

**B.Sc I yr BIOLOGICAL CHEMISTRY  
SEMESTER WISE SYLLABUS  
(For the batch admitted in 2015-2016 )**

**SEMESTER I  
(Paper-I)**

**(BCH 101 W)**

**Unit-I ( Inorganic Chemistry)**

**15h(1 hr/week)**

**S1-I-1 Theory of Quantitative Analysis**

**8 h**

Principle of Volumetric Analysis- introduction, standard solutions, indicators, end point, titration curves, Types of titrations: i) neutralization titration- principle, titration curves and selection of indicators- strong acid - strong base, strong acid –weak base, weak acid- strong base and weak acid –weak base. ii) Redox titrations- principal, detection of end point, redox indicators. iii) Precipitation titrations, principle, detection of end point, indicators. iv) Complexation titrations- principle, metal ion indicators.

Principle of Gravimetric analysis- nucleation, precipitation, growth of precipitate, filtration and washing, drying and incineration of precipitate, coprecipitation and post precipitation

**S1-I-2 Molecular orbital theory:**

**7 h**

Shapes and sign convention of atomic orbitals. Modes of overlapping. Concept of  $\sigma$  and  $\pi$  bonds. Criteria for orbital overlap. LCAO concept. Types of molecular orbitals- bonding, antibonding and non bonding. Electron distribution diagram for  $H_2$ , MOED of homonuclear diatomic molecules -  $H_2$ ,  $N_2$ ,  $O_2$ ,  $O_2^-$ ,  $O_2^{2-}$ ,  $F_2$  (unhybridized diagrams only) and heteronuclear diatomic molecules  $CO$ ,  $CN^-$ ,  $NO$ ,  $NO^+$  and  $HF$ . Bond order and magnetic properties.

**UNIT - II (Organic Chemistry)**

**15h(1 hr/week)**

**S1-O-1: Structural Theory in Organic Chemistry**

**7 hours**

**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. (b) acidity of carboxylic acids. Hyper conjugation and its application to stability of carbonium ions, Free radicals and alkenes. Structure and geometry of carbanions, carbenes and nitrenes.

**Types of organic reactions:** Addition reactions- electrophilic, nucleophilic and free radical. Substitution reactions – electrophilic, nucleophilic and free radical. Elimination and Rearrangement reactions– Examples(mechanism not required)

### **S1-O-2: Acyclic Hydrocarbons**

**8 hours**

**Alkanes** –IUPAC Nomenclature of Hydrocarbons. Methods of preparation: Corey-House reaction. Chemical reactivity - inert nature, free radical substitution, Halogenation example- reactivity, selectivity and orientation.

**Alkenes** - Preparation of alkenes (a) by dehydration of alcohols (b) dehydrohalogenation of alkyl halides (c) by dehalogenation of 1,2 dihalides (brief mechanism), Zaitsev'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<sub>2</sub>O, HOX, H<sub>2</sub>SO<sub>4</sub> with mechanism and addition of HBr in the presence of peroxide (anti – Markonikov's addition). Oxidation – hydroxylation by KMnO<sub>4</sub>, OsO<sub>4</sub>, Peracids (via epoxidation), hydroboration, ozonolysis – location of double bond. Dienes – Types of dienes, reactions of conjugated dienes – 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 acetylides) preparation of higher acetylenes, metal-ammonia reductions. Physical properties. Chemical reactivity – electrophilic addition of X<sub>2</sub>, HX, H<sub>2</sub>O (tautomerism), Oxidation (formation of enediol, 1,2 diones and carboxylic acids), and reduction.

### **UNIT – III (Physical Chemistry )**

**15 h (1 hr/week)**

#### **S1-P-1: Atomic structure and elementary quantum mechanics**

**6 hours**

Failures of classical mechanics, black body radiation, heat capacities of solids, Rayleigh Jeans law, Planck's radiation law, photoelectric effect, Compton effect, De Broglie's hypothesis. Heisenberg's uncertainty principle, sinusoidal wave equation, Hamiltonian operator, Schrodinger's wave equation and its importance. Physical interpretation of the wave function, significance of  $\psi$  and  $\psi^2$ , 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.

#### **S1-P-2: Gaseous State**

**5 hours**

Deviation of real gases from ideal behaviour. Van der Waals equation of state. Critical phenomenon. PV isotherms of real gases, continuity of state. Andrew's isotherms of CO<sub>2</sub>. The Van der Waal's equation and critical state. Derivation of relationship between critical constants and van der Waal's constants. Experimental determination of critical

constants. The law of corresponding states, reduced equation of states. Joule Thomson effect and inversion temperature of a gas. Liquefaction of gases: i) Linde's Method based on Joule Thomson effect ii) Claude's Method based on Adiabatic expansion of a gas.

### **S1-P-3: Liquid State**

**4 hours**

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 into Smectic and Nematic, differences between liquid crystal and solid / liquid. Application of liquid crystals as LCD devices, lubricants and in digestion/assimilation of food.

## **Unit IV (Biological Chemistry)**

**15 h (1 hr/week)**

### **S1-B-1 Chemical aspects of Food and Nutrition**

**8 h**

Chemical composition of Human body. Energy yielding nutrients and Calorific value of carbohydrates, fats and proteins. Determination of Calorific value of foodstuffs by Bomb Calorimeter. Basis metabolic rate & factors effecting its specific dynamic action of food. Energy requirement & recommended daily allowance(RDA) for children, pregnant & lactating women & normal adults.

### **S1-B-2 Essential elements**

**7 h**

Sources, absorption, biochemical functions, deficiency states of Na, K, Ca, Mg, P, S, Cl, F, I, B, Se, Fe, Zn, Cu, V, Cr, Mn. Co, Mo.

Sources, physiological functions, deficiency states, recommended daily allowances of amino acids, lipids and vitamins.

Protein malnutrition & its consequences.

## **References**

### **Unit- I**

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications 1996.
2. Concise Inorganic Chemistry by J.D. Lee 3<sup>rd</sup> edn.
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3<sup>rd</sup> edn Wiley Publishers 2001.
4. Vogel's Text Book of Quantitative Analysis by G.H.Jeffery, J.Bassett,
5. J.Mendham and R.C. Denney 5<sup>th</sup> edn Addison Wesley Longman Inc. 1999.

### **Unit- II**

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.

### **Unit III**

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

### **Unit IV**

1. Nutritional Biochemistry by Dr. S. Ramakrishnan.
2. Fundamentals of Food & Nutrition by Sumati R. Mudumbai & M. V. Rajagopal.
3. Food & Nutrition by Swaminathan.
4. Animal Physiology by A. K. Berry.
5. Text Book of Biochemistry by Rama Rao.

**Paper I Quantitative Analysis**

**Acid - Base titrations**

1. Determination of Carbonate
2. Determination of carbonate and bicarbonate in a mixture

**Redox Titrations**

1. Determination of Fe(II) using  $K_2Cr_2O_7$
2. Determination of Fe(II) using  $KMnO_4$  with sodium oxalate as primary standard.
3. Determination of Cu(II) using  $Na_2S_2O_3$  with  $K_2Cr_2O_7$  as primary standard

**Complexometry**

1. Estimation of Copper by direct titration.
2. Estimation of Nickel by direct titration.
3. Estimation of Nickel by back titration
4. Estimation of Calcium by substitution titration

**Gravimetry:**

1. Estimation of Barium as Barium Sulphate

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**SEMESTER II (BCH 201 W)**

**Unit-I ( Inorganic Chemistry) 15 h (1 hr/week)**

**S2-I-1: General Principles of Inorganic qualitative analysis 7 h**

Anion analysis: Theory of sodium carbonate extract, classification and reaction of anions-  $\text{CO}_3^{2-}$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{CH}_3\text{COO}^-$ ,  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{PO}_4^{3-}$ ,  $\text{BO}_3^{3-}$ .

Cation Analysis: Principles involved - Solubility product, common ion effect, general discussion for the separation and identification of group I individual cations ( $\text{Hg}_2^{2+}$ ,  $\text{Ag}^+$ ,  $\text{Pb}^+$ ) 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 ( $\text{Hg}^{2+}$ ,  $\text{Pb}^{2+}$ ,  $\text{Bi}^{3+}$ ,  $\text{Cd}^{2+}$ ,  $\text{Sb}^{2+}$ ), III ( $\text{Al}^{3+}$ ,  $\text{Fe}^{3+}$ ), IV ( $\text{Mn}^{2+}$ ,  $\text{Zn}^{2+}$ ) 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 ( $\text{Ba}^{2+}$ ,  $\text{Sr}^{2+}$ ,  $\text{Ca}^{2+}$ ) with flow chart and chemical equations. Theory of flame test. Identification of Group VI cations ( $\text{Mg}^{2+}$ ,  $\text{NH}_4^+$ ).

