

# B.Sc (GENERAL) SYLLABUS DISTRIBUTION 2020-21

## **CHEMISTRY (General)**

### **Course: B.Sc (Semester I)**

**Name of the Teacher: Dr. Pradipta Kumar Basu**

#### **Organic Chemistry**

##### 1. Fundamentals of Organic Chemistry

Electronic displacements: inductive effect, resonance and hyperconjugation; cleavage of bonds: homolytic and heterolytic; structure of organic molecules on the basis of VBT; nucleophiles electrophiles; reactive intermediates: carbocations, carbanions and free radicals. **5 classes**

6. Alkenes: (up to 5 Carbons). Preparation: elimination reactions: dehydration of alcohols and dehydrohalogenation of alkyl halides; cis alkenes (partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alkaline  $\text{KMnO}_4$ ) and trans-addition (bromine) with mechanism, addition of HX [Markownikoff's (with mechanism) and anti-Markownikoff's addition], hydration, ozonolysis, oxymercuration-demercuration and hydroboration-oxidation reaction. **9 classes**

**Name of the Teacher: Dr. Debasish Kundu**

#### **Organic Chemistry**

##### 2. Stereochemistry

Different types of isomerism; geometrical and optical isomerism; concept of chirality and optical activity (up to two carbon atoms); asymmetric carbon atom; elements of symmetry (plane and centre); interconversion of Fischer and Newman representations; enantiomerism and diastereomerism, meso compounds; threo and erythro, D and L, cis and trans nomenclature; CIP Rules: R/S (upto 2 chiral carbon atoms) and E/Z nomenclature. **5 classes**

##### 3. Nucleophilic Substitution and Elimination Reactions

Nucleophilic substitutions:  $\text{SN}_1$  and  $\text{SN}_2$  reactions; eliminations:  $\text{E}_1$  and  $\text{E}_2$  reactions (elementary mechanistic aspects); Saytzeff and Hofmann eliminations; elimination vs substitution. **5 classes**

5. Alkanes: (up to 5 Carbons). Preparation: catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: mechanism for free radical substitution: halogenation. **5 classes**



*Dr. Pradipta Kumar Basu*

## Name of the Teacher: Dr. Dhruvjyoti Mondal

### **Inorganic Chemistry**

#### 1. Atomic Structure

Bohr's theory for hydrogen atom (simple mathematical treatment), atomic spectra of hydrogen and Bohr's model, Sommerfeld's model, quantum numbers and their significance, Pauli's exclusion principle, Hund's rule, electronic configuration of many-electron atoms, Aufbau principle and its limitations. 5 classes

#### 2. Chemical Periodicity

Classification of elements on the basis of electronic configuration: general characteristics of s-, p-, d- and f-block elements. Positions of hydrogen and noble gases. Atomic and ionic radii, ionization potential, electron affinity, and electronegativity; periodic and group-wise variation of above properties in respect of s- and p- block elements. 5 classes

#### 3. Acids and bases

Brönsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), applications of HSAB process. 5 classes

#### 4. Redox reactions

Balancing of equations by oxidation number and ion-electron method oxidimetry and reductimetry. 3 classes

### **Organic Chemistry**

#### 4. Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structures. 3 classes

7. Alkynes: (up to 5 Carbons). Preparation: acetylene from  $\text{CaC}_2$  and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal dihalides. 5 classes

8. Reactions: formation of metal acetylides, addition of bromine and alkaline  $\text{KMnO}_4$ , ozonolysis and oxidation with hot alkaline  $\text{KMnO}_4$ . 5 classes



## Discipline 1 (Chemistry): CC-1A (Prac)

**Name of the Teacher: Dr. Dhruvdyoti Mondal & Dr. Debasish Kundu**

### Inorganic Chemistry

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with  $\text{KMnO}_4$ .
3. Estimation of water of crystallization in Mohr's salt by titrating with  $\text{KMnO}_4$ .
4. Estimation of Fe (II) ions by titrating it with  $\text{K}_2\text{Cr}_2\text{O}_7$  using internal indicator.
5. Estimation of Cu (II) ions iodometrically using  $\text{Na}_2\text{S}_2\text{O}_3$ .

**Name of the Teacher: Dr. Pradipta Kumar Basu & Dr. Debasish Kundu**

### Organic Chemistry

Qualitative Analysis of Single Solid Organic Compound(s)

1. Detection of special elements (N, Cl, and S) in organic compounds.
2. Solubility and Classification (solvents:  $\text{H}_2\text{O}$ , dil.  $\text{HCl}$ , dil.  $\text{NaOH}$ )
3. Detection of functional groups: Aromatic- $\text{NO}_2$ , Aromatic  $-\text{NH}_2$ ,  $-\text{COOH}$ , carbonyl (no distinction of  $-\text{CHO}$  and  $>\text{C}=\text{O}$  needed),  $-\text{OH}$  (phenolic) in solid organic compounds.

Experiments 1 to 3 with unknown (at least 6) solid samples containing not more than two of the above type of functional groups should be done.



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# SEMESTER III SYLLABUS DISTRIBUTION (2020-21)

## CHEMISTRY (General)

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### Course: B.Sc (Semester III)

Name of the Teacher: Dr. Pradipta Kumar Basu

Discipline 1 (Chemistry): CC-3 (Theo)

4 Credits

Course Title: Chemical energetic, equilibria, organic chemistry

#### Organic Chemistry

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structures.

