

CMJ UNIVERSITY, SHILLONG

REGULATION FOR MSc CHEMISTRY

Duration – Two Years

Eligibility - B.Sc. with relevant subject or its equivalent

Scheme of Distribution of Marks

Sr. No.	First Year	Internal Assessment Marks	Term End Examination	Total Marks	Passing Marks
1	Organic Chemistry – I	30	70	100	40
2	Inorganic Chemistry-I	30	70	100	40
3	Physical Chemistry – I	30	70	100	40
4	Spectroscopy	30	70	100	40
Sr. No.	Second Year	Internal Assessment Marks	Term End Examination	Total Marks	Passing Marks
1	Organic Chemistry - II	30	70	100	40
2	Inorganic Chemistry - II	30	70	100	40
3	Physical Chemistry - II	30	70	100	40
4	Environmental chemistry	30	70	100	40
5	Practical – II				

M.Sc CHEMISTRY (Frist year)

ORGANIC CHEMISTRY – I MSC 101 SYLLABUS

UNIT – I

Types of Reactions, Mechanisms and Reaction intermediates

Types of reactions : Substitutions, Additions, Eliminations, Rearrangements, Oxidations and Reductions reactions – a general study.

Reaction mechanisms: Types of mechanisms : Heterolytic, Homolytic and Pericyclic mechanisms – a general study.

Reaction intermediates: Formation, stability and structure of carbonium ions, carbanions, carbenes, and nitrenes.

UNIT -2

Free radicals.

Long lived and short lived free radicals, methods of generation and detection of free radicals, free radical reactions: Sandmeyer reaction, Gomberg-Bachmann reaction, Pschorr reaction and Ullmann reaction, mechanism of Hunsdiecker reaction.

UNIT -3

Aliphatic Nucleophilic Substitution Reactions mechanism

The S_N^2 , S_N^1 , mixed S_N^1 and S_N^2 , S_N^i and SET mechanisms. The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance. Nucleophilic substitution at an allylic, aliphatic trigonal and vinylic carbon.

UNIT -4

Nucleophilic Substitution Reactivity Effects

Reactivity effects of substrates structure, attacking nucleophile, leaving group and reaction medium, ambident nucleophile, regioselectivity. Substitution at carbon doubly bonded to oxygen and nitrogen, Williamson reaction, Von-braun reaction, hydrolysis of esters, Claisen and Dieckmann condensation.

UNIT 5

Heterocyclic Compounds

Synthesis and properties of imidazole, oxazole, thiazole and indole. General methods of Synthesising Anthocyanidins, Synthesis and Structural elucidation of Cyanidin Chloride, Synthesis and Structural elucidation of flavones and isoflavones (Daidzein), Synthesis of pyrimidine and its derivativess, Synthesis of purine, uric acid and caffeine

INORGANIC CHEMISTRY-I

MSC 102

SYLLABUS

UNIT-I

Structure and Bonding

Van der Waals bonding, Hydrogen bonding and applications, Hard and Soft acids and bases-classification, Acid-Base strength, hardness, Symbiosis, Theoretical basis of Hardness and Softness, applications of HSAB.

Polyacids - Isopolyacids of V, Cr, Mo and W; Heteropoly acids of Mo and W (only structural aspects). Inorganic polymers-Silicates-structure, Pauling's rule, properties, correlation and application; Molecular sieves.

UNIT-II

Nuclear Chemistry-Properties, Detection, Decay

Nuclear properties-Nuclear spin and moments, origin of nuclear forces, features of the liquid drop and the shell models of the nucleus; Modes of radioactive decay - orbital electron capture, nuclear isomerism, internal conversion; Detection and determination of activity - Cloud chamber, nuclear emulsion, Bubble chamber, GM, Scintillation and Cherenkov counters.

UNIT III

Stability of complexes and Stereochemical aspects

Stability of complexes - Factors affecting stability of complexes, thermodynamic aspects of complex formation, Stepwise and overall formation constants, stability correlations, statistical and chelate effects; Determination of stability constant-polarographic, photometric and potentiometric methods.

Stereochemical aspects-Stereoisomerism in inorganic complexes, isomerism arising out of ligand distribution and ligand conformation, chirality nomenclature of chiral complexes; application of ORD and CD in the identification of chirality of complexes.

UNIT IV

Electronic Spectra of Complexes

Spectroscopic Term symbols for d^n ions-derivation of term symbols and ground state term symbol, Hund's rule; Selection rules-break down of selection rules, spin-orbit coupling, band intensities, weak and strong field limits-correlation diagram; Energy level diagrams; Orgel and Tanabe-Sugano diagrams; effect of distortion and spin orbit coupling on spectra; Evaluation of Dq and B values for octahedral complexes of Nickel; Charge transfer spectra; magnetic properties of complexes

UNIT V

Analytical Chemistry –Polarograph

Polarography-Theory, apparatus, DME, diffusion, kinetic, catalytic currents, current voltage curves for reversible and irreversible systems; qualitative and quantitative applications to Inorganic systems. Amperometric titrations-Theory, apparatus, types of titration curves, successive titrations and two indicator electrodes; applications; Complexometric titrations-Chelating agents; types of EDTA titration-direct and back titrations; replacement titrations-making and demasking reagents.

