With increasing awareness of the importance of learning process in chemical education, extended learner-oriented, enquiry-oriented and interactive teaching methods are required to be introduced in the instructional system. Accordingly, efforts need to be made with an objective of shifting emphasis from teaching to learning. Students must be encouraged to study select parts of the syllabus themselves and be given assignments so as to make them use the library, laboratory and Internet.

More specifically, lectures should be supplemented with hand-outs, tutorials, seminars, problem-solving sessions and continuous assessments so that students derive maximum benefit from the programme of study and prepare themselves for diverse styles of evaluation/examination.

**COURSE STRUCTURE AND SCHEME OF EXAMINATION**

The M.Sc. Chemistry and Applied Chemistry courses shall have 4 semesters each. The number of theory papers and practical courses, along with their marking system, are described below. It is necessary to secure minimum 36% pass marks separately in each theory paper and practical courses in each semester. It is also necessary to secure minimum 36% marks in internal assessment in each semester to qualify to appear in subsequent full examination of the respective semester. The Course is governed by the University Ordinance No. 79.

**Continuous Evaluation (Internal Assessment). Semesters I to IV.** There shall be fortnightly / monthly internal examinations of 1-hour duration each based on unit or portion thereof taught in prescribed syllabus and theory papers. Each test shall carry 10 marks. In **Semesters I to III**, total marks awarded (out of 40) shall be the sum of 4 best scored tests. In Semester IV, total marks awarded (out of 40) shall be the sum of 3 best scored tests (30 marks) and one seminar presentation (10 marks) by the student. In each semester there will be 10 marks for attendance. A record of continuous evaluation should be maintained.

**External Assessment. Semesters I and II.** In **Semester I**, there will be 4 compulsory theory papers, Course 101 to Course 104; and three practical- Course 106, Course 107 and Course 108. In **Semester II**, there will be 4 compulsory papers, Course 201 to Course 204; and three practicals- Course 206, Course 207 and Course 208. Each practical examination shall be of 6 hours duration, completing within the same day. The total marks for each Semester (I or II) shall be of **350 marks** with the distribution of marks given in the respective Table.

**External Assessment. Semester III.** There will be 3 compulsory papers, Course 301 to Course 303; 2 elective papers from the range of courses provided, Course 304 and Course 305, opted by the candidate in consultation with the Department; and three practicals- Course 307, Course 308 and Course 309. Each practical examination shall be of 6 hours duration completing within the same day. The total marks for Semester III shall be of **350 marks** with the distribution of marks given in the Table for Semester III.

**External Assessment. Semester IV.** There will be 3 compulsory papers, Course 401 to Course 403; 2 elective papers from the range of courses provided, Course 404 and Course 405, opted by the candidate in consultation with the Department; and three practicals- Course 407, Course 408 and Course 409. The practical examination shall be of 6 hours duration completing within the same day. The total marks for Semester IV shall be of **350 marks** with the distribution of marks given in the Table for Semester IV.

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**SYLLABUS FOR M.Sc. CHEMISTRY AND APPLIED CHEMISTRY**

(A FOUR SEMESTERS COURSE)

Syllabus effective from July 2018

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**SEMESTER I:**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Paper No.</th>
<th>Title of the Paper (duration of examination)</th>
<th>Teaching Hrs.</th>
<th>Max. Marks</th>
<th>Min. Pass Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>THEORY COURSES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course MCH 101</td>
<td>Paper I</td>
<td>Inorganic Chemistry (3 hours)</td>
<td>60</td>
<td>50</td>
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<tr>
<td>Course MCH 102</td>
<td>Paper II</td>
<td>Organic Chemistry (3 hours)</td>
<td>60</td>
<td>50</td>
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<tr>
<td>Course MCH 103</td>
<td>Paper III</td>
<td>Physical Chemistry (3 hours)</td>
<td>60</td>
<td>50</td>
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<tr>
<td>Course MCH 104</td>
<td>Paper IV</td>
<td>Spectroscopy (3 hours)</td>
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<td>50</td>
<td>18</td>
</tr>
<tr>
<td>Course MCH 105</td>
<td></td>
<td>Continuous Evaluation (Internal Assessment) on Mathematics (bio group)/Biology (maths group): subject matter of above four papers.</td>
<td>50</td>
<td>18</td>
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<tr>
<td>PRACTICAL COURSES</td>
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</tr>
<tr>
<td>Course MCH 106</td>
<td></td>
<td>Inorganic Chemistry (6 Hrs; 1 day)</td>
<td>90</td>
<td>34</td>
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<td>Course MCH 107</td>
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<td>Organic Chemistry (6 Hrs; 1 day)</td>
<td>90</td>
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<tr>
<td>Course MCH 108</td>
<td></td>
<td>Physical Chemistry (6 Hrs; 1 day)</td>
<td>90</td>
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<td><strong>Total Marks, I SEM</strong></td>
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**SYLLABUS FOR M.Sc. CHEMISTRY & APPLIED CHEMISTRY (SEMESTERS I TO IV); JULY 2018 and onward**

### SEMESTER II:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Paper No.</th>
<th>Title of the Paper (duration of examination)</th>
<th>Teaching Hrs.</th>
<th>Max. Marks</th>
<th>Min. Pass Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THEORY COURSES</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Course MCH 201</td>
<td>Paper I</td>
<td>Inorganic Chemistry (3 hours)</td>
<td>60</td>
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<tr>
<td>Course MCH 202</td>
<td>Paper II</td>
<td>Organic Chemistry (3 hours)</td>
<td>60</td>
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<tr>
<td>Course MCH 203</td>
<td>Paper III</td>
<td>Physical Chemistry (3 hours)</td>
<td>60</td>
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<tr>
<td>Course MCH 204</td>
<td>Paper IV</td>
<td>Spectroscopy &amp; Diffraction Methods (3 hours)</td>
<td>60</td>
<td>50</td>
<td>18</td>
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<tr>
<td>Course MCH 205</td>
<td>Paper IV</td>
<td>Continuous Evaluation (Internal Assessment) on Computers for Chemists (practical exercises); and subject matter of above four papers.</td>
<td>60</td>
<td>50</td>
<td>18</td>
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<tr>
<td><strong>PRACTICAL COURSE</strong></td>
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<tr>
<td>Course MCH 206</td>
<td></td>
<td>Inorganic Chemistry (6 Hrs; 1 day)</td>
<td>90</td>
<td>34</td>
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<tr>
<td>Course MCH 207</td>
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<td>Organic Chemistry (6 Hrs; 1 day)</td>
<td>90</td>
<td>33</td>
<td>12</td>
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<tr>
<td>Course MCH 208</td>
<td></td>
<td>Physical Chemistry (6 Hrs; 1 day)</td>
<td>90</td>
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<td><strong>Total Marks, II SEM</strong></td>
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### SEMESTER III:

<table>
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<tr>
<th>Course No.</th>
<th>Paper No.</th>
<th>Title of the Paper (duration of examination)</th>
<th>Teaching Hrs.</th>
<th>Max. Marks</th>
<th>Min. Pass Marks</th>
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<td>Course MCH 301</td>
<td>Paper I</td>
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<td>Course MCH 302</td>
<td>Paper II</td>
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<tr>
<td>Course MCH 303</td>
<td>Paper III</td>
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<tr>
<td>Course MCH 304</td>
<td>Paper IV</td>
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<tr>
<td>Course MCH 305</td>
<td>Paper V</td>
<td>Elective 2. One from 305A to 305D (3 hours)</td>
<td>60</td>
<td>50</td>
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<tr>
<td>Course MCH 306</td>
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<td>Inorganic Chemistry (6 Hrs; 1 day)</td>
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<td>Course MCH 307</td>
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<td>Organic Chemistry (6 Hrs; 1 day)</td>
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<td>Course MCH 308</td>
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<td>Physical Chemistry (6 Hrs; 1 day)</td>
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### SEMESTER IV:

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<th>Max. Marks</th>
<th>Min. Pass Marks</th>
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<td></td>
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<td>Course MCH 401</td>
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<td>Course MCH 403</td>
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<td>Physical Chemistry (3 hours)</td>
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<td>Course MCH 404</td>
<td>Paper IV</td>
<td>Elective 3. One from 404A to 404D (3 hours)</td>
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<td>50</td>
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<td>Course MCH 405</td>
<td>Paper V</td>
<td>Elective 4. One from 405A to 405D (3 hours)</td>
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<td>50</td>
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<td><strong>PRACTICAL COURSE</strong></td>
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<tr>
<td>Course MCH 406</td>
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<td>Inorganic Chemistry (6 Hrs; 1 day)</td>
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<td>Course MCH 407</td>
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<td>Course MCH 408</td>
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<td>Physical Chemistry (6 Hrs; 1 day)</td>
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<td><strong>Total Marks, IV SEM</strong></td>
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<td><strong>Grand Total of Marks</strong></td>
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</table>
M.Sc. I SEMESTER
Course MCH 101 (PAPER I): Inorganic Chemistry
(Effective M.Sc. Chemistry, and Applied Chemistry: July 2018)

Maximum Marks 35 +15 (CCE)

UNIT I
Stereochemistry and Bonding in Main Group Compounds. VSEPR theory and its application for treating structures of inorganic molecules and ions containing lone pairs of electrons, shortcomings of VSEPR model. MO treatment of polyatomic molecules, e.g., ozone, nitrite, nitrate, hydrazoic acid and benzene.

