# 2-Years MSC Chemistry Curriculum and Syllabus

## 1st Year – 2nd Semester

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Contact Hrs. / Week</th>
<th>Credit</th>
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<tr>
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<td>Career Advancement Skill Development-II</td>
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<td>Organic Chemistry</td>
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<td>Inorganic Chemistry</td>
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<td>Analytical Chemistry</td>
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Module 1

Electrochemistry
Quantitative treatment of Debye-Hückel theory of ion-ion interaction and activity coefficient, applicability and limitations of Debye-Hückel limiting law, its modification for finite-sized ions, effect of ion-solvent interaction on activity coefficient. Debye-Hückel-Onsager (D-H-O) theory of conductance of electrolyte solution, its applicability and limitations, Pair-wise association of ions (Bjerrum and Fuoss treatment), Modification of D-H-O theory to account for ion-pair formation, Determination of association constant ($K_A$) from conductance data.

Module 2

Surface Chemistry
A. Reactions on surfaces: Adsorption, adsorption isotherms, unimolecular surface reaction, bimolecular surface reactions-reaction between a gas molecule and an adsorbed molecule, reaction between two adsorbed molecules, inhibition and activation energy of such reactions, volcano curve.

B. Transition state theory of surface reactions: rates of chemisorptions and desorption, unimolecular and bimolecular surface reaction, comparison of homogeneous and heterogeneous reaction rates.

C. Micelles: Surface active agents and their classifications, micellization, factors affecting cmc of surfactants, Thermodynamics of micellization: phase separation and mass action models, micro-emulsions, reverse micelles.

Module 3

Quantum Mechanics
A. Fundamentals of quantum mechanics: Black-body radiation, photoelectric effect, Davison and Gerner experiment, Franck-Hertz experiment, Young’s double slit experiment; identification of classical and quantum systems, Bohr’s correspondence principle with examples, the uncertainty principle.

C. Quantum mechanical treatment on various systems:
Translational motion of a particle, particle in one and three dimensional boxes, harmonic-oscillator, rotational motion of a particle: particle on a ring, particle on a sphere, rigid rotator, step-potential and tunneling, hydrogen atom.

D. Approximation methods: Stationary perturbation theory for non-degenerate and degenerate systems with examples, Variation method.

Books Recommended


Physical Chemistry Practical
TIUCHE 201L

L-T-P: 0-0-3

Experiment 1: Conductometric study of the kinetics of Saponification of methyl/ethyl acetate
Experiment 2: Determination of equivalent conductance at infinite dilution of KCl at room temperature
Experiment 3: Determination of strengths of strong and weak acids in a mixture conductometrically
Experiment 4: Determination of CMC of a surfactant by conductometric method
Experiment 5: Potentiometric titration of a strong acid with strong base using quinhydrone electrode
Experiment 6: Spectrophotometric study on hydrogen bonded complexation

Credit: 2
Module 1
Pericyclic reactions: Molecular orbital symmetry, frontier orbitals of ethylene, 1,3-buta
diene, 1,3,5-hexatriene and allyl systems. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach, concept of aromaticity of
pericyclic transition states. Selection rules and stereochemical aspects of electrocyclic
reactions, cycloaddition and sigmatropic shifts. Electrocyclic reactions: conrotatory and
disrotatory motions, 4n, 4n+2 and allyl systems. Cycloaddition reactions: antarafacial and
suprafacial additions, 4n and 4n+2 systems; 1,2 addition of ketenes, 1,3 dipolar
cycloadditions and cheleotropic reactions. Sigmatropic rearrangements: suprafacial and
antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3,3- and 5,5-
sigmatropic rearrangements. Sommelet-Hauser, Cope, Claisen, and aza-Cope rearrangements.
Fluxional tautomerism. Ene reaction.

Module 2
Esterification and hydrolysis of ester: Evidence for tetrahedral intermediate in BAc2 and
AAc2 mechanisms, steric and electronic effects, the AAc1 and other pathways involving
alkyl to oxygen bond cleavage.

