

**NORTH MAHARASHTRA UNIVERSITY
JALGAON**

SYLLABUS FOR

**Master of Science
In
CHEMISTRY
PART- I**

**(Semester I and II)
w.e.f. 2010-2011**

NORTH MAHARASHTRA UNIVERSITY, JALGAON

M.Sc. (Part I) Chemistry

Semester I and II

Syllabus w.e.f. 2010-2011

SEMESTER - I

CH-110:-Physical Chemistry-I

CH-130:-Inorganic Chemistry-I

CH-150:-Reaction Mechanism and Stereo Chemistry

CH-P-1:-Physical Chemistry Practicals (Annual)

CH-I-1:-Inorganic Chemistry Practicals (Annual)

CH-O-1:-Organic Chemistry Practicals (Annual)

SEMESTER - II

CH-210:-Physical Chemistry-II

CH-230:-Inorganic Chemistry-II

CH-250:-Synthetic Organic Chemistry & Spectroscopy

CH-290:-General Chemistry

Practical Courses(Annual)

Course Title	Semester	Periods	Marks	
CH-P-1:-Physical Chemistry Practical	Annual	104	80	20
CH-I-1:-Inorganic Chemistry Practical	Annual	104	80	20
CH-O-1:-Organic Chemistry Practical	Annual	104	80	20

Note:

1. There are in all three theory courses for first semester, four theory papers for second semester and Three annual practical courses.
2. The marks for each paper are distributed as external (80 marks) and internal (20 marks) examinations. For internal assessment of each theory course 3 written test /tutorial will be taken in which best of two will be considered for internal marks.
3. Each theory course to be completed in 60 lectures of 60 min duration each.
4. Practical courses to be conducted during the whole year. The examination of practical courses will be conducted only once, at the end of academic year (annually). Each practical course will carry 100 Marks out of which 20 Marks will be allotted for internal assessment and University Examination will be conducted for 80 Marks.

5. Each practical course is having weight age Six Hours per week.

The annual examination for the practical courses CH-P-1,CH-I-1,CH-O-1 will be held at the end of semester II.

The internal examination of 20 Marks for practical courses will be held before the annual practical examination.

A student is expected to submit a journal certified by the Head of the Department / Head of the Institution.

A student will not be permitted to appear at the practical examination unless he / she produce a certified journal. If the journal is lost ,the student should produce a certificate from Head of the department / Head of the Institution stating that he /she has satisfactorily completed the practical work.

Rules for personal safety:

- 1) For eye protection, safety goggles must be worn in the laboratory at all times. If the student wears contact lenses, full protection goggles, which provide total seal around eyes, must be worn. All students are expected to wear safety goggles.**
- 2) A long sleeved, knee length laboratory coat is recommended. Long pants and closed toed shoes must be worn for individual safety. Loose clothing, open style shoes and sandals are prohibited. Long hair must be tied up. Each student will have to get his / her own necessary protection items.**
- 3) Prior to the practical examination, the teacher-in-charge will check all protective equipment to ensure that they are in order.**
- 4) Pipetting by mouth should be avoided. Use of pro-pipette bulbs is recommended.**
- 5) All laboratories should be equipped with safety chart, adequate first aid requirements and fire extinguishers.**

NORTH MAHARASHTRA UNIVERSITY, JALGAON

M.Sc. Part –I (Semester-I & II)

Revised syllabus in Chemistry (with effect from June 2010)
Course structure- Semester –I : Physical Chemistry – I (CH-110)

Sr. No	Name of the chapter	No.of periods	Weightage without option	Weightage with option
1	Quantum Chemistry	20	27	40
2	Nuclear and Radiation Chemistry Element of radiation Chemistry	22	29	44
3	Electrochemistry	10	13	20
4	Surface Chemistry	08	11	16
	TOTAL	60	80	120

Semester –II : Physical Chemistry – II (CH-210)

Sr.No	Name of the chapter	No.of periods	Weightage without option	Weightage with option
1	Thermodynamics	16	22	32
2	Statistical Thermodynamics	08	11	16
3	Chemical Kinetics	16	22	32
4	Molecular Spectroscopy			
	Infrared spectroscopy	08	10	16
	Raman spectroscopy	04	05	08
	Electronic spectroscopy	08	10	16
	TOTAL	60	80	120

**M.Sc. I-Skeleton for question paper of
CH – 110 (Physical Chemistry –I) & CH – 210 (Physical Chemistry –II)**

Time Allowed:– **3 hours.**

Marks:- **80**

	Periods	Marks	Marks with Option
TOTAL	60	80	120

Questions Paper Pattern:–There are total four questions.

1. Answer any four of the following: **(20)**

- a)
- b)
- c)
- d)
- e)
- f)

2. Attempt any four of the following: **(20)**

- a)
- b)
- c)
- d)
- e)
- f)

3. Answer any four of the following: **(20)**

- a)
- b)
- c)
- d)
- e)
- f)

4. Attempt any four of the following: **(20)**

- a)
- b)
- c)
- d)
- e)
- f)

Note:–One problem is compulsory in each question.

CH-110: Physical Chemistry-I

CHAPTER -1:Quantum Chemistry:-

(P-20)

Wave function and its interpretation by Born, conditions for the function to be accepted as wave function eigenfunctions and eigenvalues, normalisation of wave function orthogonality and orthonormality, Hermitian operators, eigenvalues of Hermitian operator are real and its corollary, eigen functions of Hermitian operator corresponding to different eigenvalues are orthogonal, the free particle, particle in one and three dimensional box, separation of variables, energy levels and degeneracy, rigid rotator, spherical coordinates, one dimensional harmonic oscillator, Hermite polynomials, energy levels and wave functions, even and odd functions, hydrogen like atoms, radial and angular parts of wave functions sketches of radial functions and probability distribution functions, variation principles, LCAO-MO's for hydrogen molecule ion (H_2^+), Hückel MO theory for ethene and butadiene, plots and nodes of molecular orbitals.

Ref.4: (Relevant Chapters).