UNIT II
Reaction Mechanism of Transition Metal Complexes. Inert and labile complexes, interpretation of lability and inertness of transition metal complexes on the basis of valence bond and crystal field theories. Kinetics of octahedral substitution: acid hydrolysis, factors affecting acid hydrolysis.

UNIT III

Electronic Spectra and of Transition Metal Complexes. Spectroscopic term, terms and microstates for the p^2 and d^2 configurations, Hund’s rules for ground state terms, the correlation of spectroscopic terms into Mulliken symbols, electronic transition selection rules, Orgel diagrams for transition metal complexes (d^1-d^9 states). Jahn-teller effect and electronic spectra of complexes.

UNIT IV
Metal π-Complexes. Metal carbonyls: structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation. Dioxygen complexes, Wilkinson’s catalyst

UNIT V
Borane Chemistry Metal Clusters. Bonding and topology of boranes, 4-digit coding (s, t, y, x) numbers for B_2H_6, B_3H_10, B_3H_9, B_4H_11 and B_5H_10 and their utilities. Acquaintance with carboranes and metallocarboranes. Metal clusters: synthesis, reactivity and bonding.

Books Suggested
M.Sc. SEMESTER I
Course MCH 102 (PAPER II): Organic Chemistry
(Effective M.Sc. Chemistry, and Applied Chemistry: July 2018)

Maximum Marks 35 +15 (CCE)

UNIT I
Aromaticity in benzenoid and non-benzenoid compounds, alternate and non-altimate hydrocarbons. Hückel rule, anti-aromaticity, homo-aromaticity.
Bonds weaker than covalent bond. Hydrogen bonding, crown ether complexes, and cyclodextrins

UNIT II
Conformational analysis of cyclohexanes and decalins. Effect of conformation on reactivity.

UNIT III
Reaction Mechanism. Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, and control. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects.
Effect of structure on reactivity -resonance and field effects, steric effect. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation.

UNIT IV
Aliphatic Nucleophilic Substitution. The $S_{N} 2$, $S_{N} 1$, mixed $S_{N} 2$ and $S_{N} 1$, and SET mechanisms. The $S_{N} 1$ mechanism. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium. The neighbouring group mechanism, neighbouring group participation by $\pi$ and $\sigma$ bonds. Classical and nonclassical carbocations, norbornyl system, carbocation rearrangements.

UNIT V
Ultraviolet and Visible Spectroscopy. Electromagnetic radiation, wavelength, wave number, frequency, and energy calculation. Electronic transitions (185-800 nm), Beer-Lambert law, effect of solvent on electronic transitions, Fieser-Woodward rules for conjugated dienes and carbonyl compounds.
Optical Rotatory Dispersion (ORD) and Circular Dichroism (CD). Concept of ORD and CD, deduction of absolute configuration, octant rule for ketones.

Books Suggested
M.Sc. I SEMESTER
Course MCH 103 (PAPER III): Physical Chemistry
(Effective M.Sc. Chemistry, and Applied Chemistry: July 2018)

Maximum Marks 35 +15 (CCE)

UNIT I

Introduction to exact quantum mechanical results. The Schrodinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to systems such as particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom.

UNIT II


Angular Momentum. Ordinary angular momentum, generalized angular momentum, eigen functions for angular momentum, eigen values of angular momentum, addition of angular momenta, spin, antisymmetry and Pauli exclusion principle.

UNIT III

Classical Thermodynamics. Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties; partial molar free energy, partial molar volume and partial molar heat content and their significance. Determinations of these quantities. Concept of fugacity and determination of fugacity.

Derivation of phase rule and its application to three component systems, second order phase transitions.

UNIT IV

Chemical Dynamics (Part I). Methods of determining rate laws, Arrhenius equation, collision theory of reaction rates, steric factor, activated complex theory, ionic reactions, kinetic and thermodynamic control of reactions.

UNIT V

Chemical Dynamics (Part II). Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen-bromine and hydrogen-chlorine reactions) and oscillatory reactions, homogeneous catalysis, kinetics of enzyme reactions.

Books Suggested
1. Physical Chemistry, P.W. Atkins, ELBS.
4. Coulson's Valence, R. Mc Weeny, ELBS.
UNIT I

*Unifying Principles.* Electromagnetic radiation, interaction of electromagnetic radiation with matter-absorption, emission, transmission, reflection, refraction, dispersion, polarisation and scattering. Uncertainty relation and natural line width and natural line broadening, transition probability, transition moment, selection rules, intensity of spectral lines.

UNIT II

*Microwave Spectroscopy.* Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field. Applications.

UNIT III

*Infrared Spectroscopy.* Review of linear harmonic oscillator, vibrational energies of diatomic molecules, zero point energy, force constant and bond strengths; anharmonicity, Morse potential energy diagram, vibration-rotation spectroscopy, P,Q,R branches. Vibrations of polyatomic molecules. Selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, far IR region.

UNIT IV


UNIT V


Molecular Spectroscopy. Energy levels, molecular orbitals, vibronic transitions, vibrational progressions and geometry of the excited states, Franck-Condon principle, electronic spectra of polyatomic molecules. Emission spectra; radiative and non-radiative decay, internal conversion, charge-transfer spectra.

Books suggested
CONTINUOUS EVALUATION (Internal Assessment)
Course MCH 105 (a): Mathematics for Chemists
(For students without Mathematics in B.Sc.)
(Effective M.Sc. Chemistry, and Applied Chemistry: July 2018)

Maximum Marks 35 +15 (CCE)

Unit I
Vectors. Vectors, dot, cross and triple products etc. gradient, divergence and curl, Vector Calculus.
Matrix Algebra. Addition and multiplication; inverse, adjoint and transpose of matrices.

Unit II
Differential Calculus. Functions, continuity and differentiability, rules for differentiation, applications of differential calculus including maxima and minima (examples related to maximally populated rotational energy levels, Bohr’s radius and most probable velocity from Maxwell’s distribution etc.).

Unit III
Integral calculus. Basic rules for integration, integration by parts, partial fractions and substitution. Reduction formulae, applications of integral calculus. Functions of several variables, partial differentiation, co-ordinate transformations (e.g. Cartesian to spherical polar).

Unit IV
Elementary Differential equations. First-order and first degree differential equations, homogenous, exact and linear equations. Applications to chemical kinetics, secular equilibria, quantum chemistry etc. second order differential equation and their solutions.

Unit V
Permutation and Probability. Permutations and combinations, probability and probability theorems average, variance root means square deviation examples from the kinetic theory of gases etc., fitting (including least squares fit etc with a general polynomial fit.

Book Suggested
1. The chemistry Mathematics Book, E.Steiner, Oxford University Press.
7. Mathematics for Chemists: Bhupendra Singh, Pragati Prakashan
CONTINUOUS EVALUATION (Internal Assessment)
Course MCH 105 (b) Biology for Chemists
(For students without Biology in B.Sc.)
(Effective M.Sc. Chemistry, and Applied Chemistry: July 2018)

Maximum Marks 35 +15 (CCE)

Unit I  

Unit II  

Unit III  

Unit IV  

Unit V  
Nucleic Acids. Purine and pyrimidine bases of nucleic acids, base pairing via Hbounding. Structure of ribonucleic acids (RNA) and deoxyribonucleic acid (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and trinucleoside.

Book Suggested
PRACTICAL COURSES
M.Sc. SEMESTER I
LABORATORY COURSES MCH 106, MCH 107 and MCH 108
(Effective M.Sc. Chemistry, and Applied Chemistry: July 2018)

Emphasis should be placed on physical principles, reaction chemistry and the technique involved in experiments. Attention should be placed on stoichiometric calculations and statistical analysis of results. In regular classes, each student should perform all the experiments as selected by the Department from the list in the syllabus. In examination, students should be given different experiments or combination of experiments.