**S2-I-2. s-block elements:** Reducing nature of Lithium, diagonal relationship between Li & Mg, Be & Al. **2 h**

**S2-I-3. p-block elements-I: 6 h**

Group – 13: Boron halides, electron deficiency, Lewis acidity. Synthesis and structure of diborane and higher boranes ( $\text{B}_4\text{H}_{10}$  and  $\text{B}_5\text{H}_9$ ), boron-nitrogen compounds ( $\text{B}_3\text{N}_3\text{H}_6$  and BN)

Group – 14: Preparation and applications of silanes and silicones.

Group – 15: Preparation and reactions of hydrazine, hydroxylamine, phosphazenes.

**UNIT - II (Organic chemistry) 15 h (1 hr/week)**

**S2-O-1: Alicyclic Hydrocarbons (Cycloalkanes) 4 hours**

Nomenclature, Preparation by Freund's 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.

**S2-O-2: Benzene and its Reactivity****8 hours**

Concept of aromaticity – aromaticity (definition), Huckel's rule – application to Benzenoid (Benzene, Naphthalene, Anthracene and Phenanthracene) and Non – Benzenoid compounds (cyclopropenyl cation, cyclopentadienyl anion and tropylium cation).

Reactions - General mechanism of electrophilic substitution, mechanism of nitration and sulfonation. Mechanism of halogenation, Friedel Craft's alkylation (polyalkylation) and acylation. Orientation of aromatic substitution - Definition of ortho, para, and meta directing groups. Ring activating and deactivating groups with examples. (Electronic interpretation of various groups like  $\text{NO}_2$  and Phenolic). Orientation: 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).

**S2-O(II)-2: Arenes and Polynuclear Aromatic Hydrocarbons****3 hours**

Preparation of alkyl benzenes by Friedel Craft's alkylation, Friedel Craft's acylation followed by reduction, Wurtz-Fittig reaction. Nuclear substitution reactions, side chain substitution reactions and oxidation.

Polynuclear hydrocarbons – Structure of naphthalene and anthracene (Molecular Orbital diagram and resonance energy) Reactivity towards electrophilic substitution. Nitration and sulfonation as examples.

**Unit-III (Physical Chemistry)****15 h (1 hour/week)****S2-P-1: Solutions****3 hours**

Liquid - liquid mixtures, ideal liquid mixtures, Raoult's and Henry's laws. Non ideal systems. Azeotropes  $\text{HCl-H}_2\text{O}$  and  $\text{C}_2\text{H}_5\text{OH} - \text{H}_2\text{O}$  systems. Fractional distillation, Lever rule. Partially miscible liquids- Phenol – Water, Trimethyl amine – Water and Nicotine – Water systems. Lower upper consolute temperatures. Effect of impurity on consolute temperature. Immiscible liquids and steam distillation. Nernst distribution law. Calculation of the partition coefficient. Applications of distribution law with solvent extraction.

**S2-P-2: Solid state Chemistry****5 hours**

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). X-ray diffraction by crystals; Derivation of Bragg's equation, Determination of structure of  $\text{NaCl}$ ,  $\text{KCl}$  &  $\text{CsCl}$  (Bragg's method and Powder method). Band theory of Semiconductors: Extrinsic and intrinsic semiconductors, n-type and p-type and their applications in photo-electro chemical cells.

Classification of materials- classification as metals, ceramics, organic polymers, composites, e.t.c. biological material e.t.c. The property of super conductivity of materials.

Super conducting materials- elements, alloys and compounds. Properties of super conductors- zero resistivity, Meissner effect Meissner effect and thermal properties. Composites- meaning of composites, advanced composites, classification –particle reinforced fiber reinforced and structural composites general characters of composite materials-Particle- reinforced composites – large particle and dispersion- strengthened composite. Fiber reinforced composites (continuous and discontinuous fiber composites).

### **S2-P-3: Colloids, nanomaterials & surface chemistry**

**7 hours**

*Colloids:* Definition of colloids. Classification of colloids. Solids in liquids (sols): preparations and properties. Kinetic, Optical and Electrical stability of colloids, Protective action. Hardy–Schultz law, Gold number. Liquids in liquids(emulsions): Types of emulsions, preparation and emulsifier. Liquids in solids(gels); Classification, preparations and properties, inhibition, general applications of colloids. Micelles: Classification of surface active agents. Surfactant action, micellization and micellar interactions, Structure of micelles – spherical and lamellar. Critical micellar concentration (CMC). Factors affecting the CMC of surfactants. Counter ion binding to micelles.

*Nanomaterials:* Nano structured materials – Definition, description of graphite, fullerenes, carbon nano tubes.

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

Production of carbon nano tubes – arc discharge, pyrolysis, laser vaporization and electrolysis methods.

Mechanical and electronic properties of carbon nano tubes (CNT)

Properties and applications of nano-materials. Nano material advantage, importance in technological applications

Basics of advanced organic materials and their applications such as in LEDs, OLEDs, etc.

*Adsorption:* Types of adsorption, Factors influencing adsorption. Freundlich adsorption isotherm. Langmuir theory of unilayer adsorption isotherm. Applications.

*Nanomaterials:* Nano structured materials – Definition, description of graphite, fullerenes, carbon nano tubes.

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

Production of carbon nano tubes – arc discharge, pyrolysis, laser vaporization and electrolysis methods.

Mechanical and electronic properties of carbon nano tubes (CNT)

Properties and applications of nano-materials. Nano material advantage, importance in technological applications

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## Unit IV ( Biological Chemistry)

15 h (1 hour/week)

### S2-B-1: Vitamins

(15hrs)

Introduction and Discovery of Vitamins. Classification of vitamins based on their solubility, sources, Recommended dietary allowance(RDA),History, Chemistry, Absorption, transport, and storage of Vitamins, Metabolic functions and Biochemical manifestations of Water soluble Vitamins-B-Complex Vitamins : Vitamin –B<sub>1</sub>, Vitamin – B<sub>2</sub>, Vitamin-B<sub>3</sub>, Vitamin –B<sub>6</sub>, Biotin, Panthothenic acid, Folic acid, Vitamin-B<sub>12</sub>. Co-enzymes of B-Complex Vitamins. Fat soluble Vitamins : Vitamin -A, Vitamin - D, Vitamin-E, Vitamin- K.

### References

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2. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications
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4. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3<sup>rd</sup> edn
5. Wiley Publishers 2001. Chem 1996.
6. Qualitative Analysis by Welcher and Hahn.
7. Qualitative Inorganic analysis by A.I.Vogel
8. Chemistry of the elements by N.N.Greenwood and A. Earnshaw Pergamon Press 1989.
9. Inorganic Chemistry by Shriver and Atkins 3<sup>rd</sup> edn Oxford Press 1999.

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5. Physical Chemistry through problems by S.K. Dogra.
6. Text Book of Physical Chemistry by R.P. Verma.
7. Elements of Physical Chemistry by Lewis Glasstone.
8. Material science by Kakani & Kakani
9. Colloidal and surface chemistry , M. Satake, Y. Hayashi, Y.Mido, S.A.Iqbal and M.S.sethi
10. Material science by Kakani & Kakani
11. Nano: The Essentials by T. Pradeep, McGraw-Hill Education.
12. Chemistry of nanomaterials: Synthesis, Properties and applications by CNR Rao et.al.
13. Nanostructured Materials and Nanotechnology, edited by Hari Singh Nalwa, Academic Press

## Unit IV

1. Text Book of Biochemistry by Rama Rao.
2. Biochemistry by Satyanarayana.
3. Text book of Biochemistry by Dr. A. C Deb

## Laboratory Course

### Paper II (BCH 251 W) - Qualitative Analysis

45hrs (3h/week)

#### Analysis of two anions and two cations in the given mixture.

Anions:  $\text{CO}_3^{2-}$ ,  $\text{SO}_3^{2-}$ ,  $\text{S}^{2-}$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ ,  $\text{CH}_3\text{COO}^-$ ,  $\text{NO}_3^-$ ,  $\text{PO}_4^{3-}$ ,  $\text{BO}_3^{3-}$ ,  $\text{SO}_4^{2-}$