Ref.7: (Relevant Chapters).

Ref.8: (Relevant Chapters).

Ref.9: (Relevant Chapters).

Ref.10: (Relevant Chapters).

CHAPTER -2:Nuclear and Radiation Chemistry:-

(P-22)

Parent-daughter decay growth relationships:-daughter nucleus is stable, general expression for the activity of daughter nuclide, parent shorter lived than daughter, parent and daughter of nearly the same half life, parent longer lived than daughter, secular and transient equilibrium, application of radioactivity: Szillard-Chalmer's reaction, radiochemical principles in the use of tracers, applications of radioisotopes in the determination of rates of diffusion, analytical applications:- isotope dilution analysis- direct isotope dilution analysis, inverse isotope dilution analysis, sub-stoichiometric isotope dilution analysis, neutron activation analysis prompt gamma neutron activation analysis.

Elements of radiation chemistry:-

Radiation chemistry, interaction of radiation with matter, primary effects due to charged particles/radiation, linear energy transfer, Bremsstrahlung, interaction of gamma radiation with matter, photoelectric effect, Compton scattering, pair production, units for measuring radiation absorption, radiation dosimetry:- units of radiation energy, chemical dosimetry conversion of measured dose values.

Ref.5: (Relevant chapters).

CHAPTER -3:Electrochemistry:-

(P- 10)

Strong electrolyte, Debye Hückel theory of conductivity, DHO equation (derivation not expected), activity coefficients, ionic strength, Debye- Hückel limiting law and its derivation, deviations from Debye Hückel limiting law, transport number, Hittorff's and moving boundary methods for determination of transport number.

Ref.1:(Relevant Chapters).

Ref.2:Chapter 7.

Ref.3:(Relevant Chapters).

Ref.6:(Relevant Chapters).

CHAPTER -5:Surface Chemistry:-

(P- 08)

Adsorption, Langmuir theory of adsorption and derivation of Langmuir equation, BET theory and derivation of BET equation, its application to determine surface area of adsorbent, Gibbs-adsorption isotherm and its derivation.

Ref.2:(Relevant Chapters).

Ref.3:(Relevant Chapters).

References:-

Ref.1: Physical Chemistry 8th edition,

By P. Atkins, J d Paula, Oxford University Press.

Ref.2: Physical Chemistry 2nd edition,

By K. J. Laidler, J. H. Meiser, CBS publication Shers and distributors.

Ref.3: Principles of Physical Chemistry 41th millennium edition,

By Sharma, Puri and Pathaniya.

Ref.4: Physical Chemistry, Low priced edition,

By Thomas Engel, Philip Reid, Pearson Education.

Ref.5: Essential of Nuclear Chemistry 4th Edition,

By H. J. Arnikar.

Ref.6: An Introduction of Electrochemistry,

By Glasstone.

Ref.7: Quantum Chemistry 4th Edition,

By R. K. Prasad, New Age International.

Ref.8: Physical Chemistry: A Molecular Approach,

By Donald A. McQuarrie, John D. Simon; Viva Books.

Ref.9: Quantum Chemistry,

By Donald A. McQuarrie, Viva Books.

Ref.10: Quantum Chemistry,

By Levine.

CH-210: Physical Chemistry-II

CHAPTER -1:Thermodynamics:-

(P-16)

State functions and path functions, exact and inexact differentials, test of exactness, change in internal energy in terms of internal pressure and C_v , changes in internal energy at constant pressure, temperature dependence of enthalpy, isothermal compressibility, Joule-Thomson effect, relation between C_p and C_v , partial molar quantities, Gibbs-Duhem equation, slope method and method of intercept for measurement of partial molar volume, chemical potential, thermodynamics of mixing. Some thermodynamic relationships: Maxwell relations, thermodynamic relations of state. Some applications of thermodynamic relationships: real gases and fugacity, determination of fugacity for real and van der Waals gas, Joule Thomson coefficient and internal pressure for van der Waals gas, third law of thermodynamics, determination of absolute entropies for solids, liquids and gases, entropy and probability, residual entropies.

Ref.1: Chapter 2, 5.

Ref.2: Chapter 3, 5.

Ref.3: (Relevant Chapters).

Ref.7: (Relevant Chapters).

CHAPTER -2:Statistical Thermodynamics:-

(P- 08)

Thermodynamic probability of a system of distinguishable and indistinguishable particles, Stirling approximation, Boltzmann distribution law, partition function, energy in terms of partition function, entropy in terms of partition function, separation of partition functions, translational partition function, translational energy and entropy for mono-atomic gases, Sukur-Tetrode equation, rotational partition function, rotational energy and entropy, vibrational partition function, vibrational energy and entropy.

Ref.5: Relevant pages.

Ref.6:Relevant pages.

Ref.7:(Relevant Chapters).

CHAPTER -3:Chemical Kinetics:-

(P-16)

Rate laws and rate constants, reactions approaching equilibrium, consecutive elementary reactions, variation of concentration with time, rate determining steps, steady state approximation, pre-equilibrium, Michaelis- Menten mechanism with equation and

derivation.

Kinetics of complex reactions: chain reactions, rate laws of chain reactions, explosions, chain and stepwise polymerization and their rate laws.

Molecular reaction dynamics: diffusion controlled reactions, activated complex theory, Eyring equation, thermodynamic aspects, reaction between ions, linear free energy relationship, Hammett and Taft equation.

Fast reactions: Flash Photolysis, Flow technique and relaxation methods.

Ref.1:(Relevant Chapters).

Ref.2:(Relevant Chapters).

Ref.7:(Relevant Chapters).

CHAPTER -4:Molecular Spectroscopy:-

Infrared Spectroscopy:-

(P-08)

Vibrating diatomic molecule, simple harmonic oscillator, anharmonic oscillator, diatomic vibrating rotator, vibration-rotation spectrum of CO, Breakdown of Born-Oppenheimer approximation, vibration of polyatomic molecules, fundamental vibration and their symmetry, , influence of rotation on spectra of polyatomic linear and symmetric top molecules, influence of nuclear spin.