<table>
<thead>
<tr>
<th>Course MCH 106: Inorganic Chemistry (6 hours; 1 day)</th>
<th>Max. Marks 34</th>
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<tbody>
<tr>
<td>Viva voce</td>
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<tr>
<td>Two or three Experiments based on the following:</td>
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</tr>
<tr>
<td>(a) Synthesis</td>
<td></td>
</tr>
<tr>
<td>(b) Quantitative analysis</td>
<td></td>
</tr>
<tr>
<td>(c) Qualitative</td>
<td></td>
</tr>
<tr>
<td>(d) Spectral analysis of known compounds</td>
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<table>
<thead>
<tr>
<th>Course MCH 107: Organic Chemistry (6 hours; 1 day)</th>
<th>Max. Marks 33</th>
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<tr>
<td>Viva voce</td>
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<tr>
<td>Two or three Experiments based on the following:</td>
<td>28</td>
</tr>
<tr>
<td>(a) Qualitative analysis</td>
<td></td>
</tr>
<tr>
<td>(b) Quantitative analysis</td>
<td></td>
</tr>
<tr>
<td>(c) Qualitative analysis</td>
<td></td>
</tr>
<tr>
<td>(d) Spectral analysis of known compounds</td>
<td></td>
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<table>
<thead>
<tr>
<th>Course MCH 108: Physical Chemistry (6 hours; 1 day)</th>
<th>Max. Marks 33</th>
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</thead>
<tbody>
<tr>
<td>Viva voce</td>
<td>5</td>
</tr>
<tr>
<td>Two Experiments based on the following:</td>
<td>28</td>
</tr>
<tr>
<td>(a) Adsorption</td>
<td></td>
</tr>
<tr>
<td>(b) Phase Equilibria</td>
<td></td>
</tr>
<tr>
<td>(c) Solutions</td>
<td></td>
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</table>

Course MCH 106: Inorganic Chemistry

Qualitative and Quantitative Analysis
a. Less common metal ions: Ti, Mo, w, Ti, Zr, Th, V, U (two metal ions in cationic/anionic forms).
b. Insoluble- Oxides, sulphates and halides.
c. Separation and determination of two metal ions Cu-Ni, Ni-Zn, Cu-Fe etc. Involving volumetric and gravimetric methods.

Chromatography
Separation of cations and anions by Paper Chromatography

Preparations
Preparation of selected inorganic compounds and their studies by measurements of decomposition temperature, molar conductance, IR and electronic spectra.

\[
\begin{align*}
[Zn(acac)_2(H_2O)] & \quad [Co(acac)_2(H_2O)_2] \\
[Ni(acac)_2(H_2O)_2] & \quad [Cu(acac)_2 \cdot H_2O] \\
[Co(Meacac)_2(H_2O)_2] & \quad [Ni(NH_3)_6]Cl_2 \\
[Cu(Meacac)_2] \cdot H_2O & \quad \text{cis-K}([Cr(C_2O_4)_2(H_2O)_2]} \\
\end{align*}
\]

Interpretation of IR and Electronic Spectra of some known compounds

Course MCH 107: Organic Chemistry

Qualitative Analysis
Separation, purification and identification of compounds of binary mixture (one solid and one liquid/solid) using chemical separation and sublimation/distillation, etc. Their analysis by semi-micro chemical tests and spot tests. IR spectra to be used for functional group identification. Preparation of one derivative of each compound.
Emphasis should be placed on physical principles, reaction chemistry and the technique involved in analysis.

Organic Synthesis
Purification of compounds by TLC and column chromatography.
Aromatic electrophilic substitutions:
Synthesis of m-dinitrobenzene from nitrobenzene
Synthesis of 2,4-dinitro-1-chlorobenzene from chlorobenzene
Synthesis of 4-bromoaniline from acetanilide
Reduction reaction:
Synthesis of m-nitroaniline from m-dinitrobenzene

Quantitative Analysis
Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method

Interpretation of IR and Electronic Spectra of some known compounds

Course MCH 206: Physical Chemistry
A list of experiments under different headings is given below. Typical experiments are to be selected from each type.

Adsorption
(i) To study surface tension -concentration relationship for solutions (Gibbs equation).

Phase Equilibria
(ii) To construct the phase diagram for three component system (e.g., chloroform-acetic acid-water).

Chemical Kinetics
(iii) Determination of the effect of (a) Change of temperature (b) Change of concentration of reactants and catalyst and (c) Ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions.
(iv) Determination of the primary salt effect on the kinetics of ionic reactions and testing of the Bronsted relationship (iodide ion is oxidised by persulphate ion)

Solutions
(v) Determination of molecular weight of non-volatile and non-electrolyte/electrolyte by cryoscopic method and to determine the activity coefficient of an electrolyte.
(vi) Enzyme kinetics -inversion of sucrose

Books Suggested
10. Findley's Practical Physical Chemistry, B. P. Levitt, Longman
12. Practical Physical Chemistry, A. M. James and F. E. Prichard, Longman
M.Sc. II SEMESTER
Course MCH 201 (PAPER I): Inorganic Chemistry
(Effective M.Sc. Chemistry and Applied Chemistry: January 2019)

Unit I

**Metal-Ligand Equilibria in Solution.** Stepwise and overall formation constants and their relationship, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by Bjerrum method, Job’s and Mole ratio methods.

UNIT II

**Reaction Mechanism of Transition Metal Complexes.** Base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism. Substitution reactions in square planar complexes: The Trans effect and the trans influence: Polarization and π-Bonding theories, applications of Trans effect in synthesis, Kurnakove’s test of distinguishing cis and trans isomers using the concept of trans effect, mechanism of substitution reactions in square planar complexes, factors affecting substitution reactions. Acquaintance of Trans effect in octahedral complexes.

UNIT III

**Metal-Ligand Bonding. Molecular orbital theory:** Qualitative aspect of metal-ligand π-bonding in octahedral complexes, tetrahedral and square planar complexes.

**Electronic Spectra and Magnetic Properties of Transition Metal Complexes.** Calculations of Dq, B and β parameters for Cr(III), Co(II) and Ni(II) complexes using electronic spectral data. Charge transfer spectra: ligand to metal and metal to ligand.

UNIT IV

**Metal π-Complexes.** Metal nitrosyls: Nitrosylating agents for synthesis of metal nitrosyls, vibrational spectra and x-ray diffraction studies of metal nitrosyls for bonding and structure elucidation, important reactions of transition metal nitrosyl complexes pertaining to potentiality in air pollution control, biomedical applications. Dinitrogen complexes, Vaska’s compound.

UNIT V

**Group Theory.** Symmetry elements and symmetry operations, symmetry groups or point groups, Schoenflies symbols, point group classifications, matrix representation of symmetry operations, group, necessary conditions for any set of elements to form a group, subgroups, classes in a group.

Books Suggested

UNIT I
Aliphatic Electrophilic Substitution. Bimolecular mechanisms, $S_{E2}$ and $S_{E1}$ mechanisms. The $S_{E1}$ mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and solvent polarity on the reactivity.

Aromatic Electrophilic Substitution. The arenium ion mechanism, orientation and reactivity. The ortho/para ratio, ipso attack. Vilsmeier reaction, Fries rearrangement.

UNIT II

Electron spin resonance (ESR) spectroscopy. Electron paramagnetism, derivative curves, g values and hyperfine splitting.

UNIT III

Addition to Carbon-Hetero atom Multiple Bonds. Mechanism of metal hydride reduction of carbonyl compounds, acids, esters and nitriles. Wittig reaction.

Mechanism of condensation reactions involving enolates. Mannich, Benzoin, Perkin, and Stobbe reactions.

UNIT IV
Aromatic Nucleophilic Substitution. The $S_{N}Ar$, $S_{N}1$, benzyne and $S_{RN}1$ mechanisms. Reactivity, effect of substrate structure, leaving group and attacking nucleophile. Bucherer reaction, alkylation, and amination. The Bamberger rearrangement. The von Richter rearrangement.

UNIT V
Infrared and Raman Spectroscopy. Instrumentation and sample handling. Calculation of vibrational frequencies. Characteristic vibrational frequencies of alkanes, alkenes, alkynes, carbonyl compounds, alcohols, ethers, amines, phenols and aromatic compounds. Finger-print region. Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance. FT-IR.

Resonance Raman effect. Concept and factors that influence group frequencies.

Books Suggested
M.Sc. II SEMESTER

Course MCH 203 (PAPER III): Physical Chemistry

(Effective M.Sc. Chemistry and Applied Chemistry: January 2019)

Maximum Marks 35 +15 (CCE)

UNIT I

Chemical Dynamics (Part III). General features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method. Dynamics of molecular motions and of barrierless chemical reactions in solution, probing the transition state. Dynamics of unimolecular reactions; Lindemann-Hinshelwood and Rice-Ramsperger-Kassel-Marcus and Slater theories of unimolecular reactions.

UNIT II


UNIT III


UNIT IV


UNIT V


Books Suggested

1. Physical Chemistry, P. W. Atkins, ELBS.
4. Coulson's Valence, R. McWeeny, ELBS.
5. Chemical Kinetics, K. J. Laidler, Mcgraw-Hill.
7. Micelle, Theoretical and Applied Aspects, V. Moroi, Plentm
M.Sc. II SEMESTER
Course MCH 204 (PAPER IV): Spectroscopy & Diffraction Methods
(Effective M.Sc. Chemistry and Applied Chemistry: January 2019)

Maximum Marks 35 +15 (CCE)

UNIT I

Photoelectron Spectroscopy. Basic principles; photo-electric effect, ionization process, Koopman’s theorem. Photoelectron spectra of simple molecules, ESCA, chemical information from ESCA. Auger electron spectroscopy - basic idea.

Photoacoustic Spectroscopy. Basic principles of photoacoustic spectroscopy (PAS), chemical and surface applications.

UNIT II


UNIT III

Electron Diffraction. Scattering intensity vs. scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules. Low energy electron diffraction and structure of surfaces.

Neutron Diffraction. Scattering of neutrons by solids and liquids, magnetic scattering, measurement techniques. Elucidation of structure of magnetically ordered unit cell.