##### 1. Aromatic Hydrocarbons

Benzene: Preparation: from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions: electrophilic substitution (general mechanism); nitration (with mechanism), halogenations (chlorination and bromination), sulphonation and Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene); side chain oxidation of alkyl benzenes (up to 4 carbons on benzene).

##### 3. Aryl Halides

Preparation: (chloro-, bromo- and iodobenzene): from phenol, Sandmeyer reactions. Reactions (Chlorobenzene): nucleophilic aromatic substitution (replacement by -OH group) and effect of nitro substituent (activated nucleophilic substitution).

##### 4. Alcohols, Phenols and Ethers

c. Phenols: Preparation: cumene hydroperoxide method, from diazonium salts; acidic nature of phenols; Reactions: electrophilic substitution: nitration and halogenations; Reimer-Tiemann reaction, Houben-Hoesch condensation, Schotten-Baumann reaction, Fries rearrangement and Claisen rearrangement.

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# **Course: B.Sc (Semester III)**

**Name of the Teacher: Dr. Debasish Kundu**

## **Organic Chemistry**

### *2. Organometallic Compounds*

Introduction; Grignard reagents: Preparations (from alkyl and aryl halide); concept of umpolung; Reformatsky reaction.

### *5. Carbonyl Compounds*

Aldehydes and Ketones (aliphatic and aromatic): (Formaldehyde, acetaldehyde, acetone and benzaldehyde); Preparation: from acid chlorides, from nitriles and from Grignard reagents; general properties of aldehydes and ketones; Reactions: with HCN, ROH, NaHSO<sub>3</sub>, NH<sub>2</sub>-G derivatives and with Tollens' and Fehling's reagents; iodoform test; aldol condensation (with mechanism); Cannizzaro reaction (with mechanism), Wittig reaction, benzoin condensation; Clemmensen reduction, Wolff- Kishner reduction and Meerwein-Ponndorf- Verley (MPV) reduction.

**Discipline 1 (Chemistry): CC-1C (Theo)**

4 Credits

**Course Title: Chemical energetic, equilibria, organic chemistry**

## **Physical Chemistry**

### *4. Chemical Energetics*

a. Intensive and extensive properties; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics; Concept of heat, work, internal energy and statement of first law; enthalpy, H; relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases

b. Standard states; Heats of reaction; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; Laws of thermochemistry; bond energy, bond dissociation energy and lattice energy from thermochemical data, Kirchhoff's equations and effect of pressure on enthalpy of reactions; Adiabatic flame temperature; explosion temperature

c. Statement of the second law of thermodynamics; Concept of heat reservoirs and heat engines; Carnot cycle; Physical concept of Entropy; Carnot engine, refrigerator and efficiency; Entropy change of systems and surroundings for various processes and transformations; Auxiliary state functions (G and A) and Criteria for spontaneity and equilibrium.



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# **Course: B.Sc (Semester III)**

**Name of the Teacher: Mr. Dinesh Maity**

## **Organic Chemistry**

### *4. Alcohols, Phenols and Ethers*

- a. Alcohols: (up to 5 Carbons). Preparation: 1<sup>o</sup>-, 2<sup>o</sup>- and 3<sup>o</sup>- alcohols: using Grignard reagent, reduction of aldehydes, ketones, carboxylic acid and esters; Reactions: With sodium, HX (Lucas test), oxidation (alkaline KMnO<sub>4</sub>, acidic dichromate, concentrated HNO<sub>3</sub>); Oppenauer oxidation;
- b. Diols: Preparation (with OsO<sub>4</sub>); pinacol- pinacolone rearrangement (with mechanism) (with symmetrical diols only).
- d. Ethers: Preparation: Williamson's ether synthesis; Reaction: cleavage of ethers with HI.

## **Physical Chemistry**

### *5. Chemical Equilibrium:*

- a. Thermodynamic conditions for equilibrium, degree of advancement; Variation of free energy with degree of advancement; Equilibrium constant and standard Gibbs free energy change; Definitions of K<sub>p</sub>, K<sub>c</sub> and K<sub>x</sub> and relation among them; van't Hoff's reaction isotherm, isobar and isochore from different standard states; Shifting of equilibrium due to change in external parameters e.g. temperature and pressure; variation of equilibrium constant with addition to inert gas; Le Chatelier's principle

### *6. Ionic Equilibria:*

- a. Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water; Ionization of weak acids and bases, pH scale, common ion effect; Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts; Buffer solutions; Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.



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## Name of the Teacher: Dr. Debasish Kundu & Dinesh Maity

Discipline 1 (Chemistry): CC-1C (Prac)

2 Credits

Course Title: Chemical energetic, equilibria, organic chemistry

Physical Chemistry

*Ionic Equilibria*

1. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter and compare it with the indicator method
2. Preparation of buffer solutions and find the pH of an unknown buffer solution by colour matching method (using following buffers)
  - a. Sodium acetate-acetic acid
  - b. Ammonium chloride-ammonium hydroxide
3. Study of the solubility of benzoic acid in water

## Name of the Teacher: Dr. Pradipta Kumar Basu & Dinesh Maity

Organic Chemistry

*Identification of a pure organic compound by chemical test*

1. Solid compounds: oxalic acid, succinic acid, resorcinol, urea, glucose, benzoic acid and salicylic acid.
2. Liquid Compounds: acetone, aniline and nitrobenzene.

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