Raman Spectroscopy:-

(P-04)

Quantum and classical theories of Raman effect, pure rotational Raman spectra, linear molecules, symmetric top molecules, spherical top molecules, Raman activity of vibration, rule of mutual exclusion, vibrational Raman spectra, rotational fine structure.

Ref.4:(Relevant Chapters).

Electronic Spectroscopy:-

(P-08)

Electronic spectra of diatomic molecules, Born-Oppenheimer approximation, vibrational coarse structure, intensity of vibrational electronic spectra, Frank-Condon principle, dissociation energy and dissociation products, rotational fine structure of electronic vibrational transitions, Fortrat diagram, Pre-dissociation.

Ref.4:(Relevant Chapters).

Ref.7:(Relevant Chapters).

References:-

Ref.1: Physical Chemistry, 8th edition,

By P. Atkins, J d Paula, Oxford University Press.

Ref.2: Physical Chemistry 2nd edition,

By K. J. Laidler, J. H. Meiser, CBS publication Shers and distributors.

Ref.3: Principles of Physical Chemistry,

By Sharma, Puri and Pathaniya, 41th millennium edition.

Ref.4: Fundamentals of Molecular Spectroscopy, 4th edition,

By G.N.Banwell and E.M.McCash, Tata Mac-Graw Hill Publishing Co Ltd.

Ref.5: Principles of physical Chemistry, 4th edition,

By S.H.Maron and C.F.Prutton.

Ref.6: Thermodynamics for Chemists,

By S.Glasstone,D. Van Nostrand Co. Inc.

Ref.7: Physical Chemistry, Low priced edition,

By Thomas Engel, Philip Reid, Pearson Education.

CH-P-1: PHYSICAL CHEMISTRY PRACTICALS **Skeleton for question paper of CH – I -1**

Time Allowed – 6.5 hours

Marks : 80

Q 1: Instrumental

30 marks

Q 2: Non-Instrumental

30 marks

Q 3: Oral

10 marks

Q 4: Journal

10 marks

The Student should perform minimum of 18 experiments. It is expected to perform at least one experiment from each technique.

INSTRUMENTAL:-

Conductometry:-

- 1) Determination of degree of hydrolysis and hydrolysis constant of sodium acetate conductometrically.
- 2) To determine solubility of sparingly soluble salt at different temperatures conductometrically and determination of ΔG , ΔH and ΔS of the dissolution.
- 3) Determination of the concentration of sulphuric acid, acetic acid and copper sulphate by conductometric titration with sodium hydroxide.
- 4) To determine concentration of Fe^{+2} ions by titrating it with potassium dichromate solution conductometrically.

Potentiometry:-

- 1) To determine the stability constant of a complex ion $[Ag (S_2O_3)]^{-3}$

potentiometrically.

2) To determine the amount of each halide in a mixture of halides containing a) KI and KBr/KCl or b) KI, KBr and KCl potentiometrically.

3) To determine standard free energy change ΔG^0 and equilibrium constant for the reaction $\text{Cu} + 2\text{Ag}^+ = \text{Cu}^{+2} + 2\text{Ag}$ potentiometrically.

4) To determine activity coefficient of an electrolyte by potentiometry.

pH -metry:-

1) Determination of Hammett constant of a given substituted benzoic acid by pH measurements.

2) To determine acidic and basic dissociation constants of an amino acid and hence the isoelectric point of the acid.

3) To determine pH values of various mixtures of sodium acetate and acetic acid in aqueous solutions and hence dissociation constant of the acid.

4) To determine the three dissociation constants of polybasic acid such as H_3PO_4 by pH measurements.

Colorimetry/ Spectrophotometry:-

1) To determine pKa and Ka of given indicator by colorimetry/spectrophotometry.

2) Determination of amount of Cu (II) and Fe (III) in a mixture by titrating it against standard EDTA solution spectrophotometrically.

3) To determine the empirical formula of Ferric salicylate complex by Job's method and verify by slope ratio method.

4) Simultaneous determination of $\text{Cr}_2\text{O}_7^{2-}$ and MnO_4^- ions or Co^{2+} and Ni^{2+} in the solution by spectrophotometry.

Turbidimetry:-

1) To determine the molecular weight of a given polymer by turbidimetry.

Radioactivity:-

1) To determine the maximum energy of beta particles and calculate the absorption coefficients and half thickness of Aluminium absorber for beta particles.

Flame photometry:-

1) Estimation of Na, K in the given drinking water sample by flame photometry.

Polarimetry:-

- 1) To investigate the inversion of cane sugar in presence of HCl at room temperature.
- 2) Determine the percentage of two optically active substances (d-glucose and d-tartaric acid) in a mixture polarimetrically.

NON INSTRUMENTAL:-

PART-1:- Chemical kinetics:-

- 1) To determine the rate constant for depolymerization of diacetone alcohol catalyzed by sodium hydroxide using dilatometer.
- 2) To determine the rate constant for the hydrolysis of acetal catalyzed by an acid using dilatometer.
- 3) To determine the order of the reaction between potassium persulphate and potassium iodide by fractional change method.
- 4) To investigate the kinetics of iodination of acetone.
- 5) To determine energy of activation of the hydrolysis of methyl acetate in presence of hydrochloric acid (Calculations and graphs expected from excel programming).

PART-2:-Non instrumental:-

- 1) Determine the transport number of H^+ and Cl^- ions by moving boundary method.
- 2) Freundlich and Langmuir adsorption isotherms for adsorption of acetic acid on activated charcoal.
- 3) Determination of partial molar volume of ethanol in dilute aqueous solutions.

References:-

- 1) Findley's Practical physical Chemistry (9th edition),
Edited by B.P.Levitt (Longman group Ltd).
- 2) Systematic experimental Physical Chemistry (2nd edition),
By S.W.Rajbhoj and Dr. T.K.Chondekar (Anjali Publication, Aurangabad).
- 3) Advanced Practical Physical Chemistry (19th edition or latest edition),
By J.B.Yadav (Goel Publishing House, Meerut).
- 4) Experimental physical Chemistry,
By V.D.Athawale P.Mathur (New age international Ltd, New Delhi).
- 5) Advanced Practicals in physical Chemistry (4th revised edition 2008 or latest

edition).By Dr.Pande, Dr.Mrs. Datar &, Dr.Mrs. Bhadane (Manali Publication, Pune).

