DEPARTMENT OF CHEMISTRY

Chemistry department has been introduced in the year of 2005 as a supportive department of Botany honours and only it is studied as general course till now. However honours will be introduced from the next academic year whose process is undergoing .

ACADEMIC CALENDAR

First Year General

Term -I

Paper -I

CGT-11a

Unit -I : General Chemistry :

1. Extra nuclear structure of atoms : Bohr's theory for hydrogen atom (simple mathema□cal 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 configura□on of many electron atoms, Au□au Principle and its limita□ons**.(6 classes)**

2. Radio ac□vity and nuclear structure of atoms : Natural radioac□vity; radioac□ve disintegra□on series; group displacement law; law of radio ac□ve decay; half life of radio elements; Atomic nucleus: Stability of atomic nucleus, n/P ra□o, nuclear binding energy, mass defect. Nuclear reac□ons : fission, fusion, transmuta□on of elements**.(5 classes)**

3. Chemical periodicity : Classifica□on of elements on the basis of electronic configura□on; general characteris□cs of S-, p-, d- and f- block elements. Atomic and ionic radii, ionisa□on poten□al, electron affinity and electronega□nity; Periodic and group-wise varia□on of above proper□es in respect of s- and p- block elements **(4 classes). (Jhilmil Bhattacharyya)**

Unit - II: Principles of Organic qualita□ve analysis.

Reac□ons involving the detec□on of special elements N, S and Cl in an organic compound (only Lassaigne's test)**.(2 classes)**

Reac□ons involving the detec□on of the following func□onal groups:

Aroma□c primary amino group (Diazo-coupling reac□on); Nitro group (Mulliken Barker's test); Carboxylic acid group (reac□on with $NaHCO_3$); Phenolic -OH ($FeCl_3$ test); Carbonyl (aldehyde and Ketone) group (DNP test, etc.)**(8 classes), (Jhilmil Bhattacharyya)**

CGT-11b

Unit -1: Basic Organic Chemistry I

Induc□ve effect, resonance and resonance energy Homoly□c and heteroly□c bond breaking, electrophiles and nucteophiles; carboca□ons, Carbonions and radicals (stability and reac□vity).

(4 classes)

Stereochemistry of carbon compounds : Different types of isomerism, geometrical and op□cal isomeriom, op□cal ac□vity, asymmetric carbon atom, elements of symmetry (plane and centre), Chirality, enan□omers and diastereomers, R and S nomenclature, E and Z nomenclature, D and L nomenclature, Fischer projec□on formula of simple molecules contain¬ing one and two asymmetric carbon atoms. **(4 classes)**

Alkanes, Alkenes and Alkynes : Synthesis and chemical re-ac□vity of alkanes, mechanism of free-radical halogena□on of alkanes, general methods and synthesis of alkenes, elec-trophilic addi□on reac□ons, mechanism of bromina□on and hydrohalogena□on, Markownikoffs addi□on, peroxide effect, hydrobora□on, Ozonide forma□on, Polymerisa□on reac□on of alkenes (defini□on and examples only), general methods of synthesis, acidity, hydra□on and subs□tu□on reac□ons of alkynes. **(4 classes)**

Aromatic Hydrocarbon**. (3 classes)**

Unit - II: Basic Organic Chemistry II

Aldehydes and Ketones : The nature of Carbonyl group, methods of synthesis, physical proper□es, Cannizzaro reac□on, rela□ve reac□vites and dis□nc□on of aldehydes and Ketones, Aldol condensa□on (with mechanism), Perkin reac□on, Benzoin condensa□on, claisen condensa□on, Oxida□on and reduc□on reac□ons**(6 classes)**

. Alkyl andArylhalides: SN_1, SN_2, E_1 and E_2 reac□ons (elementary mechanis□c aspects), Saytzeff and Hoffmann elimina□on reac□ons. Nucleophilic aroma□c subs□tu□on. . **(4 classes), (Jhilmil Bhattacharyya)**