UNIT IV


Bioenergetics. Standard free energy change in biochemical reactions; exergonic and endergonic reactions. Hydrolysis of ATP. Synthesis of ATP from ADP.

Statistical Mechanics in Biopolymers. Chain configuration of macromolecules, statistical distribution end to end dimensions. Polypeptide chain binding and proteins, introduction to protein folding problem.

UNIT V

Thermodynamics of Biopolymer Solutions. Thermodynamics of biopolymer solutions, osmotic pressure, membrane equilibrium.

Transport of ions. Biopolymers and their molecular weights. Structure and functions of cell membrane, ion transport through cell membrane, Nerve conduction; Evaluation of size, shape and molecular weight of biopolymers by various experimental techniques.

Books Suggested
15. Instrumental Methods of Analysis, Willard, Meritt and Dean.
CONTINUOUS EVALUATION (Internal Assessment)
Course MCH 205: Computers for Chemists
(Effective M.Sc. Chemistry, and Applied Chemistry: January 2019)

Maximum Marks 35 +15 (CCE)

This is a theory cum-laboratory course with more emphasis on laboratory work.

Unit I

Unit II
Computer Programming in FORTRAN/C/BASIC. (the language features are listed here with reference to FORTRAN. The instructor may choose another language such as BASIC or C the features may be replaced appropriately). Elements of the compute language. Constants and variables. Operations and symbols Expressions. Arithmetic assignment statement. Input and output Format statement. Termination statements. Branching statements as IF or GO TO statement. LOGICAL variables. Double precession variables. Subscripted variables and DIMENSION. DO statement FUNCTION AND SUBROUTINE. COMMON and DATA statement (Student learn the programming logic and these language feature by hands on experience on a personal computer from the beginning of this topic.)

Unit III
Programming in Chemistry. Developing of small computer codes using any one of the languages FORTRAN/C/BASIC involving simple formulae in Chemistry, such as Van der Waals equation. Chemical kinetics (determination of Rate constant) Radioactive decay (Half Life and Average Life). Determination Normality, Molarity nd Molality of solutions. Evaluation Electronegativity of atom and Lattice Energy from experimental determination of molecular weight and percentage of element organic compounds using data from experimental metal representation of molecules in terms of elementary structural features such as bond lengths, bond angles.

Unit IV
Use of Computer programmes. Operation of PC. Data Processing. Running of standard Programs and Packages such as MS WORD, MS EXCEL -special emphasis on calculations and chart formations. X-Y plot. Simpson’s Numerical Integration method. Programmes with data preferably from physical chemistry laboratory.

Unit V
Internet. Application of Internet for Chemistry with search engines, various types of files like PDF, JPG, RTF and Bitmap. Scanning, OMR, Web camera.

Book Suggested
1. Fundamentals of Computer : V. Rajaraman, Prentice Hall,
M.Sc. SEMESTER II
LABORATORY COURSE MCH 206, MCH 207 and MCH 208
(Effective M.Sc. Chemistry, and Applied Chemistry: January 2019)

Emphasis should be placed on physical principles, reaction chemistry and the technique involved in experiments. Attention should be placed on stoichiometric calculations and statistical analysis of results. In regular classes, each student should perform all the experiments as selected by the Department from the list in the syllabus. In examination, students should be given different experiments or combination of experiments.

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<td>(c) Polarimetry</td>
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Course MCH 206: Inorganic Chemistry

 Chromatography Separation of cations and anions by Column Chromatography; Ion exchange.

Preparations
Preparation of selected inorganic compounds and their studies by measurements of decomposition temperature, molar conductance, I.R., electronic spectra, and magnetic susceptibility measurements.
1. [Co(NH$_3$)$_6$][Co(NO$_2$)$_3$]
2. cis-[Co(trien) (NO$_2$)$_2$]Cl.H$_2$O
3. Hg[Co(SCN)$_2$]
4. [Co(Py)$_2$Cl$_2$
5. [Ni(NH$_3$)$_2$]Cl$_2$
6. [Ni(dmg)$_2$
7. [Cu(NH$_3$)$_4$]SO$_4$.H$_2$O

Interpretation of TG and NMR spectra of some known compounds

Course MCH 207: Organic Chemistry

Organic Synthesis
Oxidation reaction:
- Synthesis of 9,10-anthraquinone by oxidation of anthracene by chromium trioxide
- Synthesis of 4-nitrobenzaldehyde by oxidation of 4-nitrotoluene by chromium trioxide
Cannizzaro reaction
- Synthesis of benzal alcohol from benzaldehyde
Claisen-Schmidt reaction:
- Synthesis of dibenzylideneacetone (1,5-diphenylpenta-1,4-dien-3-one) from acetone and benzaldehyde
Sandmeyer reaction:
- Synthesis of 2-chloroanthranilic acid from anthranilic acid
Methylation:
Synthesis of methyl 2-naphthyl ether (2-methoxynaphthalene, nerolin) by methylation of 2-naphthol by dimethyl sulphate.

Quantitative Analysis
Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method
Determination of aromatic amines or phenols using bromate-bromide mixture
Determination of number of double bonds in an organic compound
Determination of percentage or number of ester groups in an organic compound by saponification

Interpretation of NMR and mass spectra of some known compounds

Course MCH 208: Physical Chemistry
A list of experiments under different headings is given below. Typical experiments are to be selected from each type.

Electrochemistry
A. Conductometry
(i) Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.
(ii) Determination of solubility and solubility product of sparingly soluble salts (e.g., PbSO₄, BaSO₄) conductometrically.
(iii) Determination of the strength of strong and weak acids in a given mixture conductometrically.
(iv) Determination of the activity coefficient of zinc ions in the solution of 0.002 M zinc sulphate using Debye-Huckel's limiting law.

B. Potentiometry/pH meter
(i) Determination of strengths of halides in a mixture potentiometrically.
(ii) Determination of the valency of mercurous ions potentiometrically.
(iii) Determination of the strength of strong and weak acids in a given mixture using potentiometer/pH meter.
(iv) Determination of activity and activity coefficient of electrolytes.

Polarimetry
(i) Determination of rate constant for hydrolysis/inversion of sugar using a polarimeter.
(ii) Enzyme kinetics - inversion of sucrose

Books Suggested
10. Findley's Practical Physical Chemistry, B. P. Levitt, Longman
11. Experimental Physical Chemistry, R. C. Das and B. Behera, Tata Mcgraw Hill.
12. Practical Physical Chemistry, A. M. James and F. E. Prichard, Longman
M.Sc. SEMESTER III
Course MCH 301 (PAPER I): Inorganic Chemistry
(Effective M.Sc. Chemistry and Applied Chemistry: July 2019)

Maximum Marks 35 +15 (CCE)

UNIT I

Group theory. Matrix representation of point groups, Character of a representation, reducible and irreducible representations. The great orthogonality theorem (without proof) and its importance, construction of character tables for $C_{2v}$, and $C_{3v}$ point groups, importance of character tables.

UNIT II

Group theory and vibrational Spectroscopy. Group theory to symmetry, shapes and molecular energy level diagrams of molecules like BF$_3$, NH$_3$ (AB$_3$ type), [Pt(NH$_3$)$_2$]$^{2+}$, [Ni(CN)$_4$]$^{2-}$ (AB$_4$ type) and [Co(NH$_3$)$_6$]$^{3+}$ (AB$_6$ type) molecules. Modes of bonding of ligands such as SCN$^-$, β-ketoenolate and related ligands, nitrate ion and corboxylates.

UNIT III

Nuclear Magnetic Resonance Spectroscopy. NMR Shift reagents, shift mechanism and its utility in simplification of NMR spectra. Applications of NMR in characterization of coordination compounds.

UNIT IV

Bioinorganic Chemistry. Metal containing enzymes: Carboxypeptidase-A, Carbonic anhydrase, arginase, urease, DNA polymerase, phosphoglucomutase (glucose storage): structure and reactivity

UNIT V

Transport and Storage of Dioxygen: structure and function of hemoglobin, myoglobin, hemocyanins and hemerythrin. Poisoning towards hemoglobin and myoglobin.

Book Suggested
8. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, , V. Parish, Ellis Haywood.
M.Sc. SEMESTER III
Course MCH 302 (PAPER II): Organic Chemistry
(Effective M.Sc. Chemistry and Applied Chemistry: July 2019)

Maximum Marks 35 +15 (CCE)

UNIT I
Nuclear Magnetic Resonance Spectroscopy. \(^1\)H-NMR phenomenon. chemical shift, shielding and deshielding mechanism, mechanism of measurement, chemical shift values and its correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides and mercapto). Chemical exchange, effect of deuteration. Spin-spin coupling (first order spectra; AX, AB, AMX spectra). Coupling constant, Karplus curve. Complex spin-spin interactions. Simplification of complex spectra, nuclear magnetic double resonance, increased field strength, contact shift reagents. Nuclear Overhauser effect (NOE). FT technique.

UNIT II

UNIT III
Photochemistry: Part II. Photochemistry of Alkenes. Geometrical isomerisation, dimerisation reactions, rearrangement of 1,4- and 1,5- dienes. Photooxidation.