6) University Practical Chemistry (2008 or latest edition),

By P.C.Kamboj (Vishal Publishing Co. Jalandhar, Panjab).

NORTH MAHARASHTRA UNIVERSITY, JALGAON

M.Sc. Part –I (Semester-I & II)

Revised syllabus in Chemistry (with effect from June 2010)
Course structure- Semester –I : Inorganic Chemistry – I (CH-130)

Sr. No	Name of the chapter	No.of periods	Weightage without option	Weightage with option
1	Chemistry of Non-transition elements	12	16	24
2	Molecular symmetry and symmetry groups	08	11	16
3	Molecular Orbital Theory	08	11	16
4	Organometallic compounds of Transition elements	10	13	20
5	The Ionic bond	10	13	20
6	Weak forces of Chemical Bonding	08	10	16
7	Role of metal ions in biological processes	04	06	08
	TOTAL	60	80	120

Semester –II : Inorganic Chemistry – II (CH-230)

Sr. No	Name of the chapter	No.of periods	Weightage without option	Weightage with option
1	The Metallic bond	10	13	20
2	Spectra	12	16	24
3	The reaction mechanism in Transition Metal complexes	14	19	28
4	Catalysis	10	13	20
5	The Structure and Reactivity of molecules	10	13	20
6	Thermodynamic aspects of Transition Metal Chemistry	04	06	08
	TOTAL	48	80	120

M.Sc. Part- I
Skeleton for question paper of
CH – 130 (Inorganic Chemistry –I) & CH – 230 (Inorganic Chemistry: – II)
Time Allowed:– **3 hours.** Marks:- **80**

	Periods	Marks	Marks with Option
TOTAL	60	80	120

Questions:–There are total four questions.

1. Answer any four of the following : (24)

- a)
- b)
- c)
- d)
- e)
- f)

2. Attempt any four of the following : (16)

- a)
- b)
- c)
- d)
- e)
- f)

3. Answer any four of the following : (24)

- a)
- b)
- c)
- d)
- e)
- f)

4. Attempt any four of the following : (16)

- a)
 - b)
 - c)
 - d)
 - e)
 - f)
-

M.Sc. Part-I

INORGANIC CHEMISTRY – I (CH- 130)

CHAPTER -1:Chemistry of Non-transition elements:- (P-12)

Synthesis, properties and structure of boranes, carboranes, Silicates, carbides, phosphazenes, sulphur-nitrogen compounds, peroxo compounds of boron, carbon, sulphur, structure and bonding in oxyacids of nitrogen, phosphorous, sulphur and halogens, interhalogens, pseudohalides and pseudohalogens, C₆₀(Fullerenes), synthesis and reactivity of inorganic polymers of Si and P.

Ref :-1,2,5,6,8,14 - Relevant pages.

CHAPTER -2:Molecular symmetry and symmetry groups :- (P-08)

Symmetry elements and operations, Symmetry planes, reflections, inversion centre, proper / improper axes of rotation, equivalent symmetry elements and atoms, symmetry elements and optical isomerism, symmetry point groups of some molecules H₂O, NH₃, C₂H₂Cl₂, (cis & trans) , BF₃, PCl₅, H₂O₂ (trans), XeF₄, H₃BO₃, CO₂, POCl₃, C₂H₂ , NO₃⁻

Ref :- 4,6,13,15 - Relevant pages.

CHAPTER -3:Molecular Orbital Theory:- (P-08)

Linear triatomic molecules – BeH₂, CO₂. Trigonal planar molecule BF₃, Tetrahedral molecule – CH₄, Trigonal pyramidal molecule NH₃, Angular Triatomic molecules H₂O, NO₂.

Ref 7: - Relevant pages.

CHAPTER -4:Organometallic compounds of transition metals:- (P-10)

The 18 electron rule, Molecule orbital theory and 18 electron rule, Counting electrons in complexes . Alkyl & aryl complexes, Alkene complexes, Allyl and butadiene complexes, Complexes containing delocalized cyclic systems, carbenes (alkylidene) and carbene (alkylidyne) complexes, Organometallic compounds in homogeneous catalysis.

Ref 1,3,5,6,14,16 - Relevant pages.

CHAPTER -5:The Ionic bond:- (P-10)

Structures of ionic solids, radius ratio rules, calculation of some limiting radius ratio values, close packing, classification of ionic structures – Ionic compounds of the type AX (ZnS, NaCl, CsCl), Ionic compounds of the type AX₂ (CaF₂, TiO₂, SiO₂) ; Layer structures (CdI₂, CdCl₂ [NiAs])

Structures containing polyatomic ions. A cautionary word on radius ratios. Lattice energy. The Born - Haber cycle, Applications of lattice energetics.

Ref :-2,3,6 - Relevant pages.

CHAPTER -6:Weak forces of Chemical Bonding:- (P-08)

Resonance : resonance energy. Concept of formal charge, criteria for resonating structures, examples: BF_3 , CO_3^{2-} , NO, CO, NO_3^- , SO_4^{2-} , and acac^-

Odd electron bonds and odd electron molecules / ions. Hydrogen bonding concept, types, properties, methods of detection and importance. Vander waal's forces, ion-dipole interactions, dipole-dipole interactions, London forces, Repulsion forces.

Ref :- 9,10,11,12- Relevant pages.

CHAPTER -7:Role of metal ions in biological processes:- (P-04)

Selective transport and storage of iron (siderophores, iron transport proteins in higher organisms, release of iron transferrin , ferritin, the cellular Fe store), electron transfer (General considerations, Electron transfer cytochrome, FeS clusters, copper transfer centers)

Ref :-5- Relevant pages.