Term – II

CGT-12a

Unit -1: Basic inorganic chemistry I

Ionic bonding : **(4 classes)**

General characteris□cs of covalent com-pounds, valence-bond approach, direc□onal character of covalent bond, hybridisa□on involving S-, p-, d- orbitals, mul-□ple bonding, Valence Shell Electron Pair Repulsion (VSEPR) concept, shapes of simple molecules and ions (examples from main group chemistry). Bond moment and dipole moment, par□al ionic character of covalent compounds, Fajan's rules. Hydrogen bonding and its effect on physical and chemical proper□es.(**7 classes), Ambalika chakraborty**

coordinate bonds and coordina□on compounds: complex salts and double salts, Warner's theory of coordina□on, chelate complexes, stereochemistry of co-ordina□on numbers 4 and 6. IUPAC nomenclature of coordi-na□on complexes (mono nuclear complexes only). **(4 classes) , Dr. kinjalkini Biswas**

CGT-12b

Unit -1: Basic Organic Chemistry III

Carboxylic acids and their deriva□ves : acidity of carboxylic acids and effects of subs□tuents on acidity, chemical reac□vity, mechanism of esterifica□on of carboxylic acids and hydrolysis of esters (BAC_2 and AAC_2 only) **(3 classes)**

Phenols:synthesis, acidic character and chemical reac□ons of phenols, Kolbe reac□ons, Reimer : Tiemann reac□on, Fries rearrangement, Claisen rearrangement**(2 classes)**.

Organometallic compounds : Grignard reagents - prepara□on and reac□ons, applica□on of grignard reagents in organic synthesis [1°, 2° and 3° alcohols, aldehydes, Ketones and carboxylic acids] **(2 classes)**

Organic compounds containing nitrogen: aroma□c nitro compounds - reduc□on under different condi□ons[acidic, neutral and alkaline]. Methods of synthesis of alipha□c amines, Hinsberg's method of amine separa□on, Hofmann degrada□on, Gabriel's Phthalimide synthesis, dis□nc□on of primary,

secondary and ter□ary amines; methods of synthesis of aroma□c amines, bascity of alipha□c and aroma□c amines. Diazo□sa□on and coupling reac□ons and their mechanisms, Synthe□c applica□ons of benzene diazonaium salts. [Sandmeyer's reac□on, prepara□on of nitro compounds, phenols, carboxylic acids and hydrocarbons thereby]. **(8 classes) (Jhilmil Bhattacharyya)**

Term - III

CGT-12a

Unit - II: Basic inorganic chemistry II.

Compara□ve study of p block elements :

Group trends in electronic configura□ons, modifica□on of pure elements, common oxida□on states, inert pair

effect and their important compounds in respect of the following groups of elements :

i) B - Al - Ga - In - Tl

ii) C-Si-Ge-Sn- Pb.). **(4 classes), Dr. kinjalkini Biswas**

iii) N-P-As-Sb-Bi

iv) O - S - Se - Te

v) F - Cl - Br -I**. (6 classes), Ambalika chakraborty**

CGT-12b

Unit - II: Basic Organic Chemistry IV

Carbohydrates, cons□tu□on of glucose, Osazone forma□on, reac□ons of glucose and fructose, mutarota□on, Cyclic structures - pyranose and furanose forms, epimerisa□on, chain lengthening (Killiani - Fischer method) and chain shortening (Ruffs method) in aldoses. **: (6 classes)**

Amino acids, Proteins : methods of synthesis of -amino acids (glycine and alanine using Gabriel's Phthalimide synthesis and Strecker synthesis). Physical proper□es, Zwri□erion structures, isoelectric point. **(4 classes) (Jhilmil Bhattacharyya)**

Term - IV

Revision.

Second Year General

Paper- II Theory

Term -1

CGT-21a Unit -1: Basic physical chemistry I

Gaseous state : Gas laws, Kine□c theory of gas, collision and gas pressure, deriva□on of gas laws from Kine□c theory, average kine□c energy of transla□on, Boltzmann constant and absolute scale of temperature, Maxwell's distribu□on law of molecular speeds (without deriva□on), most probable, average and root mean square speed of gas molecules, Principle of equipar□□on of energy (without deriva□on), Mean free path and collision frequencies, Heat capacity of gases (molecular basis); Viscosity of gases. **: (8 classes)**

Real gases; compressibility factror, devia□on from ideality, Van der Weal's equa□on of state, cri□cal phenomena, con□nuity of states, cri□calconstants. **: (4 classes)**

Liquid state : Physical proper□es of liquids and their measurement; surface tension and viscosity. **: (3 classes)**

Unit - II: Basic physical chemistry II.