PHYSICAL CHEMISTRY – I

MSC 103

SYLLABUS

UNIT – I

Classical Thermodynamics – I

Maxwell's relations and thermodynamic equations of state – applications in the evaluation of $C_p - C_v$ for solids and for vanderwaals gases, $C_p - C_v$ in terms of coefficient of expansion and coefficient of compressibility – Relation between C_p and C_v – Partial molar properties – Gibbs – Duhem equation –

UNIT – II

Statistical Thermodynamics

Objectives of Statistical Thermodynamics – concept of thermodynamical and mathematical probabilities – Distribution of distinguishable and non-distinguishable particles.

Maxwell – Boltzmann, Bose – Einstein and Fermi – Dirac statistics – comparison and application.

UNIT – III

Group Theory – I

Symmetry elements and symmetry operations – Point groups – identification and representation of groups – comparison of Molecular symmetry with Crystallographic symmetry – Reducible and irreducible representation – Direct product representation – Great orthogonality theorem and its consequences – Character Table and their uses.

UNIT IV

Chemical Kinetics-I

Theories of Reaction rates – Arrhenius theory – effect of temperature on reaction rate – Hard – Sphere collision theory of reaction rates – molecular beams – collision cross section – effectiveness of collisions – Probability factor

UNIT – V

Chemical Kinetics-II

Theory of Absolute Reaction Rate – Potential energy surface – Partition functions and activated complex – Eyring equation – Comparison of results with Eyring and Arrhenius equations – Estimation of free energy, enthalpy and entropy of activation and their significance

SPECTROSCOPY

MSC 104

SYLLABUS

UNIT I

Microwave Spectroscopy

Interaction of matter with radiation – Einstein's theory of transition probability – Rotation spectroscopy – Rigid Rotor – Intensity of spectral lines – Molecular parameters from Rotation spectra – Effect of isotopic substitution on the rotation spectra.

UNIT II

IR and Raman Spectra

Theory, principle, instrumentation of IR and Raman Spectra. Characteristic group frequencies of organic molecule, Factors influencing vibrational frequencies, interpretation of IR spectra of organic molecules. Raman spectroscopy – Raman effect – Rotational and vibrational Raman Spectra. Applications of Raman Spectra.

UNIT III

UV-VIS and Emission Spectra

Theory, principle, instrumentation of UV – VIS and Emission spectra. UV-VIS : Woodward – Fieser rules for dienes, enones. Calculation of λ_{max} for organic molecules. Chromophores and effect of conjugation, substituents with unshared electrons and their capability of π - conjugation . Colour in compounds. Applications of UV – VIS and Emission spectra.

UNIT IV

^1H and ^{13}C NMR Spectra

NMR spectroscopy: Theory, principle, instrumentation, Chemical shift, factors influencing chemical shift, spin-spin coupling, NMR of simple AX and AMX type organic molecules, calculation of coupling constants, identification of H in various chemical environments to assign structure to the organic molecules using chemical shift values, resonance coupled and decoupled spectra ^{13}C NMR, applications of ^{13}C NMR to find the different carbon functional groups.

UNIT V

Mass spectra

Mass spectra – theory, principle, instrumentation and applications. McLafferty rearrangement, fragmentation pattern, Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

MASTER OF SCIENCE [CHEMISTRY]Second Year

ORGANIC CHEMISTRY - II MSC - 201

UNIT - I

HYDROCARBONS

Alkanes, Classification Of Hydrocarbons, Alkynes, Methods Of Preparation Of Aromatic Hydrocarbons, Structure Of Benzene, Properties Of Benzene, S_e -Reactions Of Toluene (Methyl Benzene)

UNIT - II

ALCOHOLS AND PHENOLS

Preparation Of Monohydric Alcohols, Dihydric Alcohols (Ethylene Glycol), Trihydric Alcohols (Triols), Preparation Of Trihydric Alcohols, Phenols, Preparation Of Phenols, Properties Of Phenols,

UNIT - III

THE CARBONYL COMPOUNDS

Structure Of The Carbonyl Group, General Methods Of Preparation, Reduction Of Carbonyl Compounds, Polymers Of Carbonyl Compounds, Aromatic Carbonyl Compounds, Properties Of Benzaldehyde

UNIT - IV

CARBOXYLIC ACIDS AND THEIR DERIVATIVES,

Aliphatic Carboxylic Acids, Aromatic Carboxylic Acids, Acid Derivatives, Nucleophilic Acyl Substitution, Acid Or Acyl Chlorides, Reactions Of The Acyl Chlorides, Acid Anhydride $(Rco_2)O$, Acid Amides, Esters

UNIT - V

NITROGEN CONTAINING COMPOUNDS

Amines, Aliphatic Amines, Aryl Amines, Cyanides And Isocyanides, Alkyl Cyanides $(R-C\equiv N)$, Alkyl Isocyanides Or Alkyl Isonitriles $(R-N\equiv C)$, Nitro Compounds, Nitro Alkanes, Aromatic Nitro Compounds

