Unit II - the basics of spectroscopy and its applications are required to be understood by all biologists and chemists

Unit III -- Catalysis are totally theoretical studies but are essential for students, as it is an important topic for all post graduate entrance exams

Laboratory Course:

1. Instrumentation-use of colorimeter, conductometer and ph-meter will help the students in the industries

PAPER VIII OBJECTIVES:

Unit I - Basics of drugs & formulation chemistry is important for the pharmaceutical industries.

Unit II - Use of green pesticides and harmful effect of other pesticides are important area of study.

Unit III - Material science, polymers and nanotechnology are the allied subjects in chemistry, which find a great place in modern research.

Laboratory Course:

1. Kinetic studies and determining the order of a reaction are the main experiments in this paper.
2. Distribution co-efficient for associated and non-associated compounds are also studied.
3. A project on analyses of spectra is allotted to the students

REFERENCE BOOKS SEM V & VI

PAPER V &VII

ORGANIC CHEMISTRY

1. Organic Chemistry by R.T.Morrison and R.N .Boyd
2. Organic chemistry by John Mc Murrys.
3. Problems and their solutions in organic chemistry by I.L Finar
4. Reaction mechanisms in organic chemistry by S.M.Mukherji and S.Singh

INORGANIC CHEMISTRY

1. Concise Inorganic Chemistry by J.D.Lee
2. Basic Inorganic Chemistry by Cotton and Wilkinson
3. Advanced Inorganic Chemistry Vol-I by Satyaprakash,Tuli,Basu and Madan
4. Inorganic Chemistry by J.E.Huheey.
5. Inorganic Chemistry by Chopra and Kapoor.
6. Inorganic chemistry by R. R Heslop and P. L Rohinson.
7. Inorganic chemistry by D.F Shriver, P.W Atkins and C.H Langford.

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PHYSICAL CHEMISTRY

1. Principles of Physical chemistry by Puri, Sharma and Pathania
2. Physical Chemistry by D. F Shriver, P.W.Atkinson and C.H. Langford
3. An Introduction to Electrochemistry by S Glasstone.

PAPER VI

1. Industrial chemistry by B.K.Sharma
2. Molecular spectroscopy by J R Dyer
3. Molecular spectroscopy by Silver Stein
4. Spectroscopy by Banwell
5. General chemistry by Scoog & West.

PAPER VIII

1. Synthetic drugs by David Krupa Dalam
2. Biomolecules by Satyanarana
3. Biomolecules A K Dey
4. material

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SEMESTER V and VII SYLLABUS

OBJECTIVES:

Physical chemistry:

Students will gain an understanding of:

1. Concepts in thermodynamics, different thermodynamic quantities such as heat and work and how they are measured related or transformed from one to the other.
2. Chemical equilibrium and its relationship with thermodynamic quantities.
3. The transport of ions and thermodynamic functions with applications to electron transfer in biological systems.
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1. Fundamental electronic structure and bonding in organic molecules.
2. Correlate the physical properties of organic compounds with the structure of the molecules.
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In-organic chemistry:

1. Student gain in depth knowledge of orbital picture and their energy levels
2. They predict reaction mechanism and the connection between isomerism and reaction mechanism of complex compounds.
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5. They get knowledge Of complex compounds in the nature like chlorophyll and predict mechanism Of photosynthesis etc.., role of hemoglobin in oxygen transportation

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Laboratory Course:

1. The planning and implementation of advanced organic reactions.
2. Detailed organic structure analysis how to calculate a limiting reagent, yield, and percent yield.
3. How to critically evaluate data collected to determine the identity, purity, and yield of products.
4. How to summarize findings in writing in a clear and concise manner.
5. How to use the scientific method to create, test, and evaluate a hypothesis.
6. How to engage in safe laboratory practices handling laboratory glassware, equipment, and chemical reagents.
7. How to perform common laboratory techniques, including reflux, distillation, steam distillation, recrystallization, vacuum filtration, aqueous extraction, thin layer chromatography, column chromatography.

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SEMESTER VI SYLLABUS

OBJECTIVES:

Unit I - separation techniques are the basic tool to separate impurities in organic as well as inorganic compounds. Chromatography is introduced in detail

Unit II - the basics of spectroscopy and its applications are required to be understood by all biologists and chemists

Unit III - material science, polymers and nanotechnology are the allied subjects in chemistry, which find a great place in modern research.