Chemical Kine□cs and catalysis : Order and molecularity of reac□ons, rate laws and rate laws and rate equa□ons for first order and second order reac□ons (differen□als and integrated forms); Zero order reac□ons, Determina□on of order of reac□ons. Temperature dependence of reac□on rate, energy of activation. Catalytic reactions: homogeneous and heterogeneous cataly□c reac□ons, auto cataly□c reactions, catalyst poisons, catalyst promoters. **: (10 classes), (Jhilmil Bhattacharyya)**

CGT-21b

Unit -I: Principles of qualita□ve inorganic analysis. Forma□on of syblimates; principle of flame test, borax-bead test, cobalt nitrate test, fusion test, chromyl chloride test; analy□cal reac□ons for the detec□on of nitrate, nitrites, halides, phosphate, arsenate, arsenite, sulphide, thiosulphate, sulphate, thiocyanates, borate, boric acid, carbonate. Analy□cal reac□ons for the detec□on of Cr^{3+}, Fe^{3+}, Ni^{2+}, Cu^{2+}, As^{3+}, Mn^{2+}, Importance of commonion effect in the separa□on of gr II ca□ons and group III ca□ons. **(15 classes)**

Unit - II: Basic inorganic chemistry III.

Compara□ve study of S-block elements : Group trends in electronic configura□ons, modifica□on of pureelements, com¬mon Oxida□on states, inert pair effect, chemical proper□es and reac□ons in respect of the following group elements : i) Li - Na - K ii) Be - Mg - Ca - Sr – Ba Extrac□on and purifica□on of elements from natural sources: Li.Cr, Ni.Ag.Au. Electropla□ng, galvanizing and anodizing. **: (10 classes), Ambalika chakraborty**

Term - II

CGT-22a

Unit -1: Basic physical chemistry III

Thermodynamics : Defini□on of thermodynamic terms : In-tensive and extensive variables, isolated, closed and open systems. Cyclic, reversible and irreversible processes. Ther-modynamic func□ons and their differen□als. Zeroth law of thermodynamics. Concept of heat (q) and work (w). First law of thermodynamics : standard state, standard enthalpy changes of physical and chemical transforma□ons : fusion, sublima□on, vapourisa□on, solu□on, dilu□on, neutralisa□on, ionisa□on. Mess's law of constant heat summa□on. Bond dissocia□on energy, Born-Haber cycle for calcula□on of la□ce energy. Kirchoff's equa□on, rela□on between ΔH and ΔU of a reac□on. Spontaneous processes, heat engine, cornot cycle and its efficiency, second law of thermodynamics, Entropy (S) as a state func□on, molecular interpreta□on of entropy, entropy changes in simple transforma□on. Free energy: Gibb's func□on (G) and Helmholtz func□on (A). Gibb's-Helmholtz equa□on, criteria for thermodynamic equi-librium and spontaneity of a process. **(15 classes), (Jhilmil Bhattacharyya)**

CGT - 22b

Unit -1: Basic physical chemistry IV

Acids, Bases and Solvents : Modern aspects of acids and bases: Arrhenius theory, theory of solvent system, Bronsted and Lowry's concept, Lewis concept with typical examples, applica□ons and limita□ons.

Strengths of acids and bases : lonisa□on of weak acids and bases in aqueous solu□ons, applica□on of Ostwald's dilu□on law, ionisa□on constants, ionic product of water, pH-scale, buffer solu□ons and their pH values, buffer ac□ons, hydrolysis of salts. **(9 classes), (Jhilmil Bhattacharyya)**

Term - III
CGT - 22a
Unit -I: Basic physical chemistry IV Chemical equilibrium : Chemical equilibria of homogeneous and heterogeneous systems, deriva□on of expression of equi¬librium constants; temperature pressure and concentra□ondependence of equilibrium constants (Kp; Kc; Kx); Le Chatelier's principle of dynamic equilibrium. . **(5 classes),**
Colloids: Colloids and Crystalloids, Classifica□on of Colloids, prepara□on and purifica□on of colloids; ferric hydroxide sol and gold sol. Proper□es of Collbids; Brownian mo□on, pep□za□on, dialysis, Tyndal effect and its applica□ons, Protec□ng colloids, gold number, isolectric points, coagula□on of colloids by electrolytes, Schulze- Hardy rule. . **(5 classes),**