Cations:  $\text{Ag}^+$ ,  $\text{Pb}^{2+}$ ,  $\text{Hg}^+$ ,  $\text{Hg}^{2+}$   
 $\text{Pb}^{2+}$ ,  $\text{Bi}^{3+}$ ,  $\text{Cd}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{As}^{3+/5+}$ ,  $\text{Sb}^{3+/5+}$ ,  $\text{Sn}^{2+/4+}$   
 $\text{Al}^{3+}$ ,  $\text{Cr}^{3+}$ ,  $\text{Fe}^{3+}$   
 $\text{Zn}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Mn}^{2+}$   
 $\text{Ca}^{2+}$ ,  $\text{Sr}^{2+}$ ,  $\text{Ba}^{2+}$   
 $\text{Mg}^{2+}$ ,  $\text{NH}_4^+$

**B.Sc II yr BIOLOGICAL CHEMISTRY  
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**SEMESTER III**

**(BCH 301 W)**

**Paper-III**

**Unit-I ( Inorganic Chemistry)**

**15 h (1 hr/week)**

**S2-I-1 p-block Elements -II**

**7 h**

**Oxides:** Types of oxides a) Normal- acidic, basic amphoteric and neutral b) Mixed c) sub oxide d) peroxide e) superoxide. Structure of oxides of C, N, P, S and Cl.- reactivity, thermal stability, hydrolysis.

**Oxy acids:** Structure and acidic nature of oxyacids of B, C, N, P, S and Cl.

Redox properties of oxyacids of N:  $\text{HNO}_2$  (reaction with  $\text{FeSO}_4$ ,  $\text{KMnO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ ),  $\text{HNO}_3$  (reaction with  $\text{H}_2\text{S}$ , Cu),  $\text{HNO}_4$  (reaction with KBr, Aniline),  $\text{H}_2\text{N}_2\text{O}_2$  (reaction with  $\text{KMnO}_4$ ). Redox properties of oxyacids of P:  $\text{H}_3\text{PO}_2$  (reaction with  $\text{HgCl}_2$ ),  $\text{H}_3\text{PO}_3$  (reaction with  $\text{AgNO}_3$ ,  $\text{CuSO}_4$ ).

Redox properties of oxyacids of S:  $\text{H}_2\text{SO}_3$  (reaction with  $\text{KMnO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ ),  $\text{H}_2\text{SO}_4$  (reaction with Zn, Fe, Cu),  $\text{H}_2\text{S}_2\text{O}_3$  (reaction with Cu, Au),  $\text{H}_2\text{SO}_5$  (reaction with KI,  $\text{FeSO}_4$ ),  $\text{H}_2\text{S}_2\text{O}_8$  (reaction with  $\text{FeSO}_4$ , KI)

**Interhalogens-** classification- general preparation- structures of  $\text{AB}$ ,  $\text{AB}_3$ ,  $\text{AB}_5$  and  $\text{AB}_7$  type and reactivity. Basic iodine- basic nature and evidence of +I and +II . **Poly halides-** definition and structure of  $\text{ICl}_2^-$ ,  $\text{ICl}_4^-$  and  $\text{I}_3^-$ . Comparison of **Pseudohalogens** with halogens.

**S3-I-2: Chemistry of d-block elements**

**6 h**

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. Titanium triad – electronic configuration and reactivity of +3 and +4 states – oxides and halides. Chromium triad – reactivity of +3 and +6 states. Copper triad – reactivity of +1, +2 and +3 states.

**S3-I-3 Hard- and Soft and Acids & Bases**

**2 h**

Classification, Pearsons concepts of Hardness and Softness applications of HSAB principles , stability of complexes, predicting the feasibility of a reactions

**UNIT – II (Physical Chemistry)**

**15 hr (1h / week)**

**S3-P-1: Molecular spectroscopy**

**15 hrs**

**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 ( $\sigma$ ,  $\pi$ , n). Selection rules for electronic spectra. Types of electronic transitions:  $\sigma$ - $\sigma^*$ , n- $\sigma^*$ , n- $\pi^*$ ,  $\pi$ - $\pi^*$  with suitable examples.  $\lambda_{\text{max}}$  in UV spectra measured in nm. Definition of chromophore, auxochrome, bathochromic and hypsochromic shifts.

Absorption of characteristic functional groups: C=C, C-C, C=O, NO<sub>2</sub>, COOH. Meaning of extended conjugation and its effect on  $\lambda_{\text{max}}$ .

### **Infra red spectroscopy**

Dipole moment, polar and non-polar molecules, induced dipole moment, vector addition of dipole moment and structure of molecules. Energy levels of simple harmonic oscillator, molecular vibration spectrum, selection rules. Determination of force constant. Qualitative relation of force constant to bond energies. Anharmonic motion of real molecules and energy levels. Modes of vibrations in polyatomic molecules. Characteristic absorption bands of various functional groups. Finger print nature of infrared spectrum. Problems.

### **Raman spectroscopy**

Concept of polarizability, selection rules, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

### **Proton magnetic resonance spectroscopy**

Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. Chemical shift, NMR 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.

## **UNIT – III (Organic Chemistry)**

**15 hr (1h / week)**

### **S3-O-1: Symmetry of molecules**

**3 h**

Symmetry elements and symmetry operations in molecules. Definition of Plane of symmetry, Center of symmetry and Axis of symmetry (simple axis ( $C_n$ ) and alternating axis ( $S_n$ )). Examples.

### **S3-O-2: Stereochemistry of carbon compounds**

**7 h**

Isomerism: Definition of homomers and isomers. Classification of isomers: Constitutional and Stereoisomers -. definition and examples. Constitutional isomers: chain, functional, positional isomers and metamerism. Stereoisomers: enantiomers and diastereomers – definitions and examples.

Enantiomers: Optical activity: wave nature of light, plane polarised light, optical rotation and specific rotation. Chiral molecules: definition and criteria - absence of plane, center and  $S_n$  axis of symmetry – asymmetric and dissymmetric molecules. Examples of asymmetric molecules (Glyceraldehyde, Lactic acid, Alanine) and dissymmetric molecules (trans-1,2-dichlorocyclopropane). Chiral centers: definition - molecules with similar chiral carbons (Tartaric acid) – definition of mesomers. Molecules with dissimilar chiral carbons (2,3-dibromopentane). Number of enantiomers and mesomers - calculation. D, L & R, S configuration for asymmetric and dissymmetric molecules. Cahn-Ingold-Prelog rules. Racemic mixture, Racemisation and Resolution techniques. Diastereomers: Definition - Geometrical isomerism with reference to alkenes – cis, trans and E, Z configuration.

**S3-O-3: Halogen compounds****5 h**

Nomenclature and classification of alkyl (into primary, secondary, tertiary), aryl, aralkyl, allyl, vinyl, benzyl). Chemical reactivity - reduction, formation of RMgX, Nucleophilic substitution reaction – classification into S<sub>N</sub>1 and S<sub>N</sub>2. Mechanism and energy profile diagrams of S<sub>N</sub>1 and S<sub>N</sub>2 reactions. Stereochemistry of S<sub>N</sub>2 (Walden Inversion), S<sub>N</sub>1 (Racemisation) explanation of both by taking the example of optically active alkyl halide- 2-bromo butane. Structure and reactivity – Ease of hydrolysis - comparison of allyl, benzyl, alkyl, vinyl and aryl halides.

**UNIT - IV (Organic chemistry)****15 h (1 hr/week)****S3-O-4: Hydroxy compounds****6 h**

Nomenclature and classification of hydroxy compounds. Preparation: from carbonyl compounds by reduction and Grignard addition. Aryl carbinols by hydroxy methylation. Phenols – (a) by diazotisation (b) from sulfonic acid (c) from cumene (d) by hydrolysis of halobenzene. Physical properties – Hydrogen bonding (inter molecular and intramolecular) effect of hydrogen bonding on boiling point and water solubility. Chemical properties (a) acidic nature of Phenols (b) Formation of alkoxide/phenoxides and their reaction with RX (c) replacement of OH by X using PCl<sub>5</sub>, SOCl<sub>2</sub> and with HX/ZnCl<sub>2</sub>. Esterification by (a) acid halides, anhydrides and acids (mechanism) (b) Esters of inorganic acids (c) dehydration of alcohols. Oxidation of alcohols by CrO<sub>3</sub>, KMnO<sub>4</sub>. Special reactions of Phenols – (a) Bromination, (b) Kolbe- Schmidt reaction (c) Riemer Tiemann (d) Azo coupling. Identification of alcohols by oxidation - KMnO<sub>4</sub>, Ceric ammonium nitrate - Lucas reagent; Phenols by reaction with FeCl<sub>3</sub>, and by the solubility in NaOH. Poly hydroxyl compounds – Pinacol - Pinacolone rearrangement, Oxidative cleavage (Pb(OAc)<sub>4</sub> & HIO<sub>4</sub>).

