REVISED (DRAFT) SYLLABUS

FOR

M.Sc. Chemistry

(CBCS- Based)

CBCS-based syllabus for M.Sc. Chemistry (2 years) Programme

General Informations:

(1) It is two years Master Degree Programme

(2) There shall be four semester to complete programme, i.e. 1st, 2nd, 3rd and 4th semester

(3) Each semester shall consist of 15 weeks of academic work equivalent to 90 actual teaching days.

(4) This programme will have three types of courses, i.e. Core course and Elective course.

Core course- The core courses are those courses whose knowledge is deemed essential for the students registered for a particular Master's degree programme.

Elective course- The elective course can be choosen from a pool of papers in IInd and IVth semester.

(5) Each course will have 100 marks in full and divided into 70 marks for end-semester exam and 30 marks for internal assessment work except AEC, AECC-1, AECC-2 and practical papers. Internal assessment will be in two internal exams of 10 marks each, 5 marks for seminar/internal project and 5 marks for attendance/discipline.

(6) In practical papers the distribution of marks in CIA will be same as prescribed for term end semester practical papers.

(7) A student in fourth semester can choose a generic paper or CC-5 paper of any other subject of the faculty as DSE.

Credits- A unit by which the course work is measured. It determines the number of hours of instruction required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/ field work per week.

Semester- II
Core Course – V
Advances in Chemistry

Unit- I **Nuclear Chemistry**

(a) Shell model, Liquid Drop Model, Nuclear Reactions and their Types. Nuclear Reaction Cross-section.

(b) Application of radio isotopes, tracer Techniques, Neutron activation analysis, isotope dilution method, Nuclear reactor.

Unit- II **Nanomaterials and Green chemistory**

Definition, sources, examples, Bottom-up Method of synthesis, Characterizations, and applications, synthesis in green chemistory.

Unit- III **Solid State Chemistry**

Conductor, Semiconductor, and superconductor; Theory and Applications

Unit- IV **Industrial Application of Chemistry**

Chemistry of Cement, Paper and Pulp, and Petroleum

Unit- V **Waste Management**

Nuclear waste management,

e-waste management,

Recycling of plastic: sorting, washing, shredding, identification and classification, extruding.

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Semester- II
Core Course – VI
Inorganic Chemistry II

Full Marks – 70 Credits- 5

Unit- I **Electronic Spectra of Transition Metal Complexes.**

Spectroscopic ground states, correlation and spin-orbit coupling in free ions for 1st series of transition metals, Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), calculation of Dq, B and β parameters, effect of distortion on the d-orbital energy levels. Structural evidence from electronic spectrum, John-Tellar effect, Spectrochemical and nephalauxetic series, charge transfer spectra, electronic spectra of molecular addition compounds.

Unit- II **Symmetry in Chemistry.**

Symmetry elements and symmetry operations, definition of groups, sub-group, conjugate and class. Point symmetry group. Requirements of a mathematical group, multiplication table for C_{2V}, C_{3V}

Unit- III **Group theory in Chemistry.**

Representation of group by matrices. Working out representation of C_{2V}, C_{3V} point groups. Character of a representation. The great orthogonality theorem (without proof) and its importance in derivation of character table. Construction of character table for C_{2V} and C_{3v} point group.

Unit – IV **Metal π- complexes.**

Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation. Preparation, bonding, structure and important reaction of transition metal nitrosyls.

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Unit- V **Metal Clusters**

Structure and bonding in higher boranes, Wade's rules, Carboranes.

Books Recommended:

1. Advanced Inorganic Chemistry- F.A. Cotton and G. Wilkinson.
2. Inorganic Chemistry- Principles of Structure and reactivity – J.E. Huheey
3. Concise Inorganic Chemistry- J.D. Lee
4. Group Theory and its chemical applications- F.A. Cotton
5. Group Theory and its chemical applications- P.K. Bhattacharya

Semester- II

Core Course – VII

Physical Chemistry-II

Full Marks- 70 **Credits- 5**

Unit- I **Introduction of quantum mechanics**

(i) Functions and operators and their types and properties, Dirac's Bra-ket notation, normalisation and orthogonalisation of functions, Kronecker delta.

(ii) Quantum mechanical operators and physical quantities, Time dependant and time independant schrodinger wave equations, Expection values.

Unit- II **Exactly Soluble System.**

(i) Linear Harmonic oscillator, Harmonic Vibration, Hermite differential equation and its solution through recursion relation. Hermite polynomial.

(ii) H-like atoms, separation of R(r) ,Θ(θ) and **Φ** (**φ**) Equations and their solutions, radial and angular wave functions, radial distribution functions, Laguerre and Associated Laguerre Polynomials, Legendre polynomials and Associated Legendre polynomials, quantam mechanical treatment of rigid rotator.

Unit- III **Approximate Method.**

Variation method, Secular equation, Perturbation method, first order perturbation, Application to He-atom. Symmetric and antisymmetric wave functions. Slater determinant, singlet and triplet states.

Unit- IV **Chemical Bonding**

Born Oppenheimer approximation, LCAO-MO theory, application of LCAO-MO theory to H_2^+ ion and H_2 molecule, V.B. theory and it's application to H_2 molecule

Unit- V **Huckel Molecular Orbital Theory**

Huckel theory of conjugated systems, Application to ethylene, butadiene, allyl systems and benzene, calculation of D.E., π-electron density and π-bond order.