INORGANIC CHEMISTRY – II (CH- 230)

CHAPTER -1:The Metallic bond:- (P-10)

General properties of metals,conductivity, Lustre, malleability and cohesive force. Theories of Bonding in metals – free electron theory, valence bond theory, molecular orbital or band theory. Conductors, Insulators and semiconductors; Alloys – interstitial alloys and related compounds, substitutional alloys , Cu / Ni (Phase diagram expected),super conductivity.

Ref 2 - Relevant pages.

CHAPTER -2:Spectra:- (P-12)

Energy levels in an atom, coupling of orbital angular momenta, coupling of spin angular momenta, spin orbit coupling. Determining the ground state terms – Hund's rule, Hole formulation, Derivation of the terms for a d^2 configuration, calculation of the number of microstates, Electronic spectra of transition metal complexes – Laporte 'orbital' selection rule, spin selection rule, splitting of electronic energy levels and spectroscopic states. Spectra of d^1 & d^9 ions, d^2 & d^8 ions, d^5 ions.

Ref :2,6 - Relevant pages.

CHAPTER -3:Reaction mechanism in transition metal complexes:-(P-14)

Ligand substitution reaction, The classification of mechanism, The substitution of square planer complexes, the nucleophilicity of entering group, the shape of activated

complexes, K1 pathway, Substitution in Octahedral complexes, Rate law and their interpretation, The activation of octahedral complexes, , Base hydrolysis, Stereochemistry ,Isomerisation reactions.

Ref- 1,5,6,14.- Relevant pages.

CHAPTER -4:Catalysis:- (P-10)

Catalysis, Description of catalyst, Properties of catalyst, Homogeneous catalyst, Catalytic steps, Hydrogenation of alkenes, Hydroformylation, Monsanto acetic acid synthesis, Wacker oxidation of alkenes, Alkene polymerization, Heterogeneous catalysis, Nature of heterogeneous catalyst.

Ref-1,5,6. .- Relevantpages.

CHAPTER -5:The Structure and Reactivity of molecules:- (P-10)

VSEPR Theory, structures of molecules containing lone pair of electrons. Sulphur tetrafluoride, Bromine trifluoride, Dichloriodate (I) anion, Pentafluorotellurate (IV) anion, Tetrachloriodate (III) anion, Nitrogen dioxide, nitrite ion and nityrl ion, phosphorus trihalides, carbonyl fluoride, summary of VSEPR Rules.

Ref 1- Relevant pages.

CHAPTER -6:Thermodynamic aspects of Transition Metal Chemistry:- (P-04)

Crystal field stabilization energies of the octahedral and tetrahedral complexes, oxidation states in aqueous media, Ionization energies.

Ref 3,8 - Relevant pages.

References:-

- 1) Inorganic Chemistry Principles of Structures and Reactivity, 4th edition; James E. Huheey, Ellen A. Keiter, Richard L. Keiter.
- 2) Concise Inorganic Chemistry, 5th edition J. D. Lee.
- 3) Inorganic chemistry, 3rd edition Alan G. Sharpe.
- 4) Chemical Applications of Group Theory, F.A. Cotton.
- 5) Inorganic Chemistry, Fourth Edition; Shriver & Atkins Intern.student edition.
- 6) Principles of Inorganic Chemistry; Late B.R. Puri, L.R. Sharma & K.C. Kalia.
- 7) Electrons and Chemical bonding By H.B. Gray.
- 8) Modern Aspects of Inorganic Chemistry, By H. J. Emeleus and A.G. Sharpe; Universal Book Stall, New Delhi – 2.

- 9) Advanced Inorganic Chemistry; Dr. S.K. Agarwala, Dr. Keemtilal, Pragati Prakashan, Meerut.
- 10) Theoretical Principles of Inorganic Chemistry, G.S. Manku, Tata McGraw-Hill Ed.
- 11) Concepts and Models of Inorganic Chemistry, 2nd edition, B. Douglas, D.H. Mc. Daniel, J.J. Alexander.
- 12) General & Inorg. Chem. (Part one), R. Sarkar, New Central Book Agency; Kolkata.
- 13) Group Theory and its Chemical applications, P.K. Bhattacharya, Himalaya Publishing House.
- 14) Advance Inorganic Chemistry, Cotton & Wilkinson.
- 15) Concept and Applications of Group Theory, Dr. Kishor Arora, Anmol Publication Pvt. Ltd., New Delhi.
- 16) Modern Inorganic Chemistry by William L. Jolly, 2nd edition, Tata McGraw Hill Co.

INORGANIC CHEMISTRY PRACTICAL (CH – I -1)

Skeleton for question paper of CH – I -1

Inorganic Chemistry Practical

Time Allowed – 6.5 hours	Marks : 80
Q 1: Quantitative Analysis (Ores / Alloys / Drugs)	35 marks
Q 2: Instrumental methods of Analysis / Preparation of complex and its purity / Thermochemistry	25 marks
Q 3: Oral	10 marks
Q 4: Journal	10 marks

1. Analysis of ore (Any two)

- a) Pyrolusite ore - Estimation of silica gravimetrically and Manganese volumetrically.
- b) Bauxite ore - Estimation of Iron volumetrically and aluminum gravimetrically.
- c) Chromite ore – Estimation of Iron gravimetrically and chromium volumetrically.

2. Analysis of Alloy (Any two)

- a) Solder alloy – Estimation of Tin gravimetrically and Lead volumetrically.
- b) Cupro – nickel alloy – Estimation of Copper volumetrically and Nickel gravimetrically.
- c) Type metal – Estimation of Antimony volumetrically and zinc gravimetrically.

3. Instrumental method of Analysis

A) Photometric Analysis - (Any one)

- i) To study complex formation between Fe (III) and salicylic acid and find the formula and stability constant of the complex.