**S3-O-5: Ethers and epoxides****3 h**

Nomenclature, preparation by (a) Williamson's synthesis (b) from alkenes by the action of conc. H<sub>2</sub>SO<sub>4</sub>. Physical properties – Absence of Hydrogen bonding, insoluble in water, low boiling point. Chemical properties – inert nature, action of conc. H<sub>2</sub>SO<sub>4</sub> and HI. Acid and base catalysed ring opening of epoxides- orientation.

**S3-O-6: Carbonyl compounds****6 h**

Nomenclature of aliphatic and aromatic carbonyl compounds and isomerism. Synthesis of aldehydes & ketones from acid chloride, 1,3-dithianes, nitriles and from carboxylic acids. Special methods of preparing aromatic aldehydes and ketones by (a) Oxidation of arenes (b) Hydrolysis of benzal halides. Physical properties – absence of Hydrogen bonding. Keto-enol tautomerism, polarisability of carbonyl groups, reactivity of the carbonyl groups in aldehydes and ketones. Chemical reactivity – i. Addition of [a] NaHSO<sub>3</sub> (b) HCN (c) RMgX (d) NH<sub>3</sub> (e) RNH<sub>2</sub> (f) NH<sub>2</sub>OH (g) PhNHNH<sub>2</sub> (h) 2,4DNP Schiff bases, Addition of H<sub>2</sub>O to form hydrate (unstable), comparison with chloral hydrate (stable), addition of alcohols - hemiacetal and acetal formation, Halogenation using PCl<sub>5</sub> with mechanism. Base catalysed reactions – with particular emphasis on Aldol, Cannizzaro reaction, Perkin reaction, Benzoin condensation, haloform reaction,

Knoevengeal condensation. Oxidation reactions –KMnO<sub>4</sub> oxidation and auto oxidation, reduction – catalytic hydrogenation, Clemmenson’s reduction, Wolf- kishner reduction, MPV reduction, reduction with LAH, NaBH<sub>4</sub>. Analysis – 2,4 –DNP test, Tollen’s test, Fehlings test, Scihff’s test, haloform test (with equations). Introduction to  $\alpha,\beta$ -unsaturated carbonyl compounds.

## References :

### Unit- I

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia, Vishal Publications
2. 1996.
3. Concise Inorganic Chemistry by J.D. Lee 3<sup>rd</sup> edn.
4. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3<sup>rd</sup> edn Wiley Publishers 2001. Chem.
5. norganic Chemistry Principles of structure and reactivity by James E.Huhey,
6. E.A. Keiter and R.L. Keiter 4<sup>th</sup> edn.
7. Chemistry of the elements by N.N.Greenwood and A. Earnshaw Pergamon Press 1989.
8. Inorganic Chemistry by Shriver and Atkins 3<sup>rd</sup> edn Oxford Press 1999.

### Unit 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 R.P. Verma.
5. Text Book of Physical Chemistry by K. L. Kapoor.
6. Physical Chemistry through problems by S.K. Dogra.
7. Elements of Physical Chemistry by Lewis Glasstone.

### Unit- III & 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. Symmetry in Chemistry by H. H. Jaffe & M. Orchin.
5. Stereochemistry of Carbon Compounds by Eliel.
6. Text book of organic chemistry by Soni.
7. General Organic chemistry by Sachin Kumar Ghosh.

## **Laboratory Course**

**Paper III {BCH 351 W) - Organic Chemistry**

**45hrs (3h/week)**

1. Preparation of Acetanilide, Benzanilide, Tribromophenol and Azonaphthol.
2. Identification of functional groups in organic compounds: solubility tests, detection of elements, characteristic color reactions and preparation of derivatives- carboxylic acids, phenols, aldehydes, ketones, amines, amides, and carbohydrates.

**B.Sc II yr BIOLOGICAL CHEMISTRY**  
**SEMESTER WISE SYLLABUS**  
**(For the batch admitted in 2015-2016 )**

**SEMESTER IV**  
(Paper-IV)

**(BCH 401 W)**

**Unit-I ( Inorganic Chemistry)**

**15 h (1 hr/week)**

**S4-I-1: Chemistry of f-block elements:**

**7 h**

Chemistry of Lanthanides: Electronic structure, position in periodic table, oxidation state, ionic and atomic radii- lanthanide contraction- cause and consequences, anomalous behaviour of post lanthanides- basicity, complexation- type of donor ligands preferred. Magnetic properties- paramagnetism. Colour and spectra, f-f transitions –occurrence and separation – ion exchange method, solvent extraction.

Chemistry of actinides- general features – electronic configuration, oxidation state, actinide contraction, colour and complex formation. Comparison with lanthanides.

**S4-I-2: Coordination Compounds-I**

**8 h**

Nomenclature – IUPAC rules, simple inorganic molecules and coordination complexes.

1. Brief review of Werner's theory, Sidgwick's electronic interpretation and EAN rule and defects of both . 2. Coordination numbers, coordination geometries of metal ions, types of ligands. 3. Isomerism in coordination compounds, stereo isomerism-

a) geometrical isomerism in i) square planar metal complexes of the type  $[MA_2B_2]$ ,  $[MA_2BC]$ ,  $[M(A-B)_2]$ ,  $[MABCD]$ . ii) Octahedral metal complexes of the type  $[MA_4B_2]$ ,  $[M(A-A)_2B_2]$ ,  $[MA_3B_3]$  using suitable examples, b) Optical isomerism in

i). tetrahedral complexes  $[MABCD]$ , ii). Octahedral complexes  $[M(A-A)_2B_2]$ ,  $[M(A-A)_3]$  using suitable examples. Structural isomerism: ionization, linkage, coordination ligand isomerism using suitable examples. Bonding in coordination compounds

1. Valence bond theory (VBT) – postulates and application to a) tetrahedral complexes  $[Ni(NH_3)_4]^{2+}$ ,  $[NiCl_4]^{2-}$  and  $[Ni(CO)_4]$  b) square planar complexes  $[Ni(CN)_4]^{2-}$ ,  $[Cu(NH_3)_4]^{2+}$ ,  $[PtCl_4]^{2-}$  c) octahedral complexes  $[Cr(NH_3)_6]^{3+}$ ,  $[Fe(CN)_6]^{4-}$ ,  $[FeF_6]^{4-}$ ,  $[Co(NH_3)_6]^{3+}$ ,  $[CoF_6]^{3-}$ . Limitations of VBT.

**UNIT –II ( Organic chemistry)**

**15 h ( 1h/week)**

**S4-O-1: Pericyclic Reactions**

**5 h**

Pericyclic Reactions Concerted reactions, Molecular orbitals of ethane, 1,3-butadiene and allyl radical. Symmetry properties HOMO, LUMO, Thermal and photochemical pericyclic reactions. Types of pericyclic reactions – electrocyclic, cycloaddition and sigmatropic reactions – one example each and their explanation by FMO theory.

**S4-O-2: Synthetic Strategies****5 h**

Synthetic strategies Terminology – Disconnection (dix), Symbol ( ), synthon, synthetic equivalence (SE), Functional group interconversion (FGI), Linear, Convergent and Combinatorial, Target molecule (TM) Retrosynthesis of the following molecules

1) acetophenone 2) cyclohexene 3) phenylethylbromide

**S4-O-3: Asymmetric synthesis****5 h**

Asymmetric (Chiral) synthesis Definition and classification of stereoselective reactions into substrate, product stereoselective and further into enantio and diastereo selective reactions. stereospecific reaction – definition – example – dehalogenation of 1,2-dibromides by I. Enantioselective reactions – definition – example –Reduction of Ethylacetoacetate by Yeast. Diastereoselective reaction-definition-example acid catalysed dehydration of 1-phenylpropanal and Grignard addition to chiral carbonyl compound. Definition and explanation of enantiomeric excess, diastereomeric excess.

