

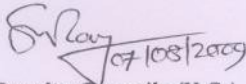
University of Kalyani

Revised Syllabus for B.Sc. (General) Course in

CHEMISTRY

(w.e.f. the session 2009-2010)

**According to the New Examination Pattern
Part – I, Part – II & Part – III**

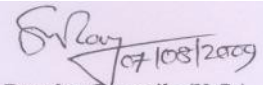

Secretary, Faculty Councils (U.G.)
University of Kalyani
Kalyani, Nadia

University of Kalyani

Revised Syllabus for Chemistry General Course (w.e.f. the session 2009-2010)

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07/08/2009
Secretary, Faculty Councils (U.G.)
University of Kalyani
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UNIVERSITY OF KALYANI

SYLLABUS OF CHEMISTRY

**For
THREE YEARS B.Sc. DEGREE COURSE (GENERAL)**

(1 + 1 + 1) SYSTEM

Structure : Total marks 400

Part – I

Paper – I (Theory) - 100 marks

Group A : General Chemistry (50 marks)

Group B : Organic Chemistry (25 marks)

Group C : Physical Chemistry (25 marks)

Part – II

Paper – II(Theory) - 100 marks

Group A : Inorganic Chemistry (50 marks)

Group B : Organic Chemistry (25 marks)

Group C : Physical Chemistry (25 marks)

Paper – III (Practical) - 100 marks

Group A : Inorganic Chemistry (50 marks)

Group B : Organic Chemistry (50 marks)

Part – III

Paper – IV

Theory – 60 marks

Group A : Principles of biological chemistry

Group B : Application oriented chemistry

Group C : Catalysis and Phase rule

Practical -- 40 marks

Physical Chemistry

PART - I**Paper – I****Time – 3 Hours****Full Marks : 100**

Group A : Atomic structure, periodic properties, nature of chemical bond, principles of chemical analysis (50 marks) 50 L

1. **Atomic structure :** 10 L
Bohr's atomic model and its limitations. Idea of de Broglie matter waves, Heisenberg's uncertainty principle, Schrodinger wave equation, significance of wave function, quantum numbers, shape of atomic orbitals.
Multi electron system : Pauli's exclusion principle, Hund's rule of maximum spin multiplicity, stability of half filled and fully filled orbitals, aufbau principle and its limitations, electronic configurations of atoms.
2. **Periodic properties :** 5 L
Atomic and ionic radii, covalent radii, different electro -negativity scales, ionization energy and their periodic trends.
3. **The nature of chemical bond :** 20 L
Ionic bonding : Size effects, radius ratio rules and their limitations, packing of ions in crystals, hcp and ccp arrangements, lattice energy, Born-Haber cycle and its applications, polarizing power, polarizability, Fajan's rule.
Covalent bonding : Directional characteristics of covalent bond, hybridization and shapes of simple inorganic molecules and ions, valence shell electron pair repulsion (VSEPR) Theory. Molecular orbitals of diatomic molecules : LCAO approximation, bonding, antibonding and nonbonding orbitals, MO configurations of simple homonuclear and heteronuclear diatomic molecules, bond properties, bond order and bond strength, resonance and resonance energy, polarity of covalent bonds.
Bonding in metals : qualitative idea of free electron and band theories, conductors, insulators and semiconductors. Hybridisation of C,N,O, formation of σ and π bonds, bond distance, bond angle, bond energy, bond polarity, bond polarisability, steric effect, inductive and field effects, resonance, dipole moment, orbital pictures of ethylene and acetylene.
Hydrogen bond, dipolar interaction, vander Waals force, physical properties (m.p., b. p., solubility) related to structure.
4. **Principles of chemical analyses :** 15 L
 - i) Qualitative inorganic analyses : Principles and reactions involved in the group separation and identification of cations and anions in the qualitative inorganic analysis.
 - ii) Volumetric analysis: Primary and secondary standard substances/(solutions), principle of acid-base, oxidation reduction and complexometric titrations, determination of hardness of water; accuracy and precision in quantitative analysis, errors, standard deviation.
 - iii) Theory of acids and bases, strength of acids and bases, P_H , hydrolysis of salts, buffer, calculation of P_H , solubility and solubility product, common ion effect.