UNIT IV
Pericyclic Reactions: Part I. Molecular orbitals and their symmetry. Molecular orbitals of ethylene, 1,3- butadiene, 1,3,5-hexatriene and allyl system, and their symmetry properties.

UNIT V
Pericyclic Reactions: Part II. Cycloadditions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Antarafacial and suprafacial additions. 4n and 4n+2 systems, 2+2 addition of ketenes. Ene synthesis.
Sigmatropic Rearrangements. Suprafacial and antarafacial 1,3- and 1,5- shifts of H, sigmatropic shifts involving carbon moieties, 2,3-, and 3,3-sigmatropic rearrangements. Claisen, Cope, aza-Cope, Sommlet-Hauser, and Fisher Indole rearrangements.

Books Suggested
8. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, J.V. Parish, Ellis Haywood.
M.Sc. SEMESTER III
Course MCH 303 (PAPER III): Physical/Solid State Chemistry
(Effective M.Sc. Chemistry and Applied Chemistry: July 2019)

Maximum Marks 35 +15 (CCE)

UNIT I

*Electronic Structure of Atoms.* Electronic configuration, Russell-Saunders terms and coupling scheme, Slater parameters, magnetic effects. Zeeman splitting; virial theorem.

UNIT II

*Molecular Orbital Theory.* Hückel theory of conjugated systems, bond order and charge density calculations. Applications to ethylene, butadiene, and cyclobutadiene. Introduction to extended Hückel theory.

UNIT III

*Homogeneous Catalysis.* Stoichiometric reactions for catalysis, homogeneous catalytic hydrogenation, Zeigler-Natta polymerisation of olefins.

*Heterogenous Catalysis.* Thermodynamics of active centres, mechanism of heterogenous catalysis; structural promotion and structural modification.

UNIT IV

*Crystal Defects.* Perfect and imperfect crystals, stoichiometric and non-stoichiometric defects. Intrinsic and extrinsic defects, point defects, line and plane defects; Schottky and Frenkel defects.

*Solid State Reactions.* General principles, coprecipitation as a precursor to solid state reactions, factors affecting solid state reactions.

UNIT V

*Electronic Properties and Band Theory.* Metals, insulators and semiconductors. Electronic structure of solids-Band theory; band structure of metals, insulators and semiconductors. Intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, superconductors.

Books Suggested.
M.Sc. SEMESTER III  
Course MCH 304A (ELECTIVE PAPER IV): Molecular Dynamics  
(Effective M.Sc. Chemistry and Applied Chemistry: July 2019)

Maximum Marks 35 +15 (CCE)

UNIT I  

UNIT II  
*Kinetic Isotope Effect*. Theory of isotope effects. Primary and secondary kinetic isotope effects. Heavy atom isotope effects. Tunneling effect. Solvent effects.

UNIT III  
*Structural Effects on Reactivity*. Linear free energy relationships (LFER). The Hammett equation, substituent constants, theories of substituent effects. Interpretation of $\sigma$-values. Reaction constant $\rho$. Deviations from Hammett equation. Dual-parameter correlations, inductive substituent constant. The Taft model, $\sigma^T_r$ and $\sigma^P_r$-scales.

UNIT IV  
*Solvation and Solvent Effects*. Quantitative understanding of solvent-solute effects on reactivity. Thermodynamic measure of solvation. Effects of solvation on reaction rates and equilibria. Various empirical indices of solvation based on physical properties, solvent-sensitive reaction rates, spectroscopic properties and scales for specific solvation. Use of solvation scales in mechanistic studies. Solvent effects from the curve-crossing model.

UNIT V  
(a) *Pharmacokinetics*. Introduction to drug absorption, disposition, elimination using pharmacokinetics, important pharmacokinetic parameters in defining drug disposition and in therapeutics. Mention of uses of pharmacokinetics in drug development process.  
(b) *Pharmacodynamics*. Introduction, elementary treatment of enzyme stimulation, enzyme inhibition, sulphonamides, membrane active drugs, drug metabolism, xenobiotics, biotransformation, significance of drug metabolism in medicinal chemistry.

**Books Suggested**
4. Introduction to medicinal chemistry, A.Griguage, Wiley-VCH.  
M.Sc. SEMESTER III

Course MCH 304B (ELECTIVE PAPER IV): Analytical Chemistry
(Effective M.Sc. Chemistry and Applied Chemistry: July 2019)

Maximum Marks 35 +15 (CCE)

UNIT I


Sample Preparation for Chromatography. Solid-phase extraction, solid-phase microextraction. Extraction with molecular imprinted polymers.

UNIT II


Capillary Electrophoresis. Principle, modes of operation, and instrumentation.

UNIT III


Solvent Extraction. The distribution coefficient. Factors favouring solvent extraction. Extraction reagents. Synergetic effects. Ion-pair extraction. Extraction and stripping. Solvent extraction with crown ethers, and factors influencing it.

UNIT IV


UNIT V

Acid-Base Titrations. Kjeldahl method for determination of nitrogen. Determination involving acetylation (amino and hydroxyl groups); and oximation (carbonyl group).


Redox Titrations. Determination of 1,2-diols by periodate oxidation. Karl Fischer titration of water. Determination of DO, BOD and COD.

Books Suggested
5. S.M. Khopkar, Basic concepts of analytical chemistry, Wiley Eastern, New Delhi.
M.Sc. SEMESTER III  
Course MCH 304C (ELECTIVE PAPER IV): Photochemistry  
(Effective M.Sc. Chemistry and Applied Chemistry: July 2019)

Maximum Marks 35 +15 (CCE)

Unit-I  
*Photochemical Reactions.* Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry.

Unit II  
*Determination of Reaction Mechanism.* Classification, rate constants and life times of reactive energy state determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions-photo dissociation, gas-phase photolysis.

Unit III  
*Photochemistry of Alkenes.* Intramolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1,5-dienes.  
*Photochemistry of Aromatic Compounds.* Isomerisations, additions and substitutions.

Unit IV  
*Photochemistry of Carbonyl Compounds.* Intramolecular reactions of carbonyl compounds-saturated, cyclic and acyclic, unsaturated and α,β-unsaturated compounds, cyclohexadienones. Intermolecular cycloaddition reactions-dimerisations and oxetane formation.

Unit V  

Books Suggested  
M.Sc. SEMESTER III
Course MCH 304D (ELECTIVE PAPER IV): Biochemistry
(Effective M.Sc. Chemistry and Applied Chemistry: July 2019)

Maxmimum Marks 35 +15 (CCE)

Unit I
Metal Ions in Biological Systems. Bulk and trace metals with special reference to Na, K, Mg, Ca, Fe, Cu, Zn, Co, and K+/Na+ pump.

Bioenergetics and ATP Cycle. DNA polymerisation, glucose storage, metal complexes in transmission of energy; chlorophyll’s, photosystem I and photosystem II in cleavage of water.

Transport and Storage of Dioxygen. Hem proteins and oxygen uptake structure and function of haemoglobin’s, myoglobin, haemocyanins and hemerythrin, model synthetic complexes of iron, cobalt and copper.

Unit II
Electron Transfer in Biology. Structure and function of metal of proteins in electron transport processes cytochrome’s and ion-sulphure proteins, synthetic models.


Unit III
Enzymes. Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer’s lock and key and Koschnid’s induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michael’s-Menten and Lineweaver Burk plots, reversible and irreversible inhibition.

Mechanism of Enzyme Action. Transition-state theory, orientation and Steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chemotrypsin, ribonuclease, lysozyme and carboxypeptidase.


Unit IV

Biotechnological Applications of Enzymes. Large-scale production and purification of enzymes, techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in food and drink industry-brewing and cheesemaking, syrups from corn starch, enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy, enzymes and recombinant DNA Technology.

Unit V


Book Suggested
8. Understanding Enzymes, Trevor Palmer, Prentice Hall.
M.Sc. SEMESTER III
Course MCH 305A (ELECTIVE PAPER V): Theoretical Chemistry
(Effective M.Sc. Chemistry and Applied Chemistry: July 2019)

UNIT I

UNIT II

UNIT III
(a) Statistical Thermodynamics: Part II. Entropy and probability, partition functions, translational, vibrational and rotational partition functions, Sackur-Tetrode equation. Relation of partition function with entropy, free energy and weak function. Application of partition function.
(b) Specific heat of solids-Einstein and Debye models, their weaknesses.

UNIT IV
Irreversible Thermodynamics. Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, transformation of the generalised fluxes and forces, non-equilibrium stationary states, phenomenological equations, microscopic reversibility and Onsager’s reciprocity relations, electrokinetic phenomena, diffusion, electric conduction, coupled reactions.

UNIT V
Enzymes. Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes such as catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer’s lock and key and Koshland’s induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michaelis-Menten and Lineweaver-Burk plots, reversible and irreversible inhibition.