Module 3
A. Electrophilic and nucleophilic aromatic substitution: Electrophilic aromatic
substitution: The Arenium ion mechanism, orientation and reactivity in monosubstituted
benzene rings, ortho/para ratio, Ipso substitution. Nucleophilic aromatic substitution: The
Aromatic SN, SN and benzyne mechanisms. Reactivity-effect of substrate structure, leaving
group, and attacking nucleophiles.

B. Elimination reaction mechanism: The E1, E2, and E1cB mechanisms, Orientation of
double bond, Hoffman elimination, Saytzeff elimination, Hoffman versus Saytzeff
elimination, Pyrolytic-syn-elimination, competition between substitution and elimination
reactions.

Module 4
Formation and reactions of enol and enolate: Enol and enolate, Stable enol, consequence
of enolization, Reactions with enols and enolates as intermediate, Stable enolate ions,
Preparation of enol ether, Reactions of enol ethers.
Books recommended


Organic Chemistry Practical
TIUCHE 202L

L-T-P: 0-0-3 Credit: 2

Experiment 1: Isolation of caffeine from tea leaves

Experiment 2: Separation, and identification of organic compounds in binary mixtures
Inorganic Chemistry  
TIUCHE 203

L-T-P: 3-1-0  
Credit: 3

Module 1
A. Kinetics and Mechanism of Substitution Reactions: Nature of substitution reactions; prediction of reactivity of octahedral, tetrahedral and square-planar complexes in terms of crystal field activation energy and structure preference energy; rates of reactions; acid hydrolysis, base hydrolysis and anation reactions.

B. Electron Transfer Reactions: Mechanism and rate laws; various types of electron transfer reactions, Marcus-Husch theory, correlation between thermal and optical electron transfer reactions; identification of intervalence transfer bands in solution.

Module 2
Metal Carbonyls and related compounds: Preparation, structure, and properties: bonding in metal carbonyls, variants of CO bridging, vibrational spectra of metal carbonyls, principal reaction types of metal carbonyls.

Module 3
Chemistry of Lanthanides and Actinides: Nuclear stability, terrestrial abundance and distribution, relativistic effect, electronic configuration, oxidation states, aqueous-, redox- and complex- chemistry, electronic spectra and magnetic properties, lanthanide and actinide contractions and their consequences, separation of lanthanides and actinides, organo-lanthanoids and actinoids.

Books Recommended

Inorganic Chemistry Practical  
TIUCHE 203L

L-T-P: 0-0-3  
Credit: 2

Preparation of coordination complexes and their characterization by various techniques
Analytical Chemistry
TIUCHE 204

Module 1
Spectroscopic Techniques
Theory, Instrumentation and applications of Atomic absorption Spectroscopy, Atomic fluorescence spectrometry, Atomic emission spectrometry, UV-Visible molecular absorption Spectrometry (principles, instrumentation, and application), Molecular luminescence spectroscopy (fluorescence, phosphorescence, chemiluminescence), Concept of Inductively coupled plasma-atomic absorption spectrophotometer, ICPA-AAS (Instrumentation and application).

Module 2
Chemical Sensors and Separation Techniques
A. Principles, types of chemical sensors based on the modes of transductions, Types of chemical sensor based on the chemically sensitive materials (solid electrolyte, gas, semiconductor), Humidity sensors, Biosensors, Electrochemical sensors (Potentiometric sensors, Ion-selective electrodes, Membrane electrodes, Amperometric sensors, Clark and Enzyme electrodes).


Module 3
Voltammetry and Thermal Analysis
Linear sweep voltammetry, Anode sweep voltammetry, Cyclic voltammetry, Polarography, Current-Voltage relationship, Theory of polarographic waves (DC and sampled DC (tast) polarograms), Instrumentation, ilkovic equation (derivation excluded), Differential pulse polarography, Qualitative and Quantitative applications. Thermal Analysis: Theory, methodology and application of Thermo Gravimetric Analysis (TGA), Differential Thermal Analysis (DTA), and Differential Scanning Calorimetry (DSC). Principles, techniques, and application of thermometric titration methods, Amperometric titrations.

Recommended books