CGT - 22b
Unit -I: Solu□ons of electrolytes : Electroly□c conductance, specific conductance, equivalent conductance and molar conductance of electroly□c solu□ons. Influence of tempera-ture and dilu□on of weak electrolytes. . **(8 classes),**
Unit - II: Basic Physical Chemistry VI
Electrode poten□al : Electrode poten□als, Nernst Equa□on, reference electrodes : normal hydrogen electrode and calomel electrodes, Emf of electrochemical cells and its measurement, electrode poten□al series and its applica□ons. . **(5 classes),**

Solu□ons of non electrolytes : Colliga□ve proper□es of solu□on, Raoult's Law, rela□ve lowering of Vapour
pressure, Osmosis and Osmo□c pressure; ele**(Jhilmil Bhattacharyya)**va□on of boiling point and depression of freezing point of solvents. . **(5 classes), (Jhilmil Bhattacharyya)**

Term - IV
Revision.
Practical
Term -1
CGP - 23
Qualitative Analysis of Single Organic Compound :
Experiment A: Detection of special elements (N, Cl and S) in Organic compounds.
Experiment B: Solubility and classifica□on (solvents H_2O, dil HCI, dil NaOH)
Experiment C : Detec□on of func□onal groups - NO_2, - NH_2, - COOH, Carbonyl (- CHO, >C = 0), - OH (phenolic) in solid organic compounds. . **(25 classes),**
Term - II & III
CGP - 24
Qualitative Analysis of Inorganic Mixtures:
Experiment A: Preliminary Tests for Acid and Basic radicals in given sample.
Experiment B: Wet tests for Acid and Basic radicals in given samples.
Experiment C : Confirmatory Tests.
Acid radicals : Cl^-, Br^-, I^-, NO_2^-, S^{2-}, SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, H_3BO_3.

Basic radicals : Na^{+}, K^{+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Cr^{3+}, Mn^{2+}, Fe^{3+}, Ni^{2+}, Cu^{2+}, NH_4^{+}.. **(30 classes), Ambalika chakraborty**

Third Year General

Paper-IV Theory
Term -I
Theory:
CGT-31a

Unit -1: Chemical analysis :
Gravimetric Analysis: Solubility product and common ion effect. Requirements of gravimetry. Gravimetric es□ma□on of chloride, sulphate, lead, barium, nickel, copper and Zinc. . **(6 classes),**

Volumetric Analysis : Primary and secondary standard substances, Principles of acid-base, Oxida□on-reduc□on and complexometric □tra□ons; acid-base, redox and metal-ion indicators, Principles of es□ma□on of mixtures of $NaHCO_3$ and Na_2CO_3 (by acidimetry); iron, copper, manganese, chromium (by redox □tra□on); Zinc, aluminium, calcium, magne¬sium (by complexometric EDTA □tra□on), Chromatographic methods of analysis: column chromatography and thin layer chromatography. **(9 classes),**

Unit - II: Error analysis and computer applica□on :
Accuracy and precision of quan□ta□ve analysis, determinate, indeterminate, systema□c and random errors. Methods of least squares and standard devia□ons.
General introduc□on to computers, different components of a computer, hardware and so□ware, input and output devices, binary numbers and arithme□c Introduc□on to computer languages programming and opera□ng systems. . **(10 classes), (Jhilmil Bhattacharyya)**

CGT-31b
Unit - I: Industrial Chemistry I
Fuels : Classifica□on of fuel, hea□ng values. Origin and composi□on of petroleum, petroleum refining, cracking, knocking, octane number, an□-knock compounds, Kerosene, liquified petroleum gas (LPG), Liquified natural gas (LNG), petrochemicals (C1 to C3 compounds and their uses). **(8 classes),**

Fer□lizers : Manufacture of ammonia salts, urea, super-phosphate, biofer□lizers. **(2 classes),**

Glass and Ceramics : Defini□on and manufacture of glasses, op□cal glass and coloured glass. Clay and feldspar, glazing and vitrifica□on, glazed porceliein, enamel. Portland cement : Composi□on and se□ng of cement, white cement. **(5 classes), (Jhilmil Bhattacharyya)**

Unit - II: Industrial Chemistry II

Polymers : Basic concept, structure and types of plas□cs, polythene, polystyrene, phenol formaldehydes, PVC, manufacture, physical proper□es and uses of natural rubber, synthe□c rubber, siJicone rubber; Synthe□c fibres: Nylon-66, Polyester, Terylene, rayon; foaming agents, plas□cizers and stabilizers. .