Books Suggested
1. Theoretical Chemistry, S. Glasstone, East-West, India.
2. Quantum Chemistry, Eyring and Kimball.
6. Physical Chemistry, P.W. Atkins, ELBS.
M.Sc. SEMESTER III
Course MCH 305B (ELECTIVE PAPER V): Chemistry of Materials
(Effective M.Sc. Chemistry and Applied Chemistry: July 2019)

Maximum Marks 35 +15 (CCE)

UNIT I

UNIT II

UNIT III
Ionic Conductors. Types of ionic conductors, mechanism of ionic conduction, interstitial jumps (Frenkel); vacancy mechanism, diffusion superionic conductors, phase transitions and mechanism of conduction in superionic conductors. Examples and applications of ionic conductors.

UNIT IV

UNIT V

Books Suggested
5. Thermotropic Liquid Crystals, G.W. Gray, editor, John Wiley.
M.Sc. SEMESTER III
Course MCH 305C (ELECTIVE PAPER V): Electrochemistry
(Effective M.Sc. Chemistry and Applied Chemistry: July 2019)

Maximum Marks 35 +15 (CCE)

Unit I


Unit II

Unit III

Unit IV

Unit V
Potential Sweep Method. Linear sweep Voltammetry, Cyclic Voltammetry, theory and applications. Diagnostic criteria of cycli voltammetry. Controlled current microelectrode techniques : comparison with controlled potentials methods, chronopotentiometry, theory ad applications. Bulk Electrolysis Methods. Controlled potential coulometry, Controlled Coulometry, Electroorganic synthesis and its important applications. Stripping analysis : anodic and Cathodic modes, Pre electrolysis and Stripping steps, applications of Stripping Analysis.

Books Suggested
7. Electroanalytical Chemistry by Basil H. Vessor & alen w. ; Wiley Interscience.
8. Topics in pure and Applied Chemistry, Ed. S. K. Rangrajan, SAEST Publication, Karaikudi (India)
M.Sc. SEMESTER III
Course MCH 305D (ELECTIVE PAPER V): Medicinal Chemistry
(Effective M.Sc. Chemistry and Applied Chemistry: July 2019)

Maximum Marks 35 +15 (CCE)

Unit I


Unit II

Pharmacodynamics. Introduction, elementary treatment of enzymes stimulation, enzyme inhibition, sulfonamides, membrane active drugs, drug metabolism, xenobiotics, biotransformation, significance of drug metabolism in medicinal chemistry.

Unit III


Unit IV


Unit V

Non-steroidal Anti-inflammatory Drugs. Diclofenac Sodium, Ibuprofen and Netopam Antihistaminic and antiasthmatic agents: Terfenadine, Cinnarizine, Salbutamol and Beclometasone dipropionate.

Books Suggested

1. Introduction to Medicinal Chemistry, A Gringuage, Wiley-VCH.
5. Strategies for Organic Drug Synthesis and design, D. Lednicer, John wiley.
PRACTICAL COURSES

M.Sc. SEMESTER III

LABORATORY COURSES MCH 307, MCH 308, MCH 309
(Effective M.Sc. Chemistry, and Applied Chemistry: July 2019)

Emphasis should be placed on physical principles, reaction chemistry and the technique involved in experiments. Attention should be placed on stoichiometric calculations and statistical analysis of results. In regular classes, each student should perform all the experiments as selected by the Department from the list in the syllabus. In examination, students should be given different experiments or combination of experiments.

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<td>(c) Qualitative analysis</td>
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<td>(d) Spectral analysis of known compounds</td>
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<td>(c) Polarimetry</td>
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Course MCH 307: Inorganic Chemistry

**Synthesis**

Synthesis of selected inorganic compounds and their studies by measurements of decomposition temperatures and molar conductance, magnetic and IR electronic spectra.

1. Aquabis(acetylacetonato)nitrosylchromium(II), [Cr(NO)(acac)_2(H_2O)]
2. cis-Bis(glycinato)copper(II) and trans-Bis(glycinato)copper(II)
3. Preparation of Zn, Cd and Hg thiocyanates from their respective chlorides
4. Bis(benzoylacetonato)copper(II)
5. Bis(acetylacetonato)oxovanadium(IV), [VO(acac)_2]
6. [MoO_2(acac)_3]
7. Hexaammminenickel(II)tetrafluoroborate, [Ni(NH_3)_{6}][BF_4]_2 and determination of nickel content gravimetrically.
8. Potassium tris(oxalato)ferrate, K_3[Fe(C_2O_4)_3] and determination of oxalate using permanganate.
9. Preparation of N,N-bis(salicylaldehyde)ethylenediamine [salenH_2], Co(salen)

Qualitative test of suitable anion and determination of metal content gravimetrically in the above compounds.

Interpretation of ESR and mass spectra of some known coordination compounds.

Course MCH 308: Organic Chemistry

**Qualitative Analysis**

Separation, purification and systematic identification of the components of a mixture of three organic compounds (solids and liquids). Preparation of one derivative of each compound. Use of TLC for ascertainment of purity of compounds.
Multi-step Synthesis
This exercise should illustrate the use of organic reactions/ diverse conditions and principles for organic synthesis. Purification of compounds by chromatographic techniques.

Photochemical reaction
Benzophenone $\rightarrow$ benzpinacol $\rightarrow$ benzpinacolone

Rearrangement
Benzaldehyde $\rightarrow$ benzoic $\rightarrow$ benzil $\rightarrow$ benzilic acid
Phthalic anhydride $\rightarrow$ phthalimide $\rightarrow$ anthranilic acid $\rightarrow$ 2-chlorobenzoic acid
Benzophenone $\rightarrow$ benzophenone oxime $\rightarrow$ benzanilide

Spectral Analysis
Interpretation of pre-recorded UV-Vis, IR, NMR, Mass, Raman spectrum and characterisation of one organic compound.

Course MCH 309: Organic Chemistry

Potentiometry
1. Acid-base titration
2. Titration of mixture of acids
3. Redox titrations
4. Determination of redox potential of Fe(III)/Fe(II) system

Conductivity
5. Verification of Onsager equation for a strong electrolyte
6. Determination of dissociation constant of a weak acid
7. Acid-base titrations
8. Replacement titration
9. Solubility of sparingly a soluble salt
10. Basicity of an organic acid

Spectrophotometry
11. Verification of Beer-Lambert law
12. Determination of pKa of an acid-base indicator such as Methyl Red

Books Suggested
10. Findley's Practical Physical Chemistry, B. P. Levitt, Longman
12. Practical Physical Chemistry, A. M. James and F. E. Prichard, Longman
M.Sc. SEMESTER IV
Course MCH 401 (PAPER I): Inorganic Chemistry
(Effective M.Sc. Chemistry, and Applied Chemistry: January 2020)

Maximum Marks 35 +15 (CCE)

UNIT I

*Electron Spin Resonance Spectroscopy.* Basic principles, hyperfine and superhyperfine splitting, g value and factors affecting g values, applications to transition metal complexes.

UNIT II

*Mössbauer Spectroscopy.* Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (1) bonding and structures of Fe$^{2+}$ and Fe$^{3+}$ compounds including those of intermediate spin, (2) Sn$^{2+}$ and Sn$^{4+}$ compounds -nature of M-L bond, coordination number, structure and (3) detection of oxidation state.

UNIT III

*Application of group theory to Spectroscopy.* Use of group theory in predicting IR and Raman active modes in some simple molecules of $C_{2v}$, $C_{3v}$, and $D_{xh}$ point groups.

UNIT IV

*Bioinorganic Chemistry.* Metal complexes in transmission of energy; chlorophylls, photosystem-I and photosystem-II in cleavage of water, model systems.

Unit V


Books Suggested
M.Sc. SEMESTER IV
Course MCH 402 (PAPER II): Organic Chemistry
(Effective M.Sc. Chemistry, and Applied Chemistry: January 2020)

UNIT I
$^{13}$C-NMR Spectroscopy General considerations, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), wide band H-decoupled and off-resonance H-decoupled spectra. Calculation of chemical shift values for alkanes and substituted benzene.

Two dimension NMR spectroscopy. COSY, and DEPT techniques.

Conjoint Spectroscopy Problems. Application of UV, IR, Raman, NMR and Mass spectrometry for elucidation of structure of organic compounds.

UNIT II
Mass Spectrometry-Part I. Ion production, electron ionisation (EI), chemical ionisation (CI), field desorption (FD), field ionisation (FI), and fast atom bombardment (FAB). Atmospheric pressure ionisation techniques. Electrospray ionisation, and atmospheric pressure chemical ionisation. Thermospray ionisation. Matrix assisted laser desorption ionisation (MALDI).


UNIT III

High resolution mass spectrometry. Interpretation of mass spectra. Problems based on mass spectrometry of organic compounds.

UNIT IV

UNIT V
Enzymes. Properties of enzymes, catalytic power, specificity and regulation. Fischer's lock and key and Koshland's induced fit hypothesis. Identification of active site by the use of inhibitors.


Coenzyme chemistry. Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+, NADP+, FMN, FAD, and vitamin B12.

Methods of immobilization of enzymes. Effect of enzyme immobilization on enzyme activity.