- ii) To determine nickel as nickel dimethyl glyoximate complex.
- B) Simultaneous determination of Ni^{2+} and Co^{2+} / Fe^{2+} and Fe^{3+} in binary mixture spectrophotometrically.
- C) To determine the strength of given mixture of carbonate and bicarbonate in the given mixture by pH metric method
- D) To determine the Li / Na/ K in given solution flame photometrically, by calibration curve method.
- E) To determine the amount of copper present in given solution by iodometric method potentiometrically.

4. Preparation and purity determination (Any four)

- a) Potassium trioxalato chromate (III).
- b) Bis (ethylene diamine) copper (II) sulphate.
- c) Tris (acetylacetonato) Iron (III).
- d) Nitropentammino cobalt (III) chloride.
- e) Nitrito-pentammino cobalt (III) chloride.
- f) Hexammine nickel (II) chloride.

5. Drug Analysis

Determination of iron from given drug sample.

6. Thermochemistry

To determine the lattice energy of binary salts (NaCl, KCl, CaCl_2 , MnCl_2 , CuCl_2). (any two salts)

References:-

1. A Text book of Quantitative Analysis by A.I.Vogel , 4th edition
2. Advanced Practical Inorganic Chemistry By Gurdeep Raj
Goel Publishing House.
3. Post Graduate Practical Chemistry (Part – 1) by H.N. Patel, S.P. Turakhia,
S.S. Kelkar, S.R. Puniyani, Himalaya Publishing House.

NORTH MAHARASHTRA UNIVERSITY, JALGAON

M.Sc. Part –I (Semester-I & II)

Revised syllabus in Chemistry (with effect from June 2010)

Course structure- Semester –I :**REACTION MECHANISM AND STEREOCHEMISTRY (CH-150)**

Sr. No	Name of the chapter	No.of periods	Weightage without option	Weightage with option
1	Nucleophilic substitution at saturated carbon	12	16	24
2	Addition reaction	12	16	24
3	Elimination reactions	12	16	24
4	Electrophilic and Nucleophilic substitutions reactions of aromatic compounds	12	16	24
5	Stereochemistry	12	16	24
	TOTAL	60	80	120

Semester –II : Synthetic Organic Chemistry and Spectroscopy (CH-250)

Sr. No	Name of the chapter	No.of periods	Weightage without option	Weightage with option
1	Synthetic reagents	15	19	30
2	Rearangments	10	13	20
3	Named reaction	08	11	16
4	Pericyclic	07	10	14
5	Spectroscopy	20	27	40
	TOTAL	60	80	120

M.Sc. Part- I

Skeleton for question paper of
CH – 150 (Organic Chemistry –I) & CH – 250 (Organic Chemistry: – II)
Time Allowed:– **3 hours.** Marks:- **80**

	Periods	Marks	Marks with Option
TOTAL	60	80	120

Questions:–There are total four questions.

1. Answer any four of the following : (16)

- a)
- b)
- c)
- d)
- e)
- f)

2. Attempt any four of the following : (16)

- a)
- b)
- c)
- d)
- e)
- f)

3. Answer any four of the following : (16)

- a)
- b)
- c)
- d)
- e)
- f)

4. Attempt any four of the following : (16)

- a)
- b)
- c)
- d)
- e)
- f)

5. Attempt any four of the following : (16)

- a)
- b)
- c)
- d)
- e)
- f)

CH-150:- REACTION MECHANISM AND STEREOCHEMISTRY

CHAPTER -1:-Nucleophilic substitution at saturated carbon:- (P-12)

a) SN^1 , SN^2 and SN^1 reactions, Mechanism and stereochemistry, regioselectivity and stereo specificity of substitution reaction.

b) Scope at saturated carbon, allylic carbon and vinylic carbon.

Reference:-3 Pages 309-335.

c) Scope of nucleophilic substitution halides, oxygen, sulphur and nitrogen as nucleophile.

Reference:-1 Pages 351-354 and 359-375.

d) Neighbouring group participation by pi and sigma bonds, Nonclassical carbocations.

Reference:-4 Pages 312-322.

Reference:-1 Pages 317-339.

Reference:-2 Relevant pages.

Reference:-3 Pages 309-335.

Reference:-6 Relevant pages.

CHAPTER-2:-Addition reaction:- (P-12)

Mechanistic and stereo chemical aspect of carbon-carbon multiple bonds and carbon heteroatom multiple bonds. Scope-The mechanism of electrophilic addition AE_2 mechanism. Structural effects and reactivity halogenation, hydrohalogenation, Hydration, Hydroxylation, Hydroboration, Epoxidation, Carbene addition Hydrogenation, Ozonolysis.

Reference:-1 pages 521-554.

Reference:-3 relevant pages.

Reference:-6 relevant pages.

CHAPTER-3:-Elimination reactions:- (P-12)

Scope, The reaction mechanism E_1 , E_2 , E_1CB , E_1 versus E_2 and Elimination versus substitution.

a) Anti and syn elimination, Stereo electronics factors.

b) Dehydrohalogenation, Dehalogenation, Dehydration, Hoffmann and Saytzeffs elimination, Pyrolytic elimination.

Reference:-1 pages 465-499.

Reference:-6 relevant pages.

CHAPTER-4:-Electrophilic and Nucleophilic substitutions reactions of aromatic compounds:- (P-12)

Scope, Arhenium ion mechanism, Orientation and reactivity, Energy profile diagram, the ortho-para ratio if so attached, Diazo-coupling, Vilsmeier Haack reaction, Guttermann Koch reaction.

Reference:-4 pages 501-517 and 520-545.

Reference:-1 pages 616-631 and 639-660.

Nucleophilic aromatic substitution: Scope the S_NAr , S_N1 benzyne and S_NR1 mechanism, reactivity effect of substrate structure, leaving group and attacking nucleophile.

Reference:-4 pages 641-653.

Reference:-1 pages 662-668.

Reference:-5 relevant pages.

CHAPTER-5:-Stereochemistry:- (P-12)

Enantiomeric relationship, Distereomeric relationship, R and S, E and Z nomenclature, Introduction of optical activity in absence of Chiral centre (Biphenyls, Spirans and Allenes) and with one and two Chiral carbons.

Reference-7 relevant pages.