(4 classes)

Paints, Varnishes and synthe□c dyes : Primary cons□tuents of a paint, binders and solvents for paints. Oil based paints, latex paints, baked-on. paints (alkyl resins). Cons□tuents of varnishes. Formula□on of paints and var-nishes. Synthesis of Methyl orange, congo red, Malachite green, crystal violet. .

(3 classes),

Drugs and pharmaceu□cals : Concept and necessity of drugs and pharmaceu□cals. Prepara□on and uses of Aspirin, Paracetamol, Sulphadiazine, Quinine, Chloroquine, Phenobarbitol, Metronidazole Fermenta□on chemicals: Produc□on and purifica□on of ethyl alcohol, citric acid, lac□c acid, Vitamin B12, Penicillin. .

(3 classes), (Jhilmil Bhattacharyya)

Term - II

CGT-31C

Unit - I: Environmental Chemistry

The Atmosphere : Composi□on and structure of the at-mosphere : troposphere, stratosphere, mesosphere and ther-mosphere. Ozone layer and its role. Major air pollutants : CO, SO_2, NO and par□culate ma□ers – their origins and harmful effects, problems of ozone layer deple□on, green house effect, acid rain and photochemical smog. Air pollu□on episodes. Air quality standard. Air pollu□on control measures, cyclone collector, electrosta□c presipitator, cataly□c converter. **(6 classes)**

The hydrosphere : Environmental role of water, natural water sources, water treatment for industrial, domes□c and laboratory uses. Water pollutants: ac□on of soaps and detergents, phosphates, industrial effluents, agricultural run off, domes□c wastes; thermal pollu□on, radioac□ve pollu□on and their effects on animal and plant life, water pollu□on episodes. Water pollu□on control measures : Waste water treatment : Chemical treatment and microbial treatment; water quality standards : DO, BOD, COD, TDS and hardness parameters, Desalina□on of sea water: reverse osmosis, elec-trodialysis. **(6 classes)**

The lithosphere : Water and air in soil, waste ma□ers and pollutants in soil, waste classifica□on, treatment and dis posal. Soil pollu□on and control measures. **(3 classes)**

Unit - II: Industrial CHemistry III

Fats-Oils-Detergents : Fats and oils, natural fat, edible and inedible oil of vegetable origin. Common fa□y acids, glycer-ides. Hydrogena□on of unsaturated oil, produc□on of vanaspa□ and margarine. Produc□on of toilet and washing soaps, En¬zyme-based detergents, detergent powder, liquid soaps. **(5 classes)**

Pes□cides : Common pes□cides : Produc□on, applica□ons and residual toxicity of gammaxene, aldrins, parathion, malathion, DDT, Paraquat, decamethrin. **(2 classes)**

Food addi□ves: Food flavour, food colour, food preserva□ves, ar□ficial sweeteners, acidulants, alkalies, edible emulsifiers and edible foaming agents, sequesterants - uses and abuses of these substances in food beverages. **(3 classes), Ambalika chakraborty**

Term - III

Revision.

Practical

Term -I, Term - II and Term - III

Experiments :

1. Titration of Na_2CO_3 and $NaHCO_3$ mixture vs HCI using phenolphthalein and methylorange indicators.
2. Titration of HCI + CH_3COOH mixture vs NaOH using two different indicators to find the composi□on.
3. To find the total hardness of water by EDTA titration.
4. To find the pH of an unknown solution by comparing colour of series of HCI solutions + 1 drop of methyl orange and a similar series of NaOH solutions + 1 drop of phenolph-thalein.
5. To determine the rate constant for the acid catalysed hydrolysis of an ester.
6. Determination of the strength of the H_2O_2 sample.
7. To determine the solubility of a sparingly soluble salt, e.g. KHTa (one bottle). **(25 classes),**

Ambalika chakraborty