Books Suggested
M.Sc. SEMESTER IV
Course MCH 403 (PAPER III): Physical Chemistry
(Effective M.Sc. Chemistry, and Applied Chemistry: January 2020)

Maximum Marks 35 +15 (CCE)

UNIT I

_Nuclear Magnetic Resonance Spectroscopy._ Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurement, factors influencing chemical shift, deshielding, spin-spin interactions, factors influencing coupling constant, J. Exchange phenomenon.

UNIT II

_Electron Spin Resonance Spectroscopy._ Basic principles, zero field splitting and Kramer’s degeneracy, factors affecting the g value. Hyperfine coupling. Double resonance in esr. Spin Hamiltonian relationship, measurement techniques, applications.

UNIT III


UNIT IV


UNIT V

_Nucleophilic and Electrophilic Reactivity._ Structural and electronic effects on _S_1 and _S_2 reactivity. Solvent effects on nucleophilic displacements. Kinetic isotope effects. Intramolecular assistance. Electronic effects and reactivity in _S_2 reaction, curve-crossing model. Relationship between polar and electron transfer reactions.

Books Suggested
1. Quantum Chemistry, Eyring and Kimball.
2. Quantum Mechanics, Hanna.
5. Physical Chemistry, P.W. Atkins, ELBS.
M.Sc. SEMESTER IV
Course MCH 404A (ELECTIVE PAPER IV): Organic Synthesis
(Effective M.Sc. Chemistry, and Applied Chemistry: January 2020)

Maximum Marks 35 +15 (CCE)

UNIT I
Designing organic synthesis. The Disconnection Approach. Basic principles, synthons, functional
group interconversions. Order of events in organic synthesis. One group C-X disconnections and two

UNIT II
Organoboranes. Preparation of organoboranes and their synthetic applications. Oxidation,
protonolysis and isomerisation. Carbynylation of organoboranes. Cyanoborate process. Reaction of
alkenyl boranes and trialkylalkynyl borates.
Organosilanes. Synthetic applications of trimethylsilyl chloride, trimethylsilyl cyanide, trimethylsilyl
iodide and trimethylsilyl triflate.
Synthetic applications of α-silyl carbanions and β-silyl carbonium ions.

UNIT III
Oxidation. Oxidation of carbon-carbon double bond. Perhydroxylation, potassium permanganate,
rosmium tetroxide, iodine together with silver carboxylates, ozonolysis. Enantioselective epoxidation of
allylic alcohols (Sharpless epoxidation).
Oxidation of alcohols. Chromic acid, chromium (VI) oxide-pyridine complexes, manganese (IV)
oxide, silver carbonate, oxidation via alkoxysulphonium salts.
Baeyer-Villiger oxidation of ketones.
Oxidation with ruthenium tetroxide, thallium(III) nitrate and iodobenzene diacetate.

UNIT IV
Reduction. Catalytic hydrogenation (homogeneous and heterogenous). Stereochemistry and
mechanism, selectivity of reduction.
Reduction by dissolving metals. Metal and acid, metal and alcohol, metal and ammonia.
Reduction by hydride-transfer reagents. Aluminium alkoxides, lithium aluminium hydride, sodium
borohydride, lithium hydrido-alkoxyaluminates.

UNIT V
Phase transfer catalysis, principle and applications.
Basic principles of convergent and linear synthesis.
Stereospecific and stereoselective synthesis. Regioselectivity.
Synthetic uses of lead tetraacetate, N-bromosuccinimide, selenium dioxide, dialkyl lithium cuprate,
lithium diisopropylamine. Umpolung reaction.

Books Suggested
4. R. Bruckner, Advanced organic chemistry: Reaction and mechanism, Harcourt (India), New Delhi.
5. H.O. House and W.A. Benjamin, Modern synthetic reactions.
M.Sc. SEMESTER IV
Course MCH 404B (ELECTIVE PAPER IV): Polymers
(Effective M.Sc. Chemistry, and Applied Chemistry: January 2020)

Maximum Marks 35 +15 (CCE)

UNIT I
Basics of Polymers. Repeating units, degree of polymerisation, linear, branched and network polymers. Classification of polymers. Addition, radical, ionic, coordination and condensation polymerisation; their mechanism and examples.
Polymerisation conditions and polymer reactions. Polymerisation in homogeneous and heterogeneous systems.

UNIT II

UNIT III
Structure and Properties. Configuration of polymer chains. Crystal structure of polymers. Morphology of crystalline polymers. Polymer structure and physical properties; crystalline melting point Tm, melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, Tg relationship between Tm and Tg, effects of molecular weight, diluents, chemical structure, chain topology, branching and cross linking. Property requirements and polymer utilization.

UNIT IV

UNIT V
Properties of Polymers. Properties of polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicone polymers.
Functional polymers. Fire retarding polymers, and electrically conducting polymers.
Biomedical polymers. contact lens, dental polymers, artificial heart, kidney, skin and blood cells.

Books Suggested
M.Sc. SEMESTER IV  
Course MCH 404C (ELECTIVE PAPER IV): Organo Transitional Metal Chemistry  
(Effective M.Sc. Chemistry, and Applied Chemistry: January 2020)

Maximum Marks 35 +15 (CCE)

UNIT I

Alkyls, Aryls and hydrides of Transition Metals. Types, routes of synthesis, stability and decomposition pathways and bonding schemes of transition metal alkyls and aryls. Transition metal compounds with bonds to hydrogen: Synthetic methods, characterization and chemical behaviour of transition metal hydrido compounds.

UNIT II

Compounds of Transition Metal-Carbon Multiple Bonds. Alkylidenes, alkylidyenes, low-valent carbenes and carbynes-synthesis, Nature of bond, structural characteristics, nucleophilic and electrophilic reactions on ligands, role in organic synthesis.

UNIT III

Transition Metal π-Complexes. Transition metal complexes with unsaturated organic molecules like alkenes, alkynes, allyl, diene, dienyl and arene complexes: preparations, properties, nature of bonding and structural features.

UNIT IV

Homogeneous Catalysis. Stoichiometric reactions for catalysis and homogeneous catalytic hydrogenation, Zeigler-Natta polymerization of olefin, catalytic reactions involving hydrocarbonylation of olefins (oxo reaction), activation of C-H bonds.

UNIT V

Fluxional Organometallic Compounds. Fluxionality and dynamic equilibria in compounds such as \( \eta^2 \)-olefin, \( \eta^3 \)-allyl and dienyl complexes.

Books Suggested
M.Sc. SEMESTER IV
Course MCH 404D (ELECTIVE PAPER IV): Solid State Chemistry
(Effective M.Sc. Chemistry, and Applied Chemistry: January 2020)

Maximum Marks 35 +15 (CCE)

Unit I
Solid State Reactions. General principles, experimental procedure, co-precipitation as a precursory to solid state reactions, kinetics of solid state reactions.

Unit II
Crystal Defects and Non-Stoichiometry. Perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and plane defects, vacancies-Schottky detects and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, colour centres, non-stoichiometry and defects.

Unit III

Unit IV

Unit IV

Books Suggested
UNIT I

Structure determination, stereochemistry, and synthesis of the following representative molecules:
citral, geraniol, α-terpineol, menthol, α-pinene, camphor, and abietic acid. Biosynthesis of terpenoids.

UNIT II

Alkaloids. General methods of structure elucidation.
Structure determination, stereochemistry, and synthesis of the following representative molecules:
ephedrine, nicotine, atropine, quinine and morphine. Biosynthesis of alkaloids.

UNIT III

Steroids. Structure elucidation, stereochemistry and chemical synthesis of cholesterol, bile acids,
androsterone, testosterone, estrone, progestrone and aldosterone. Biosynthesis of steroids.

UNIT IV

Flavonoids. Nature, general methods for structure elucidation and synthesis of anthocyanins and
flavones. Structure and synthesis of cyanidin chloride, cyanin, flavone, flavonol and quercetin.
Biosynthesis of flavonoids.
Chlorophyll. Chemistry of chlorophyll.

UNIT V

Vitamins and Antibiotics. Vitamins. Structure and synthesis of vitamin B₁ (thiamine), B₂ (riboflavin)
and B₆ (pyridoxine). Chemistry of Vitamin B₁₂.
Antibiotics. Structure and synthesis of penicillins and chloramphenicol.

Books Suggested
2. J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Natural products, chemistry and biological
   significance, Longman, Essex.
M.Sc. SEMESTER IV
Course MCH 405B (ELECTIVE PAPER V): Physical Organic Chemistry
(Effective M.Sc. Chemistry, and Applied Chemistry: January 2020)

Maximum Marks 35 +15 (CCE)

UNIT I


UNIT II

UNIT III
Radical and Pericyclic Reactivity. Radical stability, polar influences, solvent and steric effects. A curve crossing approach to radical addition, factors effecting barrier heights in additions, regioselectivity in radical reactions.

Reactivity, specificity and periselectivity in pericyclic reactions.

UNIT IV

Principles of molecular association and organization as exemplified in biological macromolecules such as enzymes, nucleic acids, membranes and model systems as micelles and vesicles. Molecular receptors and design principles.