**UNIT – III (Physical Chemistry)****15 hr (1h / week)****S4-P-1: Electrochemistry & EMF****12 hours**

Electrical transport – conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of specific and equivalent conductance with dilution. Migration of ions and Kohlrausch's law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf's method for attackable electrodes. Applications of conductivity measurements: Determination of degree of dissociation, determination of  $K_a$  of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

Electrolyte and Galvanic cells – reversible and irreversible cells, conventional representation of electrochemical cells. EMF of a cell and its measurement. Computation of EMF. Types of reversible electrodes- the gas electrode, metal-metal ion, metal-insoluble salt and redox electrodes. Electrode reactions, Nernst equation, cell EMF and single electrode potential, standard Hydrogen electrode – reference electrodes – standard electrode potential, sign conventions, electrochemical series and its significance.

Applications of EMF measurements, Calculation of thermodynamic quantities of cell reactions ( $\Delta G$ ,  $\Delta H$  and  $K$ ). Determination of pH using quinhydrone electrode, Solubility product of AgCl. Potentiometric titrations.

Batteries: Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel Cells, Solar cell and polymer cell. Corrosion: cause, factors affecting corrosion and prevention of corrosion.

**S4-P-2: Phase Rule****3 hours**

Statement and meaning of the terms – Phase, Component and degrees of freedom, Gibb's Phase rule, phase equilibria of one component system – water system. Phase equilibria of

two-component system – Solid-Liquid equilibria, simple eutectic – Pb-Ag system, desilverisation of lead. Solid solutions – compound with congruent melting point – (Mg-Zn) system and incongruent melting point – (NaCl-H<sub>2</sub>O) system.

#### **UNIT - IV (Biochemistry)**

**15 hr (1 hr/week)**

##### **S4-B-1: Carbohydrates**

**4 hrs**

Classification and nomenclature of carbohydrates.

Structure of monosaccharides- (+) glucose as an example of aldo hexoses and (-) fructose as example of ketohexoses.

Stereoisomerism and optical isomerism of sugars (Glucose). Mutarotation of Glucose.

Reactions of aldehyde and ketone groups. Reactions of sugars due to hydroxyl groups.

Structural elucidation of Glucose and Fructose.

Important derivatives of monosaccharides and disaccharides (structure, occurrence and functions of important ones).

Disaccharides- nomenclature and structures of sucrose, maltose, cellobiose.

Polysaccharides- occurrence, structural features and biological function of

(i) Storage Polysaccharides: starch, glycogen and inulin.

(ii) Structural Polysaccharides: chitin and cellulose

Heteropolysaccharides- occurrence, structural features and biological significance

##### **S4-B-2: Lipids**

**4hrs**

Definition and Classification. Fatty acids: introduction, nomenclature, structure and properties of saturated and unsaturated fatty acids. Essential fatty acids and prostaglandins. Triacylglycerols – nomenclature, physical and chemical properties. Characterization of fats – Hydrolysis, Saponification number, Iodine number, Riechert – Meissel number, Rancidity of oils and fats. Biological significance of fats.

Phospholipids- Classification and functions. Sphingomyelin,– cerebroside, gangliosides. Biological significance of phospholipids. Glycolipids.

##### **S4-B-3: Amino acids & Proteins**

**7 hrs**

Amino acids: Classification of amino acids based on the structure, polarity, nutrition and metabolic fate. Methods of synthesis: General methods of synthesis of alpha amino acids (specific examples – Glycine, Alanine, valine and Leucine) by following methods: a) From halogenated Carboxylic acid b) Malonic ester synthesis c) strecker's synthesis. Physical properties: Optical activity of naturally occurring amino acids: L – configuration, irrespective of sign of rotation, RS Configuration. Zwitter ion structure – salt like character, solubility, melting points, amphoteric character. definition of isoelectric point. Titration of amino acids.

Peptides: structure of peptide bond, formation of peptide bonds.

Determination of amino acid sequence of a polypeptide chain- Sanger's method and Edman's degradation method

Proteins: Classification and biological roles. Structural organization- primary structure, secondary structure- (helix and  $\beta$  - pleated sheets), tertiary structure- (forces stabilizing the tertiary structure) and quaternary structure of proteins. Denaturation and renaturation of proteins of proteins. Behavior of proteins in solution – salting in and salting out of proteins. Structure and biological functions of fibrous proteins (keratin and collagen) and globular proteins (hemoglobin and myoglobin).

1.

## References

### Unit- I

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications 1996.
2. Concise Inorganic Chemistry by J.D. Lee 3<sup>rd</sup> edn.
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3<sup>rd</sup> edn Wiley Publishers 2001. Chem.
4. Principles of Inorganic Chemistry by G.S. Monku.
5. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey, E.A. Keiter and R.L. Keiter 4<sup>th</sup> edn.
6. Chemistry of the elements by N.N.Greenwood and A. Earnshaw Pergamon Press 1989.
7. Inorganic Chemistry by Shriver and Atkins 3<sup>rd</sup> edn Oxford Press 1999.

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3. Text Book of Physical Chemistry by Puri, Sharma and Pattania.
4. Text Book of Physical Chemistry by R.P. Verma. 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 Glasstone.
7. Industrial Electrochemistry, D. Pletcher, Chapman & Hall

### Unit III

1. Text book of organic chemistry by Morrison and Boyd
2. Text book of organic chemistry by Graham solomons
3. Fundamentals of organic synthesis and retrosynthetic analysis by Ratna Kumar Kar
4. Organic synthesis by Dr. Jagadamba Singh and Dr. L.D.S. Yadav
5. Stereochemistry of organic compounds by D. Nasipuri
6. Organic chemistry by Clayden, Greeves, Warren and Wothers

### Unit IV

1. Biochemistry by Lehninger.
2. Schaum's series of Biochemistry.
3. Biochemistry by Satyanarayana.
4. Text book of Biochemistry by Dr. A. C Deb
5. Text book of organic chemistry by Morrison and Boyd.
6. Text book of organic chemistry by Graham Solomons.
7. Biochemistry by Voet & Voet.

## Laboratory Course

### Paper IV (BCH 451 W)- Physical Chemistry

45hrs (3h/week)

1. Determination of distribution coefficient of acetic acid between n-butanol and water.
2. Adsorption of acetic acid on animal charcoal, verification of Freundlich isotherm
3. Surface tension and viscosity of liquids
4. Kinetics of hydrolysis of methyl acetate.
5. Determination of rate of decomposition of Hydrogen peroxide
6. Determination of concentration of HCl conductometrically using standard NaOH solution.
7. Determination of concentration of HCl potentiometrically using standard NaOH solution.
8. pH metric titration of weak acid, acetic acid with strong base NaOH and calculation of dissociation constant.
9. Verification of Beer-Lambert law for  $\text{KMnO}_4$  and determination of concentration of the given solution.

**B.Sc III yr BIOLOGICAL CHEMISTRY**  
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**SEMESTER V**  
**(Paper-V)**

**(BCH 501 W)**

**Unit-I ( Inorganic Chemistry)**

**11 h (1 hr/week)**

**S5-I-1: Cordination compounds –II**

**7 h**

Crystal field theory (CFT)- Postulates of CFT, splitting patterns of d-orbitals in octahedral, tetrahedral, square planer with suitable examples. Crystalfield stabilization energies and its calculations for various  $d^n$  configurations in octahedral complexes. Spectrochemical series . High Spin Low Spin complexes .

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

Electronic spectra of metal complexes – colour of transtion elements – d-d transitions.

Detection of complex formation - basic principles of various methods- change in chemical properties, solubility, colour, pH, conductivity, magnetic susceptibility. and mole ratio

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

**S5-I-2: Application of coordination compounds.**

**4 h**

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

**UNIT –II ( Organic chemistry)**

**15 h ( 1h/week)**

**S5-O-1: Carboxylic acids and derivatives**

**7h**

Nomenclature, classification and methods of preparation a) Hydrolysis of Nitrites, amides and esters. b) carbonation of grignard reagents. Special methods of preparation of Aromatic Acids. Oxidation of the side chain of Arenas.. Hydrolysis of benzotrichlorides. Kolbe reaction. Physical properties- hydrogen bonding, dimeric association, acidity – strength of acids with the examples of trimethyl acetic acid and trichloro acetic acid, Relative differences in the acidity of Aromatic and aliphatic acids. Chemical properties – Reactions involving H, OH and COOH groups -salt formation, anhydride formation, Acid halide formation, Esterification (mechanism) & Amide formation. Reduction of acid to the corresponding primary alcohol - via ester or acid chloride. Degradation of carboxylic acids by Huns Diecker reaction, Schmidt reaction (Decarboxylation). Arndt – Eistert synthesis, Halogenation by Hell – Volhard - Zelensky reaction. Carboxylic acid

Derivatives – Reactions of acid halides, Acid anhydrides, acid amides and esters (mechanism of ester hydrolysis by base and acid).