Group – B (Organic): Aliphatic hydrocarbons and their derivatives, alcohols and ethers, aldehyde and ketones, organic compounds containing nitrogen, carbohydrates (25 marks) 25 L

5. **Aliphatic hydrocarbons and their derivatives** 7 L
 Isomerism, synthesis, chemical reactivity of alkanes, mechanism of free radical halogenation of alkanes, sulphonation of alkanes, general method of synthesis of alkenes, chemical reactivity, hydrogenation, electrophilic addition reactions and their mechanism, halogenation, hydrohalogenation, hydration, Markownikoff's rule, peroxide effect, epoxidation, hydroxylation, ozonolysis, polymerization (only information – no details of reaction mechanism are required). Introduction to general methods of alkyne synthesis, acidity of alkynes, hydration, substitution reaction, polymerization; synthesis and reactivity of alkadiene and alkyl halides.
6. **Alcohols and ethers :** 3L
 Methods of synthesis, physical properties, distinction of primary, secondary and tertiary alcohols, chemical reactivity, ethers - methods of synthesis, Williamson's ether synthesis, chemical reactivity.
7. **Aldehydes and Ketones :** 5 L
 Methods of synthesis of aldehydes and ketones, chemical reactivity of carbonyl group, Cannizzaro reaction and aldol condensation, relative reactivities of aldehydes and ketones, Perkin reaction, Knoevenagel reaction, benzoin condensation, Claisen condensation.
8. **Organic compounds containing nitrogen :** 6 L
 Aromatic nitro compounds – their synthesis, reduction under different conditions; methods of syntheses of aliphatic amines, Hinsberg's method of separation, Hofmann degradation, Gabriel's phthalimide synthesis, distinction between primary, secondary and tertiary amines; methods of synthesis of aromatic amines, comparison of basicity of aliphatic and aromatic amines; diazotisation and its mechanism, synthetic applications of aromatic diazonium salts.
9. **Carbohydrates :** 4 L
 Introduction, occurrence, classification, constitution of glucose, osazone formation, reactions of glucose and fructose, mutarotation, cyclic structure -pyranose and furanose forms, epimerisation, chain lengthening and chain shortening in aldoses.

Group – C (Physical) : Kinetic theory of gases, real gases, first and second law of thermodynamics, principles of thermochemistry, dilute solution (25 marks)

25 L

10. **Kinetic theory of gases :** 4 L

Distribution of molecular velocities, root mean square speed, elementary kinetic molecular theory of ideal gases, deduction of kinetic gas equation – $p = \frac{1}{3}mn\bar{c}^2$, deduction of gas laws.

11. **Real gases :** 4 L

Deviation from ideal behavior, vander Waals equation, Andrew's experiments, critical phenomena in the light of Van der Waals equation of state, continuity of state.

12. **First and second laws of thermodynamics :** 7 L
Cyclic process, reversible and irreversible process, internal energy, enthalpy, work done in isothermal and adiabatic process, heat capacity, $C_p - C_v = R$ for an ideal gas.
Carnot cycle, elementary treatment of entropy, free energy, work function and criterion of equilibrium, Gibbs - Helmholtz equation, Clausius - Clapeyron equation and its applications.
13. **Principles of thermo chemistry :** 4 L
Exothermic and endothermic reactions, Hess Law, heat of formation, heat of combustion, heat of neutralization, bond energy, bomb calorimeter, thermo chemical calculations.
14. **Dilute solution :** 6L
Raoult's law, ideal solution, non ideal solutions, qualitative treatment of colligative properties : relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure - its application in finding molecular weights, vant Hoff factor, plasmolysis, haemolysis, isotonic solution, normal saline, role of osmosis in living organism.

PART - II

Paper- II

Full Marks : 100

Group A (Inorganic) : Coordination compounds, chemistry of elements, radiochemistry(50 marks) 50L

1. **Coordination compounds :** 14 L
Double and complex salts, Werner's theory of coordination compounds, chelates, polydentate ligands including naturally occurring ones, electronic interpretation of complex formation, stepwise and overall stability constants (elementary ideas), geometrical, linkage and optical isomerism, nomenclature of coordination compounds (mononuclear only)
2. **Chemistry of elements :** 28 L
a) Trends in electronic configuration, oxidation states, properties of i) alkali metals, ii) alkaline earth metals, iii) coinage metals.
b) Extraction, purification, uses and principal compounds of Cr, Ni, Ag, Au
c) Preparation, properties and uses of the following :
i) diborane, borohydrides, boron nitride
ii) silicones, silicates, freons, fluorocarbons
iii) hydrazine, hydroxylamine
iv) peracids and persalts of sulphur
v) interhalogens, pseudo halogens, basic properties of iodine
vi) compounds of xenon (details of bonding excluded)
3. **Radiochemistry :** 8 L
Uses of radio-isotopes in i) agriculture, ii) medicine and iii) chemical analysis; radiocarbon dating, fission and fusion reactions - nuclear energy, hazards of radioactivity.