UNIT V
Redox Reactions by Excited Metal Complex. Energy transfer under conditions of weak interaction and strong interaction-exciplex formation; conditions of the excited states to be useful as redox reactants, excited electron transfer, metal complexes as attractive candidates (2,2'-bipyridine, and 1,10-phenanthroline complexes), illustration of reducing and oxidising character of ruthenium(II)-bipyridyl complex, its comparison with Fe(II)(bipy)$_3$; role of spin-orbit coupling, life time of these complexes. Application of redox processes of electronically excited states for catalytic purposes.

Books Suggested
5. Introduction to Theoretical Organic Chemistry and Molecular Modelling, W.B. Smith, VCH.
M.Sc. SEMESTER IV
Course 405C (ELECTIVE PAPER V): Environmental Chemistry
(Effective M.Sc. Chemistry, and Applied Chemistry: January 2020)

Unit-I

Atmospheric Chemistry. Sources of trace atmospheric constituents: nitrogen oxides, sulphure dioxide and other sulphure compounds, carbon oxides, chlorofluorocarbons and other halogen compounds, methane and other hydrocarbons.


Unit-II
Air Pollution. Air pollutants and their classifications. Aerosols-sources, size distribution and effect on visibility, climate and health.

Acid Rain. Definition, Acid rain precursors and their aqueous and gas phase atmospheric Oxidation reactions. Damaging effects on aquatic life, plants, buildings and health. Monitoring of SO2 and NOx. Acid rain control strategies.

Stratospheric Ozone Depletion. Mechanism of Ozone formation, Mechanism of catalytic Ozone depletion, Discovery of Antarctic Ozone hole and Role of chemistry and meteorology. Control Strategies.

Green House Effect. Terrestrial and solar radiation Spectra, Major green house gases and their sources and Global warming potentials. Climate change and consequences.


Unit-III

Unit IV
Environmental Toxicology. Toxic heavy metals. Mercury, lead, arsenic and cadmium. Causes of toxicity. Bioaccumulation, sources of heavy metals. Chemical speciation of Hg, Pb, As, and Cd. Biochemical and damaging effects.

Toxic Organic Compound. Pesticides, classification, properties and uses of organochlorine and ionospheres pesticides detection and damaging effects.

Polychlorinated biphenyls. Properties, use and environmental continuation and effects.

Polynuclear Aromatic Hydrocarbons. Source, structures and as pollutants.

Unit-V
Soil and Environmental Disasters. Soil composition, micro and macronutrients, soil pollution by fertilizers, plastic an metals. Methods of re-mediation of soil. Bhopal gas tragedy, Chernobyl, three mile island, Minimtata Disease, Sevoso (Italy), London smog.

Books Suggested
5. Introduction to atmospheric Chemistry, P.V. Hobbs, Cambridge.
M.Sc. SEMESTER IV  
Course 405D (ELECTIVE PAPER V): Heterocyclic Chemistry  
(Effective M.Sc. Chemistry, and Applied Chemistry: January 2020)

Maximum Marks 35 +15 (CCE)

Unit I  
**Nomenclature of Heterocycles.** Replacement and systematic nomenclature (HantzsMCH-Widman system) for monocyclic fused and bridged heterocycles.  
**Aromatic Heterocycles.** General chemical behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in 1H NMR spectra. Empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations). Heteroaromatic reactivity and tautomerism in aromatic heterocycles.

Unit II  
**Non-aromatic Heterocycles.** Strain-bond angle and torsional strains and their consequences in small ring heterocycles. Conformatino of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1,3-diaxial interactic. Ateroelectronic effects anomeric and related effects, Attractive interactions-hydrogen bonding and intermolecular nucleophilic lectrophilic interactions. Heterocyclic Synthesis Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reactions.

Unit III  
**Small Ring Heterocycles.** Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiranes, azetidines, oxetanes and thietanes.  
**Benzo-Fused Five-Membered Heterocycles.** Synthesis and reactions including medicinal applications of benzopyrroles, benzofurans and benzothiophenes.

Unit IV  
**Meso-ionic Heterocycles.** General classification, chemistry of some important meso-ionic heterocycles of type-A and B and their applications.  
**Six-Membered Heterocycles with one Heteroatom.** Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and phridones. Synthesis and reactions of quionilzinum and benzopyrylium salts, coumarins and chromones.

Unit V  
**Six Membered Heterocycles with Two or More Heteroatoms.** Synthesis and reactions of diazones, triazines, tetrazines and thiazines. Seven-and Large-Membered Heterocycles Synthesis and reactions of azepines, oxepines, thiepines, diazepines thiazepines, azocines, diazocines, dioxocines and dithiocines.  
**Heterocyclic Systems Containing P, As, Sb and B.** Heterocyclic rings containing phosphorus. Introduction, nomenclature, synthesis and characteristics of 5- and 6-membered ring systems phosphorinaes, phosphorines, phospholanes and phosphophiles. Heterocyclic rings containing As and Sb. Introduction, synthesis and characteristics of 5- and 6-membered ring system. Heterocyclic rings containing B. Introduction, synthesis reactivity and spectral characteristics of 3- 5- and 6-membered ring system.

Books Suggested
2. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
M.Sc. SEMESTER IV
LABORATORY COURSE MCH 407
(Effective M.Sc. Chemistry, and Applied Chemistry: January 2020)

Emphasis should be placed on physical principles, reaction chemistry and the technique involved in experiments. Attention should be placed on stoichiometric calculations and statistical analysis of results. In regular classes, each student should perform all the experiments as selected by the Department from the list in the syllabus. In examination, students should be given different experiments or combination of experiments.

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<td>(c) Electronics</td>
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Course MCH 407: Inorganic Chemistry

Spectrophotometric Determination
1. Determination of molecular composition of ferric salicilate /iron-phenanthroline/iron-dipyridyl complex by Job’s method of continuous variation
2. Stability constant of FeSCN$^{2+}$ complex
3. Determination of the pH of a given solution by spectrophotometry using methyl red indicator

Model Experiments on Cyclic Voltammetry
Acquaintance with cyclic voltammetry experiments involving use of K$_3$[Fe(CN)$_6$]
1. Cyclic voltammograms of K$_3$[Fe(CN)$_6$] at different scan rates
2. Cyclic voltammograms of K$_3$[Fe(CN)$_6$] at different concentrations

Interpretation of ESR, NMR and Thermogravimetric pre-recorded results of known compounds
Pre-recorded spectrum/data shall be provided for their interpretation leading to structure determination of metal ion complexes with organic ligands.

Course MCH 408: Organic Chemistry

Multi-step Synthesis

Heterocyclic compounds
Phenylhydrazine $\rightarrow$ acetoacetone phenylhydrazone $\rightarrow$ 2-phenylindole  
Quinoline from Skraup synthesis  
Ethyl acetacetate $\rightarrow$ 3-methyl-1-phenylpyrazol-5-one $\rightarrow$ antipyrin (phenazine)  
Benzaldehyde $\rightarrow$ benzoin $\rightarrow$ benzil $\rightarrow$ 5,5-diphenylhydantoin  
Benzaldehyde $\rightarrow$ benzoin $\rightarrow$ benzil $\rightarrow$ 2,3-diphenylquinoxaline

Mixed principles
Aniline $\rightarrow$ 2,4,6-tribromoaniline $\rightarrow$ 1,3,5-tribromobenzene  
Aniline $\rightarrow$ 2,4,6-tribromoaniline $\rightarrow$ 2,4,6-tribromo-1-chlorobenzene
Phenol $\rightarrow$ mixture of 2- and 4- nitrophenols $\rightarrow$ separate 2- and 4- nitrophenols
Chlorobenzene $\rightarrow$ 1-chloro-2,4-dinitrobenzene $\rightarrow$ 2,4-dinitrophenylhydrazine
Quantitative Analysis
- Determination of methoxy group
- Determination of halogen by fusion or oxygen flask combustion method
- Diol groups (ring size in carbohydrates) by periodate oxidation
- Spectrophotometric (colorimetric) determination of glucose by Fehling reaction
- Determination of acetone by iodoform reaction
- Determination of vitamin C in drug formulations and in fruits

Spectral Analysis
- Interpretation of pre-recorded UV-Vis, IR, NMR, Mass, Raman spectrum and characterisation of one organic compound.

Course MCH 409: Physical Chemistry

Spectrophotometry
1. Determination of stability constant of Fe(III)-salicyclic acid complex

Chemical Kinetics
2. Determination of order of $\text{S}_2\text{O}_8^{2-} - \text{I}^-$ reaction
3. Determination of energy of activation of $\text{S}_2\text{O}_8^{2-} - \text{I}^-$ reaction
4. Studies on the effect of variation of ionic strength on the rate of $\text{S}_2\text{O}_8^{2-} - \text{I}^-$ reaction
5. Ester hydrolysis catalysed by a base
6. Kinetics of acid-catalysed reaction between acetone-iodine

Electronics
7. Voltage measurement with CRO
8. Measurement of e.m.f. with thermocouple
9. To plot the characteristic curve of a diode

Books Suggested
10. Findley's Practical Physical Chemistry, B. P. Levitt, Longman
12. Practical Physical Chemistry, A. M. James and F. E. Prichard, Longman