Laboratory Course:

1. Instrumentation-use of colorimeter, conductometer and ph-meter will help the students in the industries

SEMESTER VIII SYLLABUS

OBJECTIVES:

Unit I - Basics of drugs & formulation chemistry is important for the pharmaceutical industries.

Unit II - Use of green pesticides and harmful effect of other pesticides are important area of study.

Unit III - Catalysis and nuclear chemistry are totally theoretical studies but are essential for students, as they are important topics of all post graduate entrance exams.

Laboratory Course:

1. Kinetic studies and determining the order of a reaction are the main experiments in this paper.
2. Distribution co-efficient for associated and non-associated compounds are also studied.
3. A project on analyses of spectra is allotted to the students

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OUTCOMES

CHEMISTRY:

OUTCOMES OF LEARNING ORGANIC CHEMISTRY

Students will gain an understanding of:

1. The reactivity and stability of an organic molecule based on structure, including conformation and stereochemistry.
2. The prediction of mechanisms for organic reactions.
3. How to predict the outcome and mechanism of some simple organic reactions, using a basic understanding of the relative reactivity of functional groups.
4. How to design syntheses of organic molecules?
5. How to determine the structure of organic molecules using IR and NMR spectroscopic techniques?
6. How to perform common laboratory techniques, including reflux, distillation, steam distillation, recrystallization, vacuum filtration, aqueous extraction, thin layer chromatography, column chromatography.

OUTCOMES OF LEARNING INORGANIC CHEMISTRY

Students will:

1. Understand the basic principles and concepts of inorganic chemistry and appreciate their relevance to selected examples of biological processes and materials science
2. Demonstrate knowledge and understanding of the acid-base concept and definition.
3. Demonstrate knowledge and understanding of the structure and bonding of main group compounds and transition metal complexes and their relevance to the electronic absorption and magnetic properties of transition metal complexes
4. Gain knowledge and understanding of the thermodynamic stability of metal complex formation.
5. Demonstrate knowledge and understanding of the role of main group elements and transition metal complexes in bioinorganic chemistry.
6. Be able apply the knowledge of quantitative and qualitative analysis in day to day life and analyze and interpret the results.

OUTCOMES OF LEARNING PHYSICAL CHEMISTRY

Students will:

1. State and apply the law of thermodynamics and predict chemical equilibrium and spontaneity of chemical reactions.
2. Describe reaction rates and perform calculations to determine them.
3. Identify an oxidation – reduction (redox) reaction based on changes in oxidation numbers across the chemical change and describe the basic principles of battery design.
4. 4. Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.

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5. 5. Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems.

OUTCOMES OF LEARNING SPECTROSCOPY

1. After the end of the course the student:
1. Will gain the understanding of the use of nuclear magnetic resonance spectroscopy, mass spectrometry and infrared spectroscopy for organic structure elucidation.
2. Will be able to interpret elemental analysis technique.
3. Explain working basic and using of elemental analysis device.
4. Student will be able to select molecular spectroscopy methods suitable for solving given scientific problem.
5. Student will know the basic physical chemistry law that governs molecular spectroscopy.

OUTCOMES OF LEARNING NUCLEAR CHEMISTRY

Students will be able to:

1. Explain the macroscopic observables associated with nuclear change and the microscopic or chemists view of nuclear change.
2. Identify and define various types of nuclear transmutation including fission, fusion and decay reactions.
3. Use proper isotopic notation to write down and balance a nuclear reaction.
4. State and compare the differences and similarities between a nuclear change and a chemical change.
5. Understand the basics of nuclear chemistry applications: nuclear power, medical treatment, isotopic labeling, and carbon dating.

OUTCOMES OF LEARNING DRUGS

Students will be able to:

1. Explain the physic-chemical properties of drug molecules, its absorption, distribution, metabolism and excretion (ADME).
2. Understand the chemical basis of pharmacology and therapeutics.
3. Explain the mechanisms of drug pathways.
4. Explain the role of pharmacology in drug choice and the treatment of disease.
5. Analyze the adverse effects and side effects of drugs.