Group – B (Organic) : Stereo chemistry of organic compounds, mechanism of organic reactions, benzene and its derivatives, phenols (25 marks)

25 L

4. Stereo chemistry of organic compounds : 9 L

Different types of isomerism, geometrical and optical isomerism, optical activity, asymmetric carbon atom, elements of symmetry and chirality, enantiomers and diastereoisomers, E & Z system of nomenclature, D and L nomenclature, R and S system, inversion and racemisation, Fischer, Newman and Sawhorse projection formulae of simple molecules containing one and two (similar and dissimilar) asymmetric carbon atom. Stereochemistry of cyclohexane derivatives (simple idea upto disubstituted).

5. Mechanism of organic reactions : 8 L
 SN₁ and SN₂ reactions; E₁ and E₂ reactions; aromatic electrophilic and nucleophilic substitution.

6. Benzene and its derivatives : 4 L
 Isomerism of aromatic compounds, their nomenclature, structure of benzene, stability of benzene ring, Huckel's rule of aromaticity and its simple demonstration; aryl halides.

7. Phenols : 4 L

Synthesis, physical properties, acidic character of phenols, chemical reactions - Reimer - Tiemann reactions, Fries rearrangement, Kolbe reaction, Claisen rearrangement, cresols, nitro and amino phenols, polyhydroxy phenols.

Group – C (Physical) : Viscosity, surface tension, electrolytic conductance, emf, ionic equilibria, chemical kinetics (25 marks) 25 L

8. Viscosity : 3 L
 Definition, determination by Ostwald viscometer, variation with temperature for liquids and gases.

9. Surface tension : 2 L
 Definition, determination by stalagmometer, variation with concentration and temperature.

10. Electrolytic conductance : 6 L
 Specific, equivalent and molar conductance's, their variation with concentration in case of strong and weak electrolytes, measurement of conductance, Kohlrausch law of independent migration of ions, ionic mobility and conductance, transference number, conductometric titrations.

11. EMF : 4 L
 Electrochemical cells, half cell, electrode potential, standard electrode potential, Nernst equation, redox potential, reference electrode, standard cell, measurement of emf. determination of pH, potentiometric titration, storage battery, corrosion.

12. **Ionic equilibria :** 5 L
Strong and weak electrolytes, degree of dissociation, Ostwald dilution law, ionization of water, acid-base indicator, choice of indicator, colorimetric determination of pH, elementary idea of activity and activity coefficient of electrolytes, ionic strength, buffer action of blood.
13. **Chemical kinetics :** 5 L
Rate, order and molecularity of reaction, rate constants of first and second order reaction, half-life period, influence of temperature on reaction rate, activation energy, determination of order of reaction.

Paper - III : Practical

F.M. – 100
Time : 6 Hours X 2 days

Group – A (Inorganic)

F.M. – 50
Time : 6 Hours

1. **Qualitative analysis :** 25 marks
Systematic semi micro qualitative analysis of simple mixture containing not more than two basic radicals and one acid radical from the following list (spot tests are to be applied wherever possible) :
Lead, bismuth, copper, cadmium, antimony, tin, iron, aluminum, chromium, zinc, manganese, cobalt, nickel, calcium, strontium, barium, magnesium, potassium, ammonium and their oxides, chlorides, bromides, iodides, sulphides, sulphates, nitrates, borates, and phosphates, (acid insoluble compounds and phosphate separation omitted), boric acid .
2. **Quantitative analysis :** 15 marks
i) Determination of iron (II) by KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ solution iii)
Determination of copper(II) using sodium thiosulphate solution (iodometry)
3. **Laboratory note book** 5 marks
4. **Viva-voce** 5 marks

Group – B (Organic)

F.M. – 50
Time : 6 Hours

1. **Qualitative analysis :** 25 marks
detection of elements (nitrogen, chlorine, bromine, iodine (mixture of halide excluded), unsaturation and all the functional groups (phenolic hydroxyl, aldehyde, ketonic carbonyl, carboxylic acid, aromatic amino, nitro, amide)
present in a supplied mono or bifunctional solid organic compound.

