St. Xavier's College – Autonomous Mumbai

Syllabus for 3rd Semester Course in Chemistry (June 2015 onwards)

Contents: Theory Syllabus for Courses:

S.CHE.3.01 - PHYSICAL AND ANALYTICAL CHEMISTRY I

S.CHE.3.02 - INORGANIC AND INDUSTRIAL CHEMISTRY I

S.CHE.3.03 - ORGANIC AND INDUSTRIAL CHEMISTRY I

PRACTICAL COURSE SYLLABUS FOR S.CHE.3.PR

SYLLABUS UNDER AUTONOMY
CHEMISTRY

SEMESTER III **COURSE: S.CHE.3.01**
PHYSICAL AND ANALYTICAL CHEMISTRY I **[45 LECTURES]**

LEARNING OBJECTIVES

1. To understand some more concepts of thermodynamics from a chemist's viewpoint.
2. To predict the feasibility of a reaction.
3. To understand concepts involved in electrolytic cells and their applications.
4. To motivate students to solve numerical problems with different systems of units which illustrate the applicability of these concepts in chemistry.
5. To provide an introduction to analytical chemistry and information about latest developments in analytical techniques widely used in quality control and R&D of different types of chemical industries.

Unit I **(15 L)**

1.1: Chemical Thermodynamics
1.1.1: Recapitulation: Gibbs' free energy and Helmholtz free energy, Gibbs–Helmholtz equation (Derivation is not expected).
1.1.2: Physical equilibrium involving pure substances, Clapeyron's equation and variation of vapour pressure with temperature, Clausius- Clapeyron equation and its application. partial molal properties with special reference to volume and free energy, introduction to chemical potential and its significance, Gibbs - Duhem equation.
1.1.3: Variation of chemical potential with pressure and temperature, fugacity, activity and their relationship with chemical potential, activity and activity coefficient.
1.1.4: Techniques to achieve low temperature: (i) Joule-Thomson effect, concept of inversion temperature (Derivation is not expected), derivation of Joule -Thomson coefficient (ii) Adiabatic demagnetization technique.
1.1.5: Thermodynamic derivation of Law of Mass Action, K_p, K_c and their inter-relation, van't Hoff's reaction isotherm and reaction isochore.

1.2: Self study
Numerical problems based on first and second law of thermodynamics, Gibbs' free energy and Helmholtz free energy, Gibbs - Helmholtz equation.

Unit II **(15 L)**

2.1: Solutions of Electrolytes
2.1.1: Introduction of the terms involved: electronic and electrolytic conductors, conductivity, resistivity, specific resistivity, measurement of conductivity of solutions, conductometer, conductivity cell, cell constant, specific conductivity, molar conductivity and equivalent conductivity with their units in SI and C.G.S. systems.

2.1.2: Variation of molar conductivity with change in concentration of solution for strong and weak electrolytes. Arrhenius theory and Ostwald's dilution law for weak electrolytes.
Debye -Huckel theory for strong electrolytes (asymmetric and electrophoretic effect), concept of limiting molar conductivity.
2.1.3: Kohlrausch's law of independent migration of ions.
2.1.4: Applications of Kohlrausch's law: (i) Determination of limiting molar conductivity of weak electrolytes (ii) Determination of dissociation constant of a weak acid (iii) Determination of solubility of sparingly soluble salts.
2.1.5: Migration of ions, transport number, determination of transport number by i) Hittorf's method using unattackable electrodes (only qualitative explanation) ii) Moving boundary method. Use of coulometer, factors affecting the transport number of ions, relation between transport number and ionic conductivity of an ion.
2.1.6: Relationship between ionic mobility and ionic conductivity of an ion (Derivation is not expected).

2.2: Self study
Numerical problems based on all the above concepts.

Unit III Basic concepts of Analytical Chemistry (15 L)

3.1: Introduction to Analytical Chemistry (9L)
3.1.1: Scope and importance of analytical chemistry, analytical chemistry and chemical analysis, classification of analytical methods, classical and instrumental techniques, destructive and non-destructive testing, qualitative and quantitative analysis – an overview (introductory concepts only).
3.1.2: Steps involved in chemical analysis: selection of a method for analysis, obtaining a sample: sampling, importance of sampling, terms involved in sampling, sampling techniques, purpose of sampling, types of sample and sampling, pre-treatment, measurement, calculation, evaluation and presentation of results.