#### **S5-O-2: Synthesis based on Carbanions**

**4h**

Acidity of  $\alpha$ -Hydrogens, structure of carbanion. Preparation of Aceto acetic ester by Claisen condensation and synthetic application of Aceto acetic ester. [a) Acid hydrolysis and ketonic hydrolysis. Preparation of i] monocarboxylic acids ii) dicarboxylic acids (b) malonic ester – synthetic applications. Preparation of i] substituted mono carboxylic acids ii) substituted dicarboxylic acids. iii) trialkyl acetic acid.

### **Unit-III (Physical Chemistry)**

**15 hours(1hr /week)**

#### **S5-P-1: Chemical Kinetics**

**11 hours**

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

First order reaction, derivation of equation for rate constant. Characteristics of first order reaction. Units for rate constant. Half- life period, graph of 1<sup>st</sup> order reaction, examples. Decomposition of H<sub>2</sub>O<sub>2</sub> and decomposition of oxalic acid.

Pseudo first order reaction, Hydrolysis of methyl acetate, inversion of cane sugar, problems.

Second order reaction, derivation of expression for 2<sup>nd</sup> order rate constant, examples- Hydrolysis of ester,  $2O_3 \rightarrow 3O_2$ ,  $C_2H_4 + H_2 \rightarrow C_2H_6$ . characteristics of second order reaction, units for rate constants, half- life period and second order plots.

Zero order reaction: derivation of rate expression, examples i) combination of H<sub>2</sub> and Cl<sub>2</sub> to form HCl, ii) thermal decomposition of HI on gold surface characteristics of Zero order reaction units of k, half-life period and graph, problems.

Determination of order of reaction: i) method of integration, ii) half life method, iii) vant-Hoff differential method iv) Ostwald's isolation method.

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

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

**Unit-IV:****S5-I-3: Organometallic Chemistry****4 h**

Definition, nomenclature and classification of organometallic compounds.  
Methods of preparation, properties and applications of alkyl and aryl compounds of Li, Mg, Al & Cd.

**S5-O-3: Mass Spectrometry****4h**

Basic principles – Molecular ion / parent ion, fragment ions / daughter ions. Theory – formation of parent ions. Representation of mass spectrum. Identification of parent ion, (M+1), (M+2), base peaks (relative abundance 100%) Determination of molecular formula – Mass spectra of ethylbenzene, acetophenone, n-butyl amine and 1- propanol.

**S5-P-2: Photochemistry****4 hours**

Introduction to photochemical reactions, Difference between thermal and photochemical reactions, Laws of photo chemistry- Grotthus - Drapper law, Stark – Einsteins Law of photo chemical equivalence. Quantum yield. Examples of photo chemical reactions with different quantum yields. Photo chemical combinations of  $H_2 - Cl_2$  and  $H_2 - Br_2$  reactions, reasons for the high and low quantum yield. Problems based on quantum efficiency, Consequences of light absorptions. Singlet and triplet states. Jablonskii diagram Explanation of internal conversion, inter- system crossing, Phosphorescence, fluorescence. Photo – sensitized reactions examples i) decomposition of hydrogen molecule in the presence of Hg. ii) dissociation of oxalic acid in presence of  $UO_2^{2+}$  ion.

**References****Unit- I**

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications 1996.
2. Concise Inorganic Chemistry by J.D. Lee 3<sup>rd</sup> edn.
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3<sup>rd</sup> edn Wiley Publishers 2001. Chem.
4. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey, E.A. Keiter and R.L. Keiter 4<sup>th</sup> edn.
5. Chemistry of the elements by N.N.Greenwood and A. Earnshaw Pergamon Press 1989.
6. Inorganic Chemistry by Shriver and Atkins 3<sup>rd</sup> edn Oxford Press 1999.

**Unit- II**

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

### **Unit III**

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, Sharma and Pattania.
4. Physical Chemistry by Atkins & De Paula, 8<sup>th</sup> Editi
5. Text Book of Physical Chemistry by K. L. Kapoor.
6. Physical Chemistry through problems by S.K. Dogra.
7. Text Book of Physical Chemistry by R.P. Verma.
8. Elements of Physical Chemistry by Lewis Glasstone.
9. Basics of Chemical Kinetics by G.L. Agarwal
10. Kinetics and mechanism of chemical transformations by Rajaram & Kuriacose

### **Unit IV**

1. Advanced Inorganic Chemistry, Cotton and Wilkinson, V & VI Ed
2. Organic spectroscopy, William Kemp
3. Photochemistry by Gurdeep Raj, Goel publishing house, 5<sup>th</sup> edition

**B.Sc III yr BIOLOGICAL CHEMISTRY**  
**SEMESTER WISE SYLLABUS**  
(For the batch admitted in 2015-2016 )

**SEMESTER V**

**(BCH 502 W)**

**Paper-VI**

**Discipline Centric Elective-I**

**Biochemistry**

**UNIT-I**

**S5-DCEI-1:Enzymes and Enzyme catalysis**

**(11 hrs)**

Importance of enzymes, nomenclature, classification with examples. Properties of enzymes. Concept of holo, apoenzyme and cofactors-small organic molecules, metal ions. Nature of non enzymatic and enzymatic catalysis. Isoenzymes, and multimeric enzyme complexes. Enzyme assay and units of activity. ). Specificity of enzymes.

Basic mechanisms for increase rates by enzymes:, general acid base catalysis, covalent catalysis,. Mechanism of catalysis of carboxypeptidase, chymotrypsin. Concept of turnover, Allosteric enzymes. Structure and nature of active site. Factors affecting enzyme activity-Enzyme concentration, substrate concentration,  $P^H$  , temperature. Formation of enzyme-substrate complex. Enzyme inhibition-competition, non competitive and un competitive inhibition.

**UNIT -II**

**S5- DCEI-2 Metabolism of Bio molecules.**

**(11hrs)**

**1. Carbohydrate metabolism**

**4hrs**

Reactions and energetics of glycolysis,. Reactions and energetics of TCA cycle. Regulation of glycolysis and TCA cycle. Reactions and physiological significance of pentose phosphate path way. Major disorders of carbohydrate metabolism with respect to diabetes.

**2.Amino acid metabolism**

**4hrs**

Reactions of amino acids- Transamination, Decarboxylation, oxidative deamination, Urea cycle. Fate of the carbon skeleton of amino acids- Glycogenic and ketogenic aminoacids. Metabolism of phenylalanine, tyrosine, cysteine and valine.

**3. Lipid Metabolism**

**3 hrs**

*Denovo* synthesis of fatty acids.  $\beta$  – oxidation of fatty acids (Knoop’s theory) – activation of fatty acid, transport of fatty acids into mitochondria and  $\beta$  – oxidation. ATP yield from fatty acid oxidation – even and odd number chain fatty acids. Formation of Ketone Bodies (brief treatment).

### UNIT-III

#### **S5- DCEII-3. Endocrinology & Signal Transduction.**

**11h**

**Endocrinology:** Hormones: Definition and classification based on structure with examples, function and regulation of hormones of hypothalamus, pituitary, thyroid, adrenal, parathyroid, gonads, pancreas, placenta and gastrointestinal. Feedback inhibition and control.

**Signal Transduction:** Transduction by intracellular receptors, cell surface receptors( ion channels, catalytic receptors) and receptor involving secondary messenger molecules- CAMP, calcium and inositol- Mechanism of action.

### UNIT-IV

**12 h**

#### **S5-DCEI-4 Clinical Biochemist**

**6 h**

Importance of enzyme changes in diseases- SGOT, SGPT, LDH, Acid and Alkaline Phosphates. Gglucose tolerance test. Liver function tests- jaundice, hepatitis. Renal function tests- glomerulonephritis. Atherosclerosis and Coronary Heart Disease- contributory factors, formation and nature of plaque. Major vaccines and their uses.

#### **S5- DCEI-5: Blood and Biochemistry of Blood Coagulation**

**6h**

Introduction, Functions of Blood, Blood volume, Blood Groups, Blood Transfusion, Blood Composition, Physical Characteristics of Blood. RBC, WBC and Platelets. Blood Coagulation, Inhibitors of Coagulation. Fibrinolysis. Blood clotting Factors. Plasma Proteins. Formation of Plasma Proteins, Functions of Plasma proteins.