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SKILL ENHANCEMENT COURSE (SEC)
SEMESTER III

SAFETY RULES IN CHEMISTRY LABORATORY AND PREPARING LAB REAGENTS(credits:02) **(30 hrs 15 weeks)**
(2h/w)

UNIT I:

Laboratory Safety Rules and Regulations
General rules and regulations for lab safety: Minimizing Risks of Hazards, Personal Protective Equipment (PPE) - Hair, Dressing for the Laboratory, Eye Protection, Eye-wash fountain, Gloves.
Laboratory Protocols- Labeling Chemicals, Careful reading of labels Prevention of Inhaling Harmful Chemicals- Guide to Chemical Hazards, Chemical Spills.
Accidents- use of fire extinguisher and first aid kit in the laboratory, safety symbols
Normality/Molarity and specific gravity of concentrated acids – Preparation of dilute solutions (Numerical problems). Precautions to be taken
in the preparation of dilute acids and bases and bases.
Preparation of stock solutions of salts with specific examples. Properties of primary standard salt and preparation of standard solution. Good
laboratory practices-maintenance of observation book record.

UNIT II:

Preparation of Lab Reagents:
Preparation of indicators and use of indicators in volumetric analysis- acid base titrations, redox titrations, precipitation titrations and
complexometric titrations. Role of an indicator in detecting end point (Phenolphthalein, Methyl orange, Methyl-red, Potassium Chromate, Diphenylamine, EBT, Murexide, etc). Preparation of
buffers – pH 10 ammonical buffer and acetate buffer solutions.
Preparation of commonly used reagents : Ammonium hydroxide solution, Ammonium molybdate reagent, Ammonium hydrogen phosphate solution, Bromine water, Dimethyl glyoxime reagent, 2,4-Dinitrophenyl hydrazine reagent, Eriochrome black-T reagent Fehling solution, Ferric chloride solution, Ferrous sulphate solution, Iodine solution, Molisch's reagent,
Neutral FeCl3, Schiff's reagent, Silver nitrate solution, Sodium carbonate solution , Sodium hydroxide (Caustic soda) solution, Starch solution, Tollen's reagent.
(reference work and submission of assignments).

RECOMMENDED BOOKS
1. Vogel's Text Book of Quantitative Chemical Analysis, 5thedition.
2. Vogel's Text Book of macro and semimicro qualitative inorganic analysis. G. Svehla, 5th edition.
3. American Chemical Society Safety in Academic Chemistry Laboratories 8thedition.

OUTCOMES FOR SAFETY RULES IN CHEMISTRY LABORATORY AND PREPARING LAB REAGENTS:
- To improve the skills of students in the application of theory and practical knowledge.
- To fill the gap between theory and practicals.
- To train the students in understanding laboratory safety rules and to improve the skills in preparation of laboratory regents.
- To make students aware about best lab practices.

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SKILL ENHANCEMENT COURSE (SEC)
SEMESTER IV

GREEN METHODS IN CHEMISTRY(credits:02) **(30 hrs 15 weeks)**
(2h/w)

THEORY AND HANDS-ON EXPERIMENTS

INTRODUCTION: **8h**

Definitions of Green Chemistry. Brief introduction of twelve principles of Green Chemistry, with examples, special emphasis on atom economy, reducing toxicity,green solvents, green reactants, green reagents,one pot syntheses. Green Chemistry and catalysis and alternative sources of energy.

GREEN ENERGY AND SUSTAINABILITY. BETTER LIVING THROUGH GREEN CHEMISTRY: **10h**

1.Surfactants for Carbon Dioxide –replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments.
2 Designing of Environmentally safe marine antifoulant,green computing.
3.Rightfit pigment: synthetic azopigments to replace toxic organic and inorganic pigments, green pigments.
4 An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn, green plastics.
5.Improvement of lab atmosphere-green guidelines.