Books Suggested :

1. Quantum Chemistry : I.R. Lavine Prentiee Hall.
2. Quantum Chemistry : Pillar
3. Quantum Chemistry : R.K. Prasad
4. Quantum Chemistry : Satya Prakash Swati Saluja
5. Solid State Chemistry : D.K. Chakrabarty, New Age International
6. New Direction Solid State Chemistry : C.N. R. Rao & J. Gopal
7. Introduction to quantum : A.K. Chandra, Tata
8. Quantum Chemistory : A.B. Sannigrahi

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Kolkata 700009.

Semester- II

Core Course- VIII

Organic Chemistry- II

Full Marks – 70 **Credits- 5**

Unit- I **Addition to Carbon-Carbon Multiple Bonds :**

Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio –selectivity, orientation and reactivity. Hydrogenation, Hydroxylation Hydroboration.

Michael reaction.

Addition to Carbon- Hetero Atom Multiple Bonds :

Nucleophilic addition of carbonyl compounds,

Mechanism of metal hydride reduction of saturated carbonyl compounds, Wittig reaction. Mechanism of condensation reactions involving enolates – Aldol, Benzoin, Perkin and Stobbe reactions.

Unit- II **Photochemistry of Carbonyl Compounds :**

Principles of Photochemistry, Electronic excitation, hydrogen abstraction. photochemistry of p-benzophenones, Norrish type I and Norrish type II, reaction, Paterno-Buchi reaction.

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Photochemistry of unsaturated system

Olefins, cis-trans isomerisation, dimerisation, hydrogen abstraction and additions. photochemistry of 1, 3-butadiene (2+2) additions leading to cage structures, photochemistry of cyclohexadienes, Photo-Fries rearrangement, Photo-Fries reaction of anilides, photosubstitution reaction of benzene derivatives, Photolysis of nitride esters and Barton reaction.

Unit- III **Pericyclic Reactions**

Molecular orbital symmetry, Frontier orbitals of ethylene, 1, 3-butadiene, 1,3,5-hexatriene and allyl system, Classification of pericyclic reactions, Woodward-Hoffmann principle FMO and PMO approach, Electrocyclic reactions-conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems. Cycloadditions-antrafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3-dipolar cycloadditions and

Sigmatropic rearrangement

Suprafacial and antarafacial shift of H, sigmatropic shifts involving carbon moieties, (3,3) and (5,5) sigmatropic rearrangements, detailed treatment of Claisen and Cope-rearrangements. Introduction to Ene reactins.

Unit- IV **Oxidation:**

Different oxidative processes, oxidation of alkenes, aromatic rings, alcohols, diols, ketones with emphasis on oxidation by peracides, peroxides, HIO_4, $Pb(OAc)_4$ and SeO_2.

Unit- V **Molecular rearrangements**

General mechanistic consideration, A detail study of the following rearrangements : Wegner-Meerwein rearrangements Neber, Curtius, Arndt Eistert reaction, Benzilic acid, Beckmann rearrangements.

Books Recommended

1. Structure and Mechanism in Organic Chemistry by C.K. Ingold.
2. Modern Organic Reactions by H.O. House .
3. Principles of Organic Synthesis by R.O.C. Norman and J.M. Coxon.
4. Reaction Mechanism in Organic Chemistry by S.M. Mukherji and S.P. Singh.
5. Carbohydrate by S.P. Bhutani.
6. Organic Chemistry by I.L. Finar.
7. Photochemistry and Pericyclic reactions by Jagdamba Singh and Jaya singh.
8. Introductory Photochemistry by A. Cox and T. Camp.
9. Photochemistry by R.P. Kundall and A. Gilbert.
10. Organic Photochemistry by J. Coxon and B. Halton.
11. Organic Photochemistry by Orville L. Chapman.
12. Pericyclic Reactions by S.M. Mukherji.
13. The Conservation of Orbital Symmetry by R.B. Woodward and R. Hoffman.
14. Orbital Symmetry by R.E. Lehr and A.P. Merchant.

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Semester- II

Core Course- IX

Practical (Organic Chemistry)

Full Marks- 50 **Credits- 5**

1. Quantitative Analysis

Separation and identification of organic compounds in binary mixtures by chemical tests and preparation of their derivatives. 15 Marks

2. Organic Synthesis via two steps preparation 15 Marks

a. p-Nitroaniline from acetanilide.
b. p-Bromoaniline from acetanilide
c. Anthranilic acid from phthalic anhydride.
d. p-Bromoacetanilide from aniline.
e. p-Nitroacetanilide from aniline.

3. Viva Voce 15 Marks

4. Note Book 05 Marks

Books Recommendation :

1. Advanced Practical Chemistry by Jagdamba Singh, L. D. S. Yadav and Jaya singh
2. Systematic Qualitative Organic Analysis by H. Middleton .
3. Handbook of Organic Analysis-Qualitative and Quantitative by H. Clark.
4. Vogel's Textbook of Practical Organic Chemistry by A. R. Tatchell.

20.8.18