#### **Referances**

1. Biochemistry by Lehninger.
2. Biochemistry by Stryer.
3. Schaum's series of Biochemistry.
4. Biochemistry by Sathyanarayana.
5. Biochemistry- A case oriented approach by Montgomery.
6. Tietz Fundamentals of Clinical Chemistry.
7. Lipponacs series of biochemistry.
8. Biochemistry by Mathews.
9. Biochemistry by Voet and Voet.
10. Lecture notes on clinical biochemistry by A.F Smith.



**Paper-VI**  
**Discipline Centric Elective-II**  
**Molecular Biology**

**UNIT-I** **(11hrs)**

**S5-DCEII-1: DNA replication & transcription**

**1. DNA Replication:**

**5hrs**

DNA replication in prokaryotes-conservative, semiconservative and dispersive types. DNA polymerases, other enzymes and protein factors involved in replication. Mechanism of replication, Inhibitors of replication.

**2. Transcription:**

**6hrs**

Transcription RNA polymerase, promoters, initiation, elongation and Termination of RNA synthesis, Inhibitors of Transcription, Reverse transcriptase, post transcriptional modifications.

**UNIT-II**

**S5-DCEII-2: Translation & transgenic technology**

**1. Translation**

**6hrs**

- a) Genetic Code: Basic features of genetic code, biological significance of degeneracy, Wobble Hypothesis, gene within gene and overlapping genes.
- b) Mechanism of translation: Ribosome structure, A & P sites, charged to RNA, initiator codon, Shine-Dalgarno consensus sequence, formation of initiation complex, role of elongation factors and release factors. Inhibitors of protein synthesis, post translational modifications

**2. Transgenic technology:**

**5hrs**

Animal biotechnology-cells and cell lines, media for cell culture and equipment. Production of viral vaccines, Transgenic animals. Plant biotechnology-plant cell culture, plant protoplast isolation and protoplast fusion, plant viruses as vectors, Ti plasmid as vector and transgenic plants.

**UNIT-III**

**S5- DCEII-3 Immunology**

**(11hrs)**

Innate and acquired immunity. Introduction to antigen, antibody, hapten and antigenic determinant(epitope). Structure of antibody, classification of immunoglobulins, functions of antibody, antibody diversity- Factors and principles, antigen-antibody reactions: agglutination, immunoprecipitation, immunodiffusion. Primary and secondary response. Lymphocytes-cellular and humoral immunity, T and B cells(out lines).

**UNIT-IV**

**S5-DCEII-4: Recombinant DNA technology**

**7hrs**

Tools of r-DNA technology-Enzymes(Restriction endonucleases, ligase, phosphatases, reverse transcriptase, polynucleotide kinases, terminal transferases, S1nucleases and RNAase H), steps in DNA cloning, cloning vectors- plasmids, Ti plasmids, cosmids, Lambda phages, shuttle vectors, expression vectors. Application of recombinant DNA technology e.g., insulin and human growth hormones.

**S5-DCEII-5. Industrial microbiology**

**5hrs**

Fermentation, basic design of fermentor-oxygen supply, aeration, agitation, control systems. Types of fermentation: surface, submerged, batch, continuous down stream processing, production Fermentation, basic design of fermentor-oxygen supply, aeration, agitation, control of commercially important products like alcohol, penicillin, amylase.

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17. Lipponacs series of biochemistry.
18. Biochemistry by Mathews.
19. Biochemistry by Voet and Voet.
20. Lecture notes on clinical biochemistry by A.F Smith.

## Laboratory Course

### Paper V (BCH 551 W)

45hrs (3h/week)

- 1) Determination of  $\lambda_{\max}$  and Molar extinction coefficient (spectrophotometry).
- 2) Determination of Tryptophan by Ninhydrin method (colorimetry).
- 3) Determination of Tyrosine by Nitrosonaphthol method (colorimetry).
- 4) Determination of Glucose by Folin – Wu method (colorimetry).
- 5) Determination of Ascorbic acid (Titrimetry).
- 6) Paper Chromatography of Amino acids and Carbohydrates.
- 7) Paper Electrophoresis of Amino acids.
- 8) Demonstration of Dialysis.
- 9) Preparation of Strach, Casein & Egg Albumin.
- 10) Determination of Saponification Number & Iodine Number.

### PAPER VI (BCH 552 W)

45hrs (3h/week)

1. Determination of protein by Biuret method (colorimetry).
2. Determination of protein by Folin's method (colorimetry).
3. Determination of total sugars by anthrone method (colorimetry).
4. Determination of reducing sugars by dinitrosalicylate method (colorimetry).
5. Determination of inorganic phosphate (colorimetry).
6. Isolation of amylase from sweet potatoes and its assay.
7. Determination of Na, K, Li and Ca (Flame photometry)
8. Qualitative Analysis : Colour Reactions for Identification of Proteins, Amino acids & Lipids.
9. Determination of Acid value of Fats/Oils.

**B.Sc III yr BIOLOGICAL CHEMISTRY  
SEMESTER WISE SYLLABUS**

**(For the batch admitted in 2015-2016 )**

**SEMESTER VI**

**(BCH 601 W)**

**Paper-VII**

**Unit-I ( Inorganic Chemistry)**

**15 h (1 hr/week)**

**S6-I-1: Boranes and Carboranes**

**3 h**

Definition of clusters. Structures of boranes and carboranes- Wade's rules and its applications- closo -  $[B_nH_n]^{2-} / [B_nC_2H_{n+2}]$ :  $[B_6H_6]^{2-}$ ,  $[B_{10}H_{10}]^{2-}$ ,  $[B_{10}C_2H_{12}]$ . nido -  $[B_nH_{n+4}] / [B_nC_2H_{n+4}]$ :  $[B_5H_9]$ ,  $[B_8H_{12}]$ , arachno -  $[B_nH_{n+6}] / [B_nC_2H_{n+6}]$ :  $[B_5H_{11}]$ ,  $[B_7C_2H_{13}]$ .

**S6-I-2 Metal carbonyls and related compounds**

**3 h**

EAN rule, classification of metal carbonyls, structure and bonding in metal carbonyls of V, Cr, Mo, W, Mn, Fe, Co and Ni. Preparation and properties of  $Ni(CO)_4$ . Structure and bonding in Metal nitrosyls and metallocenes (only ferrocene).

**S6-I-4: Theories of bonding in metals**

**5 h**

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

**UNIT-II (Organic chemistry)**

**15h (1h / week)**

**S6-O-1: Nitrogen compounds**

**11 h**

**Nitro hydrocarbons:** Nomenclature and classification of nitro hydrocarbons. Structure. Tautomerism of nitroalkanes leading to aci and keto form. Preparation of Nitroalkanes . Reactivity - halogenation, reaction with HONO (Nitrous acid), Nef reaction and Mannich reaction leading to Michael addition and reduction. Aromatic Nitro hydrocarbons: Nomenclature, Preparation of Nitrobenzene by Nitration (mechanism), from diazonium salts. Physical properties, chemical reactivity – orientation of electrophilic substitution on nitrobenzene. Reduction reaction of Nitrobenzenes in different media.

**Amines:**

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). Reduction of Amides and Schmidt reaction. Physical properties and basic character – Comparative basic strength of Ammonia, methyl amine, dimethyl amine, trimethyl amine and aniline- comparative

basic strength of aniline, N- methylaniline and N,N- dimethyl aniline (in aqueous and non- aqueous medium), steric effects and substituent effects. Use of amine salts as phase transfer catalysts. 4. Chemical Properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation. 5. Reaction with Nitrous acid of 1<sup>o</sup>, 2<sup>o</sup>, 3<sup>o</sup> (Aliphatic and aromatic amines). Electrophilic substitutions of Aromatic amines – Bromination and Nitration, oxidation of aryl and 3<sup>o</sup> Amines, diazotisation. 6. Diazonium salts: Preparation with mechanism. Synthetic importance – a) Replacement of diazonium group by – OH, X (Cl)- Sandmeyer and Gatterman reaction, by fluorine (Schiemann's reaction), by iodine, CN, NO<sub>2</sub>, H and aryl groups. Coupling Reaction of diazonium salts. i) with phenols ii) with anilines. Reduction to phenyl hydrazines.