Reference-8 relevant pages.

Reference-9 relevant pages.

Reference books:-

- 1) Organic chemistry by S.H.Pine 5th edition.
- 2) Organic chemistry by Clayden, Greeves, Warren and Wothers Oxford Uni Press.
- 3) Advance Organic chemistry by Jagdamba Singh and L.D.S. Yadav.
- 4) Advance Organic chemistry by J.March 4th edition.
- 5) Organic chemistry by Morrison and Boyd 6th edition.
- 6) Advance Organic chemistry Part-A F.A.Carrey and R J Sundberg 4th edition.
- 7) Stereochemistry of organic compounds by E.L.Eliel.
- 8) Stereochemistry of carbon compounds by D.Nassipuri 2nd edition.
- 9) Stereochemistry conformation and mechanism by P.S.Kalsi.

CH – 250:-Synthetic Organic Chemistry and Spectroscopy

CHAPTER -1:-Synthetic reagents:- (P-15)

CrO_3 , $Na_2Cr_2O_7$, PCC, Collins's Reagents, $Pb(OAc)_4$, Peracids, Periodic acids, NBS, O_3 , Active MnO_2 , Gilman's Reagents, LDA, DCC, DDQ, OsO_4 , SeO_2 , LAD, Complex

Metal Hydride(NaBH_4 , LiAlH_4), Na/Liquor NH_3 , $\text{Zn-Hg/H}_2\text{O/HCl}$, $\text{NH}_2\text{-NH}_2 / \text{KOH}$,
Catalytic Reduction, Woodward-Prevost Hydroxylation.

CHAPTER -2:-Rearangments:- (P-10)

Wagner Meerwin, Pinacol, Wolf, Hoffman, Curtius, Schimidt, Lossen, Backmann,
Bayer-Villinger, benzil-Benzilic acid, Steven, Wittig, Cope, Claisen Rearrangements,
Fries, Sommler-Hauser Reaction.

CHAPTER -3:-Name reaction:- (P-08)

Mannich, Michel Addition, Stork Enamine, Fevoruski, Sharpless Epoxidation
Reaction, Barton, Hoffmann-Loffler-Freytag.

CHAPTER -4:-Pericyclic:- (P-07)

Selection Rules and Stereochemistry of Electro cyclic, Cyclo-addition and Sigma
tropic. Reaction with Suitable examples, Molecular Orbital Symmetry of Ethylene, 1,3-
Butadiene and 1,3,5- Hexatriene.

CHAPTER -5:-Spectroscopy:- (P-20)

Elemental Idea of PMR, Aspects of PMR, Number of Signals, Position of
Signals(Chemical shift), Splitting of Signals, Intensity of signals, Coupling Constant,
Calculation of Chemical Shift With Examples, Line position of Doublet, Triplet and
Quartet.

Mass Spectroscopy- Introduction, principals, Recognition of Molecular Ion Peaks,
Fragmentation, Rearrangements Joins problem based on UV-IR and PMR.

References:-

- 1) Organic Chemistry By J. O. C. Norman,
- 2) Synthetic Organic Chemistry By H. O. House
- 3) Organic Chemistry By J. Clay den
- 4) Organic Chemistry By S. H. Pine,
- 5) Named Organic Reactions By Thomas Laue, Andreas Plagen,
- 6) Organic Chemistry Reaction And Regents By O. P. Agrawal,
- 7) Spectroscopy of Organic Compounds By Silver Stein,
- 8) Spectroscopy of Organic Compounds By V. M. Parikh,
- 9) Spectral Analysis of Organic Compounds By P. S. Kalsi.

CH-O-1 Organic Chemistry Practicals

1) Derivatives Moniterd by TLC:-

- 1) Semicarbazones of Aldehyde / Ketone.
- 2) Anilide of Carboxylic Group.

3) Aryloxy Derivative of Phenol.

2) Green Chemistry Preparation (Any 3):-

1) Synthesis of Acetanilide from Aniline by using ZnO / AcOH(Acytation).

2) Synthesis of Dibenzalpropanone from Benzaldehyde and Acetone(Aldol Condensation).

3) Preparation of Adipic Acid from Cyclohexene.

4) Nitration of Salicylic Acid by CaNO_3 .

5) Bromination of acetanilide.

6) Synthesis of Dihydropyrimidinone from Ethyl acetoacetate , Benzaldehyde and Urea.

3) Single Stage Preparation Monitored by TLC (Any 5):-

1) Acetone to Iodoform.

2) Benzophenone to Benzohydrol.

3) Hydroquinone to Quinone.

4) Chlorobenzene to 2,4- Dinitrobenzene.

5) Benzaldehyde to Cinnamic Acid.

6) Acetoacetic ester to Pyrazolone.

7) Paramino Benzoic Acid to Parachloro Benzoic Acid.

4) Two Stage Preparation Moniterd by TLC (Any 2):-

1) Acetophenone to Oxime to Acetanilide.

2) Nitrobenzene to m- Dinitrobenzene to m- Nitroaniline.

3) Acetophenone to Benzalacetophenone to Epoxide.

5) Use of Computers:-

1) Chem Draw, Chem Sketch, ISI Draw, Draw the structure of simple aliphatic and aromatic compounds, heterocyclic compounds with different substituents, IUPAC name and predict the NMR Signals.

2) Literature Search and references.

6) Techniques:-

1) Steam Distillation.

2) Column Chromatography.

Ref.- Practical Organic Chemistry By Vogel's.