3.2: Use of Instrumental methods in Titrimetric analysis (6L)

3.2.1: Conductometric titrations
Basic principles, experimental set up, titration curves in the titration of :
(i) strong acid vs. strong base (ii) weak acid vs. strong base (iii) weak acid vs. weak base (iv) mixture of strong and weak acids vs. strong base (v) sodium chloride vs. silver nitrate (vi) barium hydroxide vs. magnesium sulphate. Advantages and limitations.

3.2.2: Potentiometric titration
Principle, concept of indicator electrode and different types of graphical methods to determine the equivalence point.

3.3: Self-study
Application of analytical methods in various fields such as chemical and pharmaceutical industries, environmental analysis and monitoring.

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3. Physical Chemistry : G.K. Vemulapalli (1997) Prentice Hall of India Pvt. Ltd., New Delhi.
4. Physical Chemistry: G.W. Castellan, 3rd Ed., Narosa Publishing House, New Delhi.
5. Text Book of Physical Chemistry, S. Glasstone, Affiliated East-West Press Pvt. Ltd., New Delhi.
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8. Physical Chemistry: Ira N. Levine (1995), 4th Ed., McGraw Hill, Inc.
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12. Introduction to Principles of Heterogeneous Catalysis: Thomas J.M. and Thomas W.J.
13. An Introduction to Electrochemistry – Samuel Glasstone, Affiliated East-West Press.
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16. Instrumental Methods of Chemical Analysis: Chatwal and Anand, 5th Ed., Himalaya Publication.
17. 2000 Solved Problems in Physical Chemistry : S.R.Metz, Tata McGrow Hill Publishers, New Delhi.
18. A Textbook of Physical Chemistry, K.L. Kapoor, MacMillan India Ltd.
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CIA I: Short answer questions **20 MARKS**

CIA II: Assignment+ **20 MARKS**

St. Xavier's College, Mumbai

Dept. of -----------------

ASSESSMENT OF WRITTEN ASSIGNMENT

NAME OF STUDENT :
TITLE OF ASSIGNMENT :
DATE:

Assessment Grid : Place one tick in each appropriate row. Overall mark should reflect the positions of ticks in the individual rows

100	ASSIGNMENT	80-100% (17 -20Marks)	60-80% (13- 16 Marks)	40- 60% (9-12 Marks)	20-40% (5-8 Marks)	0-20% (0-4 Marks)
30 %	ORGANISATION	Effective Presentation, Logical Format, Clear Statement of Ideas, Relevant Details, sequence of information and ideas could be easily followed	Few Problems	Many problems	Inadequate presentation, Ineffective format, Ineffective Communication of Ideas, Lack Relevant Details – But an attempt	No Attempt to organise
60%	CONTENT	Excellent - Impression of wide reading (research), good knowledge and comprehensive understanding. Evidence of thoughtful input. Ability to critique, Bibliography mentioned.	Good	Satisfactory	Poor	Very Poor
5 %	VOCABULARY	Richness of Vocabulary	Very good range of vocabulary with some errors	Good range of vocabulary with some errors	Small range of vocabulary with errors	Little or no effort has been made to demonstrate vocabulary knowledge
5%	GRAMMAR, SPELLINGS, MECHANICS	Grammar, Spellings, Punctuations Correct.	Very Few Errors	Some Errors	Many Errors	No effort

TOTAL MARKS FOR WRITTEN ASSIGNMENT: _______________ OUT OF 20
COMMENTS:

NAME OF FACULTY MEMBER:_________________________________
SIGNATURE: ________________________________

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Template of Question Paper

PHYSICAL AND ANALYTICAL CHEMISTRY I COURSE: S.CHE.3.01

OBJECTIVES

UNIT	KNOWLEDGE	UNDERSTANDING	APPLICATION	TOTAL MARKS
I	5 - 7	6 - 8	7 - 9	20
II	5 - 7	6 - 8	7 - 9	20
III	6 - 8	6 - 8	6 - 8	20
TOTAL MARKS PER OBJECTIVE	16 - 22	18 - 24	20 - 26	60
% WEIGHTAGE	27 – 37	30 – 40	37 – 43	100

END SEMESTER PAPER PATTERN:

Total marks: 60 **Maximum Time: 2 hours**
Total number of questions: 3 [all compulsory] of 20 marks each
1 question per unit.
Questions set out of 30 marks [50 % internal choice]
Sub questions will not exceed 5 marks.