LAB COURSE: **12h**

1.Alternate procedure for Lassaignes test
2.Acetylation of primary amine
3. Bromination of acetanilide
4.Transesterification reaction –synthesis of biodiesel.
5.Green photochemical reaction-photoreduction of benzophenone to benzopinacol

REFERENCE BOOKS:

1.Anastas,P.T. andWarner,J.K. Oxford -Green Chemistry-Theory and Practical, University Press,1998
2.Matlack,A.S., Marcel Dekker,2001- Introduction to Green Chemistry,
3. Sharma, R.K.,Sidhwani, I.T. andChaudhari, M.K.- Green Chemistry
4. Ahluwalia Vk Kidwai - New Trends In Green Chemistry

OUTCOMES FOR GREEN METHODS IN CHEMISTRY:

- Know about green lab practices.
- Improving reaction efficiency by changing certain parameters and making it more environment friendly.
- Learning about green reagents and their mode of action in making chemistry less hazardous.
- Atom economy and its usefulness i.e. utilizing 100% of the reactants.
- Different green reactions.

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SKILL ENHANCEMENT COURSE (SEC)
SEMESTER V

BASIC ANALYTICAL CHEMISTRY: (CREDITS :02) **(30 hrs 15 weeks)**

(2h/w)

INTRODUCTION: **5h**

Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the statistical point of view , using a few examples.

ANALYSIS OF SOIL: **5h**

Composition of soil, Concept of pH and pH measurement.
a. Determination of pH of soil samples.
b. Estimation of Calcium and Magnesium ions as carbonates by complexmetric titration.

ANALYSIS OF WATER: **5h**

Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.
a. Determination of pH, acidity and alkalinity of a water sample.
b. Determination of dissolved oxygen (DO) of a water sample.

ANALYSIS OF COSMETICS: **5h**

Major and minor constituents and their functions
a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.
b. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration.

LAB COURSE: **10h**

a. Determination of of macro nutrients in soil samples.
b. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.
c. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in aerated drinks.

REFERENCE BOOKS:

1.Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
2.Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.
3.Skoog, D.A.; West, D.M. & Holler, F.J. Fundamentals of Analytical Chemistry 6th Ed., Saunders College Publishing, Fort Worth (1992).

OUTCOMES OF ANALYTICAL CHEMISTRY:

1. It enhances the knowledge and skills required for attaining analytical and critical abilities, logical thinking, and ability to apply knowledge learnt to solve issues and problems related to chemical analysis.
2. Improve the use of statistical tools.
3.Used in determining the water quality refers to the chemical, physical, biological, and radiological characteristics of water. It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose.

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4. pH, hardness, presence of a selected group of chemical parameters, biocides, highly toxic chemicals, and B.O.D are estimated. pH is a measure of hydrogen ion concentration. It is an indicator of relative acidity or alkalinity of water. ... Drinking water should have a pH between 6.5 and 8.5.

5. ph. Soil pH is one of the most important parameter son your soil test report. The pH level of the soil can tell you a lot about the potential availability of plant nutrients and on possible toxicities of other elements (such as aluminum). Soils with pH greater than 7.0 are considered to be alkaline soils.

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SKILL ENHANCEMENT COURSE (SEC)
SEMESTER VI

CHEMINFORMATICS(credits:02) **(30 hrs 15 weeks)**
(2h/w)

INTRODUCTION TO CHEMINFORMATICS: **2h**
History and evolution of cheminformatics, use of cheminformatics, prospects of cheminformatics, molecular modelling, structure elucidation.

RERESENTATION OF MOLECULES AND CHEMICAL REACTIONS: **7h**
Chemical Nomenclature – (development, representation of elements and, Molecular formulas), types of notations, SMILES coding, matrix representation, structure of Molfiles and Sdfiles, libraries and tool kits, reaction classification.

SEARCHING CHEMICAL STRUCTURES: **9h**
Full structure search, sub-structure search, basic ideas, similarity search, 3D search methods, Basics of computation of physical and chemical data and structure descriptors.

APPLICATIONS: **12h**
Prediction of properties of compounds: Linear free energy relations, Quantitative Structure – Property Relations, Descriptor analysis, model building, modelling toxicity.
COMPUTER ASSISTED SYNTHESIS DESIGN.
DRUG DESIGN – introduction, Drug discovery process (Target identification and validation, Lead finding and optimization), Application of cheminformatics in drug design (Analysis of HTS data, virtual screening, design of combinatorial libraries, ligand based and structure based drug design).