2. **Quantitative analysis :** 15 marks
- i) Estimation of vitamin C in multivitamin tablets (containing sufficient amount of vitamin C)/ citrus fruits (by 2,6 – dichlorophenol / indophenols indicator)
- ii) Estimation of aniline
3. **Laboratory note book** 5 marks
4. **Viva-voce** 5 marks

PART – III

Paper – IV :

Theory **60 marks**
60 L

Group A : Principles of biological chemistry

1. **Amino acids and proteins :** 5 L
Methods of synthesis of α -amino acids, physical properties, zwitter ionic structure, isoelectric point, peptide synthesis (elementary ideas), familiarity with different types of structure of proteins.
2. **Nucleosides and nucleotides :** 5 L
Different nucleo bases : adenine, guanine, cytosine and thymine; structure and function of nucleosides and nucleotides, DNA and RNA (preliminary idea)
3. **Bio- inorganic chemistry** 10 L
Role of the metal ions (major trace and ultra t race) in biological system, metal ion transport across biological membrane Na^+ / K^+ pump, coordination chemistry of chlorophyll and hemoglobin and their function in living system.
Toxic metal ions and their effects, chelation the rapy, (examples only), platinum and gold complexes as drugs (examples only), metal dependent diseases. Organo mercury and lead compounds and their effects arsenic poisoning - detection and remedies
4. **Surface chemistry** 5L
Adsorption, adsorption isotherm, Freundlich and Langmuir isotherm, electro kinetic phenomena, electrical double layers, zeta potential, electrophoresis.
5. **Colloids and Macromolecules :** 5L
Types of colloids, isoelectric point , coagulation, peptization, emulsions and gels, thixotropy, micelle, cmc, average molecular mass .

Group B : Application oriented chemistry :

1. **Industrially important compounds :** 20 L
- i) Preparation and uses of aspirin, paracetamol, phenobarbital,
- ii) Fats and oils : natural fat, edible and inedible oil of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oil; detergents, product ion of toilet and washing soaps, detergent powder, liquid soap.

- iii) Pesticides : DDT, gamaxene, aldrin, methion, decamithrin.
- iv) Cosmetics and perfumes : hair spray, hair dyes, creams, lipsticks, talcum powder, face powder , tooth powder, tooth paste, shampoos, β -phenyl ethyl alcohol, jasmine, cevetone, geraniol.
- v) Food additives : food-flavor , food-colour, food preservatives and arti ficial sweeteners – uses and abuses of these substances in food and beverages.
- vi) Polymers : nylon 66, polyester, synthetic rubber.

- Group C:**
- i) **Catalysis** : criterion of catalysis, mechanism of catalytic action, enzyme catalysis , industrial catalysts. 5 L
 - ii) **Phase rule** : Phase rule (deduction excluded), phase diagram of H_2O , S, Nernst distribution law, steam distillation. 5L

Practical (Physical Chemistry)

40 marks

Time : 6 hours

1. Experiment

30 marks

- A: Viscosity – To determine the percentage composition of a given mixture from viscosity measurement.
- B: Surface tension – To determine the percentage composition of a given mixture by surface tension measurement.
- C: Refractivity –
 - i) To determine the percentage composition of a given mixture (e.g. glycerol+water) using Abbe's refractometer.
 - ii) To verify laws of refraction of mixtures such as glycerol and water using Abbe refractometer.
- D: Polarimetry –
 - i) To determine specific rotation of a given optically active compound.
 - ii) To determine the percentage composition of a substance in its aqueous solutions using polarimeter
- E: Solubility – To determine the solubility of a sparingly soluble compound (e.g. benzoic acid, salicylic acid, etc.) in water at room temperature.
- F: Distribution law – to study the distribution of acetic acid between CCl_4 / $CHCl_3$ and water.
- G: Chemical kinetics- to determine the specific reaction rate of the acid catalysed hydrolysis of methyl acetate/ ethyl acetate at room temperature.
- H: Colorimetry –to determine the pH of a given solution colorimetrically using bromocresol green/methyl red indicator.

2. Laboratory note book

5 marks

3. Viva-voce

5 marks