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SEMESTER III **COURSE: S.CHE.3.02**

INORGANIC AND INDUSTRIAL CHEMISTRY I **[45 LECTURES]**

LEARNING OBJECTIVES

1. To introduce students to the basic concepts involved in chemical bonding.
2. To help students to determine the shape of a molecule by applying VSEPR theory.
3. To encourage students to analyze and integrate concepts relevant to inorganic chemistry required to understand compound formations with special reference to Valence Bond Theory and Molecular Orbital theory.
4. To enable students to understand the theories of Acids and Bases.
5. To expose students to principles of Gravimetric Analysis.

UNIT I: Chemical Bonding **(15 L)**

1.1: Basics Of Chemical Bonding

1.1.1: Types of bonds: Ionic bond, covalent bond, single and multiple bonding, coordinate bond, sigma and pi-bonds, metallic bonds.

1.1.2: **Ionic bond:** Formation of ionic solids, lattice energy, solvation energy, Born-Haber cycle, Kapustinskii's equation (numerical problems expected).

1.1.3: Structures of some simple ionic solids like alkyl halides and stability of ionic structures based on radius ratio rules.

1.1.4: **Covalent bond:** Writing Lewis structures, formal charge and Lewis structures, concept of resonance and resonance energy, exceptions to the octet rule, bond enthalpy.

1.1.5: Sidgwick -Powell Theory.

1.1.6: **VSEPR concept:** Effect of lone pairs, effect of electronegativity, isoelectronic principle, shapes of chemical species on the basis of VSEPR theory.

1.1.7: **Metallic bond:** Theories of bonding in metals and free electron theory. MO or band theory, conductors, insulators and semiconductors.

UNIT II: Theories Of Chemical Bonding **(15L)**

2.1: Valence Bond Theory **(8L)**

2.1.1: Hybridisation: sp^3, sp^2, sp hybridization of carbon and nitrogen, sp^3 and sp^2 hybridization of oxygen in organic compounds; theory of hybridization with respect to equivalence of contributing atomic orbitals in the following examples: CH_4, NH_3 and H_2O.

2.1.2: Energetics of hybridization, types of hybridization and extent of d-orbital participation in molecular bonding. sp, sp^2, sp^3, sp^3d, sp^3d^2 , sp^3d^3 and sd with illustrations like $BeCl_2$, BF_3, $SiCl_4$, PCl_5, SF_6, IF_7, ClF_3, ICl_2^-, BrF_5, SO_2, SO_3 and $BaCl_2$.

2.1.3: Merits and Demerits of Valence Bond Theory.

2.2: Molecular Orbital Theory [M.O.T.] (7L)

2.2.1: Conditions for the formation of Molecular Orbitals.

2.2.2: Linear Combination of Atomic Orbitals to obtain Molecular Orbitals [LCAO-MO] Approach.

2.2.3: Application of the LCAO-MO to the formation of:

i) Homo- and Hetero-nuclear diatomic molecules and ions e.g. H_2, N_2, O_2, F_2, He_2, Li_2, Be_2, C_2, Ne_2, CO, NO, HCl, HF and CN^- .

ii) Occurrence of the Molecular ions O_2^+, O_2^{1-}, O_2^{2-} .

Discussion should include orbital interaction, stabilization of orbitals, bond order and correlation with stability, bond length, bond energy and magnetic properties.

UNIT III (15 L)

3.1: Theories of Acids and Bases (10L)

3.1.1: Recapitulation of Arrhenius theory.

3.1. 2: Lowry-Bronsted concept: Bronsted acids and bases, acid-base properties of water, pH, strength of acids and bases, weak acids and acid ionization constants, weak bases and base ionization constants, relationship between ionization constants of acids and their conjugate bases, diprotic and polyprotic acids.

Solvent levelling, solvent-system definition of acids and bases.

Lux-Flood, Lewis & Usanovich concept.

3.1.3: Lewis acid concept: Examples of Lewis acids and bases, characteristics of Lewis acids.

Pearsons concept of Hard and Soft Acids and Bases (HSAB), applications of HSAB.

3.1.4: Applications of acid-base chemistry: Superacids and superbases, heterogeneous acid-base reactions.

3.2: Gravimetric Analysis (5 L)

3.2.1: Definition and Types of Gravimetric Analysis.

3.2.2: Precipitation Gravimetry with respect to theory and practice.

(i) Solubility considerations: Common ion effect, diverse ion effect, pH and temperature.

(ii) Controlling particle size with respect to nucleation and rate of crystal growth.

3.2.3: Treatment of precipitates in Gravimetry: Digestion, Filtration and Washing, Drying and Ignition.