### **Cyanides and isocyanides:**

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

## **Unit-III (Physical Chemistry)**

**15 hours(1hr /week)**

### **S6-P-1: Thermodynamics**

**11 hours**

Energy, work and heat units, mechanical equivalent of heat, definition of system, surroundings. I law of thermodynamics statement- various forms mathematical expression. Thermodynamic quantities- extensive properties and intensive properties, state function, path functions energy as a state function, and exact differential. Work of expansion and heat absorbed as path function. Expression for work of expansion, sign convention problems on I law.

Heat changes at constant pressure and heat changes at constant volume. Enthalpy. Heat capacities at constant pressure and constant volume. Derivation  $C_p - C_v = R$ .

Isothermal adiabatic processes. Reversible and irreversible processes. Reversible change and maximum work. Derivation of expression for maximum work for isothermal reversible process. Problems. Internal energy of an ideal gas. Joules experiment and Joule-Thompson coefficient. Adiabatic changes in ideal gas derivation of equation,  $PV^\gamma = \text{constant}$ . P-V curves for isothermal and adiabatic processes.

Heat of a reaction at constant volume and at constant pressure, relation between  $\Delta H$  and  $\Delta V$ . Variation of heat of reaction with temperature. Kirchoff's equation and problems. Limitations of I law and need for II law. Statement of II law of thermodynamics. Cyclic process. Heat engine, Carnot's theorem, Carnot's cycle. Derivation of efficiency of heat engine problems. Thermodynamic scale of temperature.

Entropy: Definition from Carnot's cycle. Entropy as a state function. Entropy as a measure of disorder. Sign of entropy change for spontaneous and non- spontaneous processes & equilibrium processes. Entropy changes in i). Reversible isothermal process, ii). reversible adiabatic process, iii). phase change, iv). reversible change of state of an

ideal gas. Problems. Entropy of mixing inert perfect gases. Free energy Gibb's function (G) and Helmholtz's function (A) as thermodynamic quantities. Concept of maximum work and net work  $\Delta G$  as criteria for spontaneity. Derivation of equation  $\Delta G = \Delta H - T\Delta S$ . significance of the equation. Gibbs equations and the Maxwell relations. Variation of G with P, V and T.

#### **Unit-IV:**

##### **S6-I-3 Inorganic Reaction Mechanism**

**4 h**

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

Reactions of tetrahedral complexes - Hydrolysis of silicon halides and phosphorous oxides.

##### **S6-O-2: Heterocyclic compounds**

**4h**

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

Resonance structures: Indicating electron surplus carbons and electron deficient hetero atom. Explanation of feebly acidic character of pyrrole, electrophilic 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.

##### **S6-P-2:Dilute Solutions & Colligative Properties**

**4 hours**

Dilute Solutions, Colligative Properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis - laws of osmotic pressure, its measurement, determination of molecular weight from osmotic pressure. 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 for determining various colligative properties. Abnormal molar mass, Van't hoff factor, degree of dissociation and association of solutes.

## References

### Unit- I & IV

1. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3<sup>rd</sup> edn Wiley Publishers 2001.
2. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey,
3. E.A. Keiter and R.L. Keiter 4<sup>th</sup> edn.
4. Reaction mechanisms, K.Veera Reddy.

### Unit- II & IV

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

### Unit III & IV

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, Sharma and Pattania.
4. Physical Chemistry by Atkins & De Paula, 8<sup>th</sup> Edition
5. Text Book of Physical Chemistry by K. L. Kapoor.
6. Physical Chemistry through problems by S.K. Dogra.
7. Text Book of Physical Chemistry by R.P. Verma.
8. Elements of Physical Chemistry by Lewis Glasstone.
9. Thermodynamics by Rajaram.

**BSc III Yr BIOLOGICAL CHEMISTRY  
SEMESTER WISE SYLLABUS  
(For the batch admitted in 2015-2016)**

**SEMESTER VI  
PAPER VIII**

( BCH 602 W)

(Discipline Centric Interdisciplinary)

15hrs

**UNIT I**

(11 hrs)

**S6-ID-1: Bioinorganic Chemistry**

**Essential and toxic metal ions:**

Biological significance of Na, K, Mg, Ca, Fe, Co, Ni, Cu, Zn and chloride (Cl).

Toxic metal ions As, Hg & Pb

**Oxygen transport and storage:**

Need for oxygen carriers in aerobic organisms. Structure of Hb, Mb and coordination chemistry of Fe in deoxy forms and oxy forms. Co-operativity in hemoglobin and its biological significance. Role of globin chain.

**Removal of CO<sub>2</sub> by Carbonic Anhydrase:**

Structure of active site. Mechanism of reversible hydration of CO<sub>2</sub>. Role of metal ion.

**Fixation of CO<sub>2</sub> by Photosynthesis:**

Structure of chlorophyll – Coordination of Mg. Overview of light and dark reactions. Electron transport via – Z scheme in light reactions, Calvin cycle and synthesis of sucrose (brief treatment).

**Fixation of N<sub>2</sub> fixation by Nitrogenase enzyme:**

Structure of Nitrogenase enzyme. Coordination of dinitrogen to enzyme and its activation and reduction to ammonia. Mechanistic aspects and role of metal ions. Haber's process (brief treatment).

**UNIT –II**

(11hr)

**S6-ID-2: .Bioenergetics**

Principles of thermodynamics and their applications in biochemistry- introduction, , thermodynamic state functions, first and second laws of thermodynamic system thermodynamics, concept of free energy, standard free energy.

Endergonic and exergonic reactions, ATP and other energy rich phosphates. Biological redox reactions(only introduction). Structure of mitochondria and its electron transport chain. Inhibitors of electron transport. Coupling of electron transport to ATP synthesis. Inhibitors and uncouplers of oxidative phosphorylation. P/O ratio and its significance

**UNIT - III**

**S6-ID-3: Principles and applications of Analytical techniques**

(7hrs)

Blotting Techniques-southern blot, northern blot and western blot, DNA finger printing technique, Hybridoma technology.

DNA sequencing:Maxam-Gilberts method and Sangers dideoxy nucleotide method.

**S6-ID-4: Biochemical techniques**

**(4hrs)**

Polymer chain reaction(PCR) – principle & applications, Tracer techniques- Radio isotopes, units of radio activity, half life,  $\beta$  and  $\gamma$  emitters, use of radio active isotopes in biology.

**UNIT – IV**

**S6-ID-5: Chemistry and Metabolism of Nucleic acids**

**(12hrs)**

Structural components of nuclei acids-sugars, purines, pyrimidines, nucleosides and nucleotides, Watson and crick model of DNA. UV absorption and denaturation of DNA, RNA. Types of RNA and their roles. DNA as genetic material-Expt of Griffith, Avery, Hershey and Chase. Nucleotide metabolism-biosynthesis of purines and pyrimidines, Catabolism of purines and pyrimidines, Gout.

**Books Suggested:**

1. Biochemistry by Lehninger.
2. Biochemistry by Stryer.
3. Schaum's series of Biochemistry.
4. Biochemistry by Satyanarayana.
5. Lipponac's series of Biochemistry.
6. Gene Biotechnology by Joghdan.
7. Biotechnology by B.D. Singh.
8. Biochemistry by Voet & Voet.
9. Molecular Biotechnology by Glick.
10. Industrial Microbiology by Casida.

**Laboratory Course**  
**PAPER- VII (BCH 651 W)**

**45hrs(3h/week)**

1. Qualitative analysis of urine.
2. Assay of SGOT and SGPT (Colorimetry).
3. Determination of cholesterol (Colorimetry).
4. Determination of urea (colorimetry).
5. Determination of Creatinine by Jaff's method (Colorimetry).
6. Thin layer chromatography of amino acids and carbohydrates.
7. SDS-PAGE.
8. Estimation of Amino acid by Formal Titration.
9. Test for Unsaturation of Fatty acids in Lipid Sample

**Laboratory Course**  
**PAPER –VIII (BCH 652 W)**

**45hrs (3h/week)**

1. Determination of Thiamine (Fluorescence)
2. Determination of Riboflavin (Fluorescence)
3. Determination of RNA by Orcinol method (colorimetry)
4. Determination of DNA by Diphenylamine method (colorimetry)
5. Isolation of DNA and RNA
6. Determination of Calcium by compleximetry (Titration)
7. Determination of Ion Exchange Capacity of Resin.
8. Estimation of Glucose By Benedict's Quantitative method. (Titrimetry)
9. Quantitative Test for the presence of Fatty acids by Titrimetric method.

**Project Work:**

Quantitative estimations of biological samples (vegetable/animal sources)

**NOTE:** 5 marks will be awarded to project work instead of regular practical assessment.