INORGANIC CHEMISTRY - II

MSC – 202

UNIT – I

ANALYTICAL CHEMISTRY

Introduction, Physical Examination Of The Mixture, Analysis Of Acidic Radicals, Analysis Of Acidic Radicals Of Group I, Analysis Of Acidic Radicals Of Group II, Analysis Of Acidic Radicals Of Group III, Analysis Of Basic Radicals, Detection Of Basic Radicals

UNIT – II

HYDROGEN AND ITS COMPOUNDS

Isotopes Of Hydrogen, Dihydrogen (H_2 Molecule)-Industrial Preparation Of Hydrogen, Special Forms Of Hydrogen, Hydrides, Compounds Of Hydrogen, Water H_2O , Hydrogen Peroxide, Strength Of H_2O_2

UNIT – III

CHEMISTRY OF S-BLOCK ELEMENTS

Group IA Alkali Metals, Physical And Chemical Properties, Lithium Li, Sodium (Na), Properties Of Sodium, Potassium(K), Compounds Of Potassium, Group IIA Alkaline Earth Metals, Beryllium(Be), Magnesium(Mg), Calcium(Ca), Composition Of Portland Cement,

UNIT – IV

CHEMISTRY OF 4 p-BLOCK ELEMENTS

Part-1 Elements Of Group IIIA, Part-2 Elements Of Group IV A, Raw Material, Part-3-Elements Of Group VA, Part-4 Elements Of Group VI A, Parts-5 Elements Of Group VIIA, Part VI Elements Of Zero Group

UNIT – V

CHEMISTRY OF TRANSITION (D-BLOCK) AND INNER TRANSITION (F-BLOCK) ELEMENTS

General characteristics of d-block Elements, Extraction, Chromium, Manganese, Iron, Copper, Zinc, Important compounds of some Transition Metals, Part-2 *F*-Block Elements Lanthanides, Actinides, Important reactions of *D*-and *f*-Block Elements

PHYSICAL CHEMISTRY - II

MSC - 203

UNIT – I

STATES OF MATTER

The Gaseous State, Various Gas Laws With Fundamental Concepts, The Solid State, Closing Packing In Metallic Crystals, X-Ray Crystallography, Density Of A Crystal Lattice, Radius Ratio, The Liquid State Vapour Pressure, Surface Tension And Viscosity

UNIT – II

CHEMICAL AND IONIC EQUILIBRIUM

Chemical (Covalent) equilibrium, Law of Mass Action, Reaction Quotient (Q), Relative Vapour Density and Degree of Dissociation, Ionic Equilibrium, Acid and Base Concept, pH Scale, Ostwald's Dilution Law, Indicator, Solubility and Solubility Product Solubility

UNIT – III

ELECTROCHEMISTRY

Galvanic Cells or Voltaic Cells (Electrochemical Cells), Electrochemical Series,, Nernst Equation, Electrolysis, Electrical Conductance (C), Equivalent Conductance, Kohlrausch's law, Conductometric Titrations, Corrosion of Metals

UNIT – IV

RADIO AND NUCLEAR CHEMISTRY

Radio Chemistry: Radioactivity, Theory of Radioactive Disintegration, Radioactive Equilibrium, Nuclear Chemistry, Nuclear Stability, Mechanism of Radioactive Decay, Nuclear Reactions, Nuclear Isomers, Isotopes, Isosters, Application of Radioactivity,

UNIT – V

SURFACE CHEMISTRY

Adsorption, Enthalpy of Adsorption and Free Energy Change, Applications of Adsorption, Colloidal State, Methods of Preparation of Colloids, Condensation methods, Purification and Properties of Colloidal Solution, Emulsions, Catalysis and Catalyst,

ENVIRONMENTAL CHEMISTRY

MSC – 204

UNIT – I

Fundamentals Of Environmental Chemistry, Stoichiometry, Gibbs' Energy, Chemical Equilibrium, Acid Base Reactions- Relative Strengths Of Acids And Bases, Solubility Product, Radionuclides

UNIT – II

Chemical Composition Of Air, Classification Of Elements, Chemical Speciation, Particles, Ions And Radicals In The Atmosphere, Chemistry Of Air Constituents, Oxygen and Ozone Chemistry, Photochemical Smog

UNIT – III

Water Chemistry, Concept Of DO, BOD, COD Sedimentation, Coagulation, Filtration, Redox Potential, Soil Chemistry, Soil Components, Inorganic Components, Organic Components-

UNIT – IV

Toxic Chemicals In The Environment, Air, Water, Biochemical Aspects Of Various Chemicals, Lead(Pb), Mercury(Hg), Arsenic(As), Carbon Monoxide, Pesticides, Insecticides

UNIT – V

Principles Of Analytical Methods, Spectrophotometry, Chromatography, Gas Chromatography, HPLC, Atomic Absorption Spectrophotometry (AAS), Flame Photometry, Limitations Of Flame Photometry

******* MSC 205 Practical – II *******

Reference:

1. Objective Chemistry – The Pearson Guide for Engineering and Medical Entrance Examinations