REFERENCE BOOKS:
1. Andrew R. Leach & Valerie, J. Gillet (2207) An introduction to Cheminformatics.
2. Gasteiger, J. & Engel, T. (2003) Cheminformatics: A text book. Wliey-VCH

OUTCOMES FOR CHEMINFORMATICS:

- Learn about drawing chemical structures on pc
- Using the tools to search the chemicals in the database to help in research.
- Identification of protein targets.
- Spectral predictions of various drugs.
- Molecular modeling
- Hands on experiment on drug development using cehminformatics.
- Hands on molisnpiration.

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GENERIC ELECTIVE - 1
SEMESTER V

ORGANIC FARMING (CREDITS :02)

(30 hrs 15 weeks)
(2h/w)

(Course includes theory and practicals)

UNIT - I:

CONCEPT OF ORGANIC FARMING **5h**

1. Introduction: Farming, organic farming, concept and development of organic farming.
2. Principles of organic farming, Types of organic farming, Biodynamic farming
3. Benefits of organic farming: Need for organic farming, Conventional farming v/s organic farming
4. Scope of organic farming; national and international status
5. Agencies and institutions related to organic agriculture
6. Requirements for organic farming, Farm components for an organic farm

UNIT - 2: ORGANIC PLANT NUTRIENT MANAGEMENT **5h**

1. Organic farming systems: Soil tillage, Land preparation and mulching
2. Choice of varieties
3. Propagation-seed, planting materials and seed treatments, Water management
4. Green manuring, Composting- principles, stages, types and factors, Composting methods, Vermicomposting
5. Bio-fertilizers- types, methods of application, advantages and disadvantages, Standards for organic inputs- fertilizers

UNIT-III: ORGANIC PLANT PROTECTION **5h**

1. Plant protection- cultural, mechanical, botanical pesticides, control agents
2. Weed management
3. Standards for organic inputs- plant protection

UNIT- IV: ORGANIC CROP PRODUCTION PRACTICES **5h**

1. Organic crop production methods
2. Livestock component in organic farming

UNIT- V: ORGANIC CERTIFICATION **5h**

1. Farm economy: Basic concept of economics- Demand, supply, Economic Viability of a farm.
2. Basic production principles, Reducing expenses, ways to increase returns, Cost of production system. Benefit/ cost ratio, Marketing, Imports and exports
3. Policies and incentives of organic production.
4. Conversion to organic farming, Process
5. Income generation activities: Apiculture, Mushroom production, Terrace farming

PRACTICALS **5h**

1. Preparation of vermi- compost
2. Preparation of green manure
3. Visit to an organic farm

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REFERENCE BOOKS:

1. Farming system: Theory and Practice - S.A.Solaimalai
2. Organic Farming: Theory and Practice- S.P.Palaniappan and K.A. Annadurai
3. A hand book of Organic Farming by A.K.Sharma

OUTCOMES FOR ORGANIC FARMING:

Upon successful completion of this course, students will:

1) Have a better understanding of the basic principles of organic farming;
2) Recognize that organic farming systems, if practiced in a an environmentally sound manner, can constitute a larger philosophy of sustainable agriculture;
3) Be able to devise an organic farm management plan.
4) Have improved their ability to think critically about the opportunities and challenges faced by organic growers.
5) Learn the basic principles of managing biodiversity, crop rotations, non-crop competitors (weeds) and plant health for productive cropping systems with minimal off-farm resources.

GENERIC ELECTIVE - 2
SEMESTER VI

CHEMISTRY OF COSMETICS & PERFUMES: (CREDITS :02)

(30 hrs 15 weeks)
(2h/w)

(Course includes theory and practicals)

1. 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 cream, vanishing and shaving creams), antiperspirants and artificial flavors. **10h**
2. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil,2-phenylethyl alcohol, Jasmine. **10h**

Practicals: **10h**

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:

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

OUTCOMES FOR CHEMISTRY OF COSMETICS & PERFUMES:

1. Describe fundamentals of chemistry and the scientific basis for cosmetic formulation and the function of the active ingredients.
2. Comprehend the efforts of scientists in cosmetic product design and developments.
3. Explain/interpret how cosmetics suit for a specific intended function, e.g. how sunscreen works for its intended function.

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