hydrochloric acid with sodium hydroxide.
(c) Calculation of the enthalpy of ionization of ethanoic acid.
(d) Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.
(e) Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.
(f) Determination of enthalpy of hydration of copper sulphate.
(g) Study of the solubility of benzoic acid in water and determination of $\Delta H$.

(II) Indexing of given powder diffraction pattern of a cubic crystalline system.

*Any other experiment carried out in the class.*

SEMESTER IV

Paper 13-CHHT 408: Inorganic Chemistry -III

THEORY Marks: 100

Unit I: Chemistry of $s$ and $p$ block elements:

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of $s$ and $p$ block elements.

Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate.

Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses.

Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.

Theoretical principles involved in volumetric analysis, done in the lab.
Unit II: Noble gases:


Unit III: Inorganic Polymers:

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.

Recommended Texts:


Paper 14-CHHT 409: Organic Chemistry -III

THEORY Marks: 100

Unit I: Nitrogen Containing Functional Groups

Preparation and important reactions of nitro and compounds, nitriles and isonitriles

Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann’s exhaustive methylation, Hofmann-elimination reaction; Distinction between $1^0$, $2^0$ and $3^0$ amines with Hinsberg reagent and nitrous acid;

Diazonium Salts: Preparation and their synthetic applications.
Unit II: Polynuclear Hydrocarbons

Reactions of naphthalene, phenanthrene, and anthracene. Structure, Preparation and structure elucidation and important derivatives of naphthalene and anthracene; Polynuclear hydrocarbons.

Unit III: Heterocyclic Compounds

Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidin, Structure elucidation of indole, Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline and isoquinoline, Skraup synthesis, Friedlander’s synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction.

Derivatives of furan: Furfural and furoic acid.

Unit IV: Alkaloids

Natural occurrence, General structural features, Isolation and their physiological action.

Hoffmann’s exhaustive methylation, Emde’s modification, Structure elucidation and synthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.

Recommended Texts:


Unit I: Phase equilibria

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for non-reactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems, with applications.

Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points, solid solutions.

Three component systems, water-chloroform-acetic acid system, triangular plots.

*Binary solutions:* Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and nonideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation.

*Nernst distribution law:* its derivation and applications.

Unit II: Electrochemistry

Quantitative aspects of Faraday’s laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry.

Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass and SbO/Sb$_2$O$_3$ electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).
Recommended Texts:


Paper 16-PHCT 402: Physics-II

THEORY Marks: 100

Unit I: Electrostatics:
Electric field, potential due to a charge distribution and due to a dipole, electrical potential energy, flux, Gauss’s law, electric field in a dielectric, polarization, energy stored in an electric field.

Unit II: Magnetism:
Magnetic field due to a current-carrying conductor, Biot Savart law, magnetic force on a current, Lorentz force, electromagnetic induction, Lenz’s law, magnetic properties of matter, para- dia- and ferromagnetism, spinning of a magnetic dipole in an external magnetic field.

Unit III: Fundamental laws of electromagnetism:
Modification of Ampere’s law, equation of continuity and displacement current, Maxwell’s equations, wave equation and its plane wave solution, nature of electromagnetic waves, tranversality and polarization, propagation of electromagnetic plane waves in dielectric media.

Unit IV: Electronics:
Half-wave, full-wave and bridge rectifiers, ripple factor, rectification efficiency, filters (series in inductor, shunt capacitor, LC and π sections), voltage regulations, load regulation, Zener diode as voltage regulator. Characteristic curves of bipolar
transistors, static and dynamic load line, biasing (fixed and self) of transistor circuit, thermal instability of bias, the black box idea of CE, CB and CC transistor circuits as two-port network, small signal active output, hybrid model of a CE transistor circuit, analysis of a small signal amplifier: its voltage and current gains, negative and positive feedback. Barkhausen’s criterion for self-sustaining oscillations, LC and phase shift oscillators.

Unit V: Digital electronics:

Number systems (binary, BCD, octal and hexadecimal), 1’s and 2’s complements. Logic gates, AND, OR, NAND, NOR, XOR and NXOR. Boolean algebra (Boolean laws and simple expressions), binary adders, half adder, half subtractor, full adder and full subtractor.

Recommended Texts:


Paper 13-CHHP 408: Inorganic Chemistry -III

PRACTICAL

Marks: 50

(a) Complexometric Titrations:

(i) Complexometric estimation of (i) Mg$^{2+}$ (ii) Zn$^{2+}$ using EDTA

(ii) Estimation of total hardnesss of water samples

(iii) Estimation of Ca$^{2+}$ in solution by (substitution method) using Erio-chrome black-T as indicator.

(ii) Estimation of Ca/Mg in drugs and Biological samples.
(b) **Argentometry**  
Estimation of Cl⁻ (i) By Mohr’s method, (ii) By Vohlard’s method, (iii) By Fajan’s method.

(c) Paper Chromatographic separation of Ni (II) and Co(II); Cu(II) and Cd (II)C

**Paper 14-CHHP 409: Organic Chemistry - III**

**PRACTICAL**

**Marks: 50**

**Organic Preparations**

1. Diels-Alder reaction between anthracene and maleic anhydride  
2. Reduction: nitrobenzene to azobenzene (TLC of the mixture), m-dinitrobenzene to m-nitroaniline  
3. S-benzylisothiuranum salts of any one water soluble and one water insoluble acid: acetic acid, phenyl acetic acid, oxalic acid, benzoic acid, phthalic acid  
4. Photochemical reduction of benzophenone to benzopinacol  
5. Benzoin condensation of benzaldehyde (using thiamine hydrochloride)  
6. Condensation of p-toluidine with benzaldehyde/salicylaldehyde/2-hydroxy-3-methoxy benzadehyde to get Schiff’s base (solventless condensation)

**Estimation of:**

1. Phenol and aniline by bromination with potassium bromate-potassium bromide method  
2. Glycine by formylation method  
3. Saponification value of an oil/fat

**Paper 15-CHHP 410: Physical Chemistry - III**

**PRACTICAL**

**Marks: 50**

(I) Study the equilibrium of at least one of the following reactions by the distribution method:
(i) \( \text{I}_2(\text{aq}) + \text{I}^- \rightarrow \text{I}_3^- (\text{aq}) \)
(ii) \( \text{Cu}^{2+}(\text{aq}) + n\text{NH}_3 \rightarrow \text{Cu(NH}_3)_n^{2+} \)

(II) Perform the following potentiometric titrations (at least two):

(i) Strong acid with strong base (ii) weak acid with strong base and (iii) dibasic acid with strong base

(III) Potentiometric titration of Mohr's salt with potassium dichromate.

(IV) Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it.

(V) Phase equilibria: Construction of the phase diagram of (i) simple eutectic and (ii) congruently melting systems, using cooling curves and ignition tube methods.

Any other experiment carried out in the class.

**Paper 16-PHCP 402: Physics-II**

**PRACTICAL**

Marks: 50


2. Determination of high resistance by leakage method.

3. Determination of mutual inductance by Ballistic Galvanometer.


5. Study of transistor characteristics (CB, CE, CC configurations).

6. Study of power supply (rectification factor, voltage and load regulation for C, L, CL and \( \pi \) filters).

7. Study of basic RC coupled amplifier (frequency response and band width).

8. Study of Colpitts oscillator.

9. Self-inductance measurement by Owen’s bridge.

10. Measurement of magnetic field by search coil.

11. To verify experimentally OR, NAD, NOT, NOR, NAND gates.