3.2.4: Use of Organic Reagents in Gravimetric analysis e.g. Dimethyglyoxime, Salicylaldoxime, Cupron, Oxine and Cupferron.

REFERENCES:

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3. Chemistry, James E. Brady, Neil D. Jespersen and Alison Hyslop, 6th edition.
4. Chemistry, McMurry Fay, Prentice Hall.
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CIA I: Short answer questions / MCQ **20 MARKS**

CIA II: Problem solving / Presentations **20 MARKS**

Template of Question Paper

INORGANIC AND INDUSTRIAL CHEMISTRY I **COURSE : S.CHE.3.02**

OBJECTIVES

UNIT	KNOWLEDGE	UNDERSTANDING	APPLICATION	TOTAL MARKS
I	6-8	6-8	6-8	20
II	6-8	6-8	6-8	20
III	6-8	6-8	6-8	20
TOTAL MARKS PER OBJECTIVE	18-24	18-24	18-24	60
% WEIGHTAGE	30 – 40	30 – 40	30 – 40	100

END SEMESTER PAPER PATTERN :

Total Marks: 60 **Maximum Time: 2 hours**

Total number of questions: 3 [all compulsory] of 20 marks each.
1 question per unit.
Questions set out of 30 marks [50% internal choice].
Sub questions will not exceed 5 marks.

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SEMESTER III **COURSE: S.CHE.3.03**

ORGANIC AND INDUSTRIAL CHEMISTRY I **[45 LECTURES]**

Learning Objectives:
1. To understand the mechanism of reactions involving the reactive intermediates.
2. To introduce the concepts of aromatic, non aromatic and anti aromatic compounds.
3. To study the mechanism of aromatic electrophilic substitution and the effect of substituents on the orientation of an incoming electrophile.
4. To familiarize the students with preparation, reactions and applications of aromatic hydrocarbons, haloarenes, phenols, ethers and epoxides and understand mechanisms of certain reactions.
5. To introduce the aspects of a chemical plant and study the sources and classification of fuels.

UNIT I **(15 L)**

1.1: Mechanism of Organic reactions **(6L)**

The mechanism of reactions involving the following reactive intermediates:

1.1.1: Carbocations: Different types of carbocations such as alkyl, allyl, benzyl. S_N1 reaction. Electrophilic addition across an olefinic double bond. Rearrangements : Wagner-Meerwein rearrangement, Pinacole-Pinacolone rearrangement.

1.1.2: Carbanions: Concept of carbon acid. Alkylation of carbon acids (active methylene compounds and terminal alkynes) using alkyl halides and synthetic applications of these reactions. Reactions of Grignard reagents at sp^3carbon and carbonyl group. Aldol condensation with mechanism.

1.1.3: Carbon radicals: General reactions of radicals – abstraction, addition to C=C, combination, disproportionation. Addition of HBr to alkenes in presence of peroxide. Polymerization.

1.1.4: Carbenes: Generation of carbenes through alpha elimination, from diazoalkanes, from ketenes. Structure and stability of carbenes. Reactions: insertion into C-H bond and addition to olefin.

1.2 : **Tautomerism:** **(1L)**

Keto-enol tautomerism in aldehydes and ketones, acid and base catalysed enolisation, enol content and stabilized enols: β –ketoesters, β-diketones, phenols.

1.3: **Aromatic Electrophilic Substitution Reaction:** **(8L)**

1.3.1: Electronic structure and Huckel's Rule of aromaticity and its applications to carbocyclic and heterocyclic compounds, benzenoid and non-benzenoid compounds and ions including nomenclature of aromatic systems. Concept of anti-aromaticity, non- aromaticity.

1.3.2: General mechanism of aromatic electrophilic substitution reaction with energy profile diagram.

1.3.3: Drawing resonance structures of mono-substituted benzenes - activated and deactivated aromatic rings.

1.3.4: Effect of electron-withdrawing and electron-donating substituents on the orientation of an incoming electrophile on the basis of – (i) electron-density distribution (ii) stability of intermediate.
Cases to be studied: Mono and disubstituted benzenes containing - alkyl, amino, hydroxyl, alkoxy, halo, acyl, nitro, carboxy groups, ortho / para ratio.

UNIT II **(15 L)**

2.1: Aromatic Hydrocarbons **(3L)**

2.1.1: Structures of benzene, naphthalene, linear and angular arenes.

2.1.2: Alkyl arenes: Preparation of alkyl arenes through reforming, Friedel-Crafts alkylation (with mechanism), using – olefins, alcohols, alkyl halides.

2.1.3: Reactions of alkyl arenes – side-chain oxidation, ring vs side-chain halogenation (mechanism).

2.2: Haloarenes **(4L)**

2.2.1: Preparations of haloarenes. Halogenation of arenes – Halogenation of benzene and substituted benzenes with molecular halogens (mechanism), limitations.

2.2.2: Reactions of haloarenes: Lack of reactivity of aryl halides under S_N1 and S_N2 reaction conditions. General mechanism (addition-elimination) of aromatic nucleophilic substitution reaction with energy profile diagram. Effect of substituents on the reaction - hydrolysis and amination of haloarenes. Benzyne intermediate mechanism (elimination-addition) of aromatic nucleophilic substitution reaction . Grignard reagent formation. Ullmann reaction.

2.2.3: Applications of aromatic halogen compounds.

2.3: Phenols **(3L)**

2.3.1: Preparation of phenols: Preparation from (i) halobenzenes (ii) from aromatic sulfonic acids (benzene and naphthalene sulfonic acids) (iii) isopropyl and 2-butylbenzene by hydroperoxide method.

2.3.2: Reactions of phenols: Acidity of phenols – effect of substituents on acidity of phenols. Salt Formation. Etherification – direct reaction with alcohol. Williamson synthesis. O-acylation. Halogenation, Nitration, Fries rearrangement of aryl carboxylates, Claisen rearrangement of allyloxyarenes.

2.3.3: Applications of phenols.

2.4: Ethers **(3L)**

2.4.1: Preparation: Dehydration of alcohols (mechanism), reactions of phenols with alcohols, Williamson synthesis (mechanism).

2.4.2: Reactions: Acid-catalyzed cleavage – reaction with HX (mechanism).

2.4.3: Applications: Applications of ethers, Crown ethers: Structure of 12-crown-4 and 18-crown-6 and their uses.

2.5: Epoxides: **(2L)**

2.5.1: Preparation: Oxidation of olefins – ethylene oxide. Reaction of peracids with olefins; from vicinal halohydrins.

2.5.2: Reactions**:** Reactivity. Ring opening reactions by nucleophiles
(a) in acidic conditions, hydrolysis, reaction with – HX, alcohol, HCN.
(b) In neutral or basic conditions: ammonia, amines, metal cyanides, Grignard reagents, alkoxides.

2.5.3: Applications of epoxides (including chiral epoxides).

UNIT III **(15 L)**

3.1: Chemical Industry **(4L)**

3.1.1: Introduction to aspects of a chemical plant, terminology [raw materials, intermediates, end products, by-products, waste-products], unit operations, unit processes [single and multiple], batch and continuous operations, block diagrams, flow diagrams.

3.2: Sources of Organic Compounds **(7L)**

3.2.1: Introduction

3.2.2: Solid – eg. Destructive Distillation, Coal Tar Refining.

3.2.3: Liquid – eg. Petroleum: characteristics, refining of petroleum [applying block / flow diagrams to unit processes involved in refining like cracking].

3.2.4: Gaseous - eg. Natural gas: production, conversion to methanol [manufacturing process].

3.2.5: Renewable Sources – (i) conversion of biomass into chemicals (ii) biofuels: types and brief description of a few representative examples [bioethanol, biodiesel].

3.3: Manufacture of Bulk Chemicals **(4L)**

3.3.1: Phenol, styrene and dodecylbenzene [including reactions and reaction conditions, block / flow diagram, description].

REFERENCES:

1. Organic Chemistry, Francis A Carey, Pearson Education, 6th Edition, Special Indian Education, 2008.
2. Organic Chemistry, R.T. Morrison and R.N. Boyd, 6th Edition, Pearson Education.
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22. Fundamental concepts of Environmental Chemistry, G.S.Sodhi
23. Biomass for Renewable Energy, Fuels & Chemicals: Donald L. Klass, Academic Press, London, UK.

CIA I: Short answer questions **20 MARKS**

CIA II: Short answer questions **20 MARKS**

Template of Question Paper

ORGANIC AND INDUSTRIAL CHEMISTRY I **COURSE: S.CHE.3.03**

OBJECTIVES

UNIT	KNOWLEDGE	UNDERSTANDING	APPLICATION	TOTAL MARKS
I	7	7	6	20
II	7	7	6	20
III	7	7	6	20
TOTAL MARKS PER OBJECTIVE	21	21	18	60
% WEIGHTAGE	35	35	30	100

END SEMESTER PAPER PATTERN:

Total marks: 60 **Maximum Time: 2 hours**
Total number of questions: 3 [all compulsory] of 20 marks each.
1 question per unit.
Questions set out of 30 marks [50 % internal choice].
Sub questions will not exceed 5 marks.

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PRACTICAL CHEMISTRY **Course No. S.CHE.3.PR**

LEARNING OBJECTIVES

1. **To learn to perform experiments that have specific aims with correct techniques.**
2. **To develop skills of observation, recording and analyzing data.**
3. **To learn to present the experimental work in a systematic manner.**

SEMESTER III :

COURSE 1: PHYSICAL CHEMISTRY
COURSE 2: INORGANIC CHEMISTRY
COURSE 3: ORGANIC CHEMISTRY

COURSE 1: PHYSICAL CHEMISTRY

CHEMICAL KINETICS:
To study the reaction between KI and $K_2S_2O_8$ using equal concentrations and unequal concentrations.

pH METRY:
pH metric titration of weak acid vs strong base and to determine pK_a value.

CONDUCTOMETRY:
Conductometric titration of strong acid vs strong base.
Conductometric titration of weak acid vs. strong base.

COURSE 2: INORGANIC CHEMISTRY

SEMI-MICRO QUALITATIVE ANALYSIS:

Analysis of mixtures containing 2 cations and 2 anions. Dry tests and wet tests to be performed.
Cations: Cu^{2+}, As^{3+}, Bi^{3+}, Pb^{2+}, Sn^{2+}. Sb^{3+}, Al^{3+}, Fe^{2+}, Fe^{3+}, Mn^{2+}, Cr^{3+}, Zn^{2+}, Ni^{2+},
Co^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}, NH^{4+}, K^{+}
Anions: Cl^{-}, Br^{-}, NO_2^{-}, NO_3^{-}, CO_3^{2-}, SO_4^{2-}, PO_4^{3-} , $Cr_2O_7^{2-}$
At least 6 mixtures to be analyzed with interfering radicals. More emphasis to be placed on separation and detection of cations.

INORGANIC PREPARATIONS

1. Synthesis of $CuCl_2$. 2DMSO.
2. Preparation of (double salt) copper (II) ammonium sulfate $(NH_4)_2SO_4.CuSO_4.6H_2O$.
3. Synthesis of (complex) Tetrammine Copper (II) Sulphate hydrate $[Cu(NH_3)_4]SO_4.H_2O$.
4. Preparation of Double salt (Mohr's salt).

COURSE 3: ORGANIC CHEMISTRY

1. Derivative preparation: The exercise is aimed at imbibing the concept of derivative preparation as a method of identifying a given compound from a set of compounds having the same functional group. Based on the m.p. identify the given compounds looking at the chart. About 500 mg of a suitable compound be given. The candidate will prepare the given derivative. Crystallization is expected. M.P. of the dried derivative should be taken and appropriate inference drawn. The derivative preparation should involve one of the following reactions: (a) oxime preparation (b) nitration of aromatic compounds (c) N/O-acylation (d) Schiff base preparation (e) 2,4-DNP hydrazone formation (f) oxidation of aromatic compounds.

2. Estimation of an Organic Compound: The following estimations be given:

a) Estimation of formaldehyde by oxidation using iodine and alkali.
b) Estimation of aniline by bromination using brominating solution.
c) Estimation of acetamide by hydrolysis.
d) Saponification Value of the given oil.

Note:

(1) A minimum of three estimations be done by the candidates.

(2) For the estimations, the concentrations and the quantities be reduced. For dilution a standard flask of 100 cm^3 capacity and for the transfer a pipette of 10 $cm^{\mathbf{3}}$ capacity be used. The concentrations of the solutions be around 0.05N.

❖ CIA AND END SEMESTER PRACTICAL EXAMINATION

Course 1: Physical Chemistry - Exercise to test practical skills.

Course 2: Inorganic Chemistry - Exercise to test practical skills, qualitative /quantitative.

Course 3: Organic Chemistry - Exercise to test practical skills, qualitative /quantitative.

Journal: 5 marks per course.

CIA: 15 marks per course.

Duration: 4½ periods to be conducted during regular practicals by the faculty-in- charge.

One or more practical skill will be tested in the CIA.

End Semester Examination: 30 marks per course. This includes a 5 mark written test based on the theory behind all the experiments conducted per course.

Duration: 3 hrs per course. To be conducted at the end of the semester.

Batch size: Maximum 20 students per batch.

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