NORTH MAHARASHTRA UNIVERSITY, JALGAON

M.Sc. Part –I (Semester- II)

Revised syllabus in Chemistry (with effect from June 2010) Course structure- Section –I : CHEMICAL MATHEMATICS (CH-290)

Sr. No	Name of the chapter	No.of periods	Weightage without option	Weightage with option
1	Units	02	03	04
2	Differential Calculus	06	07	12
3	Integral Calculus	06	07	12
4	Partial differentiation	04	05	08
5	Differential equation	02	03	04
6	Probability and errors	02	03	04
7	Graphical methods in physical chemistry	02	03	04
8	Computer application in chemistry	02	03	04
9	Vector,Matrics and Determinant	02	03	04
10	Problem in Physical chemistry	02	03	04
	TOTAL	30	40	60

Section –II : ANALYTICAL CHEMISTRY (CH-290)

Sr. No	Name of the chapter	No.of periods	Weightage without option	Weightage with option
1	Statistics	12	16	24
2	Separation techniques	14	18	28
3	Environmental sampling and analysis	04	06	08
	TOTAL	30	40	60

Section –III : INSTRUMENTAL METHODS OF ANALYSIS (CH-290)

Sr. No	Name of the chapter	No.of periods	Weightage without option	Weightage with option
1	Voltametry and electrochemical sensors	08	11	16
2	Radioactivity as Analytical tools	04	06	08
3	Photo acoustic spectroscopy(PAS)	08	11	16
4	Atomic spectroscopy based on flume and electro thermal atomisation	10	12	20
	TOTAL	30	40	60

M.Sc. Part- I Skeleton for question paper of CH – 290

Attempt any two sections out of three.

Time Allowed:– 3 hours.

Marks:- 80

	Periods	Marks	Marks with Option
TOTAL	60	80	120

SECTION-I (CHEMICAL MATHS)

(No Derivations. Only essential formulae and their applications for solving the problems in Chemistry is expected.)

1:- UNITS : **(P-02)**

- a) Basic & Derived CGS & SI Units: - Pressure, volume, density, force, energy, Gas Constant(R).
- b) Non conventional units:- Pressure, volume, density, force, energy, R.

2:- DIFFERENTIAL CALCULUS **(P-06)**

- a) Derivative, Basic rules.
(Ref-1, PP-70-82, Chapt-VII).

- b) Differentiation of functions of function, logarithmic functions.
- c) Algebraic simplification.
(Ref-1, PP-83-90, Chapt-VIII).
- d) Graphical significance of differentiation, Applications of Maxima & Minima.
(Ref-1, PP-91-109, Chapt-IX).
- e) The differential.
(Ref-1, PP-110-113, Chapt-X).

3:-INTEGRAL CALCULUS (P-06)

- a) Basic rules, definite & indefinite integral, “e” and its significance, compound interest low, exponential equations.
(Ref-1, PP-114-141, Chapt-XI, XII).
- b) Integration of trigonometric functions.
(Ref-1, PP-142-148, Chapt. XIII).
- c) Algebraic simplification, Integration- by substitution & by partial fractions.
(Ref-1, PP-149-156, Chapt-XIV).

4:-PARTIAL DIFFRENTIATION (P-04)

- a) The fundamental theorem - special cases, Successive Partial Differentiation.
(Ref-1, PP-174-186, Chapt-XVII).

5:- DIFFERENTIAL EQUATIONS :- (P-02)

Simple differential equations in Chemistry, Homogeneous differential equations, Exact and Inexact differential equations, linear differential equations.
(Ref-1, PP-187-199, Chapt-XVIII).

6:- PROBABILITY AND ERRORS:- (P-02)

(Ref-1, PP-210-216, 220-225 Chapt-XX).

7:- GRAPHICAL METHODS IN PHYSICAL CHEMISTRY (P-02)

(Ref-1, PP-225-239, Chapt-XXI).

8:- COMPUTER:APPLICATIONS IN CHEMISTRY:- (P-02)

Introduction, Components of Computer, Hardware, Software, binary arithmetic, Softwares in chemistry - MOPAC, GAMESS, GAUSSION, MOLDRAW, etc. Internet surfing, e-journals, literature Search (Project on Specific topics on Recent Advances in Chemistry).

(Ref-2, PP-36-68, Ref-3, PP-597...Relevant pages).

9:- VECTOR, MATRICES, & DETERMINANT:-

(P-02)

(Ref-4, PP-1048-1070).

10:- PROBLEMS IN PHYSICAL CHEMISTRY :-

(P-02)

To be referred for Problems on the respective chapters in the syllabus.

(Ref-1, PP-247-259 Appendix-I).

Reference:-

Ref-1- Mathematical Preparation for physical chemistry-Farrington Daniels
Mc Graw Hill.

Ref-2- Principal of Physical Chemistry- Puri, Sharma & Pathania.
ISBN-81-8646-00-8 Millennium Ed.

Ref-3- Physical Chemistry- Thomas Engel, Philip Reid, Pearson- 2006, LPE Ed.

Ref-4 - Physical Chemistry- P.W ATKINS, 7th Ed.

SECTION-II

ANALYTICAL CHEMISTRY

Chapter:-1.Statistics:-

(P-12)

Introduction to Chemometrics Mean and Standard deviation, distribution of random errors, reliability of results, comparing of means of two samples, paired t-test, the number of replicate determinations, correlation and regression, linear regression, errors in slope and intercept, errors in the estimate of concentration, standard additions, comparison of more than two means, experimental design, two way analysis of variance, chemometrics and experimental design, factorial design.

Ref:-1, Pages 123 to 149 (Chapter 4).

Chapter:-2.Separation Techniques (Instrumental separation):- (P-14)

A) Gas chromatography:-

Principles, gas chromatography columns, gas chromatography detectors, temperature selection, theory of column efficiency in chromatography, theoretical plates, the van deemeter equation, reduced plate height in gas chromatography, open tubular columns in gas chromatography.

Ref:-2, Pages 560 to 565 (Chapter 19).

Pages 574 to 588 (Chapter 20).

B) High performance liquid chromatography:- Principles, equipments for HPLC, HPLC

method development.

Ref:-2, Pages 604 to 616 (Chapter 21).

C)Electrophoresis:-Theory of Electrophoresis, instrumentation for capillary Electrophoresis, capillaries, applied field, detectors, applications.

Ref-1 Pages 246 to 249 (Chapter 1).

Chapter:-3.Environmental sampling and analysis:- (P-04)

Air sample collection and analysis, water sample collection and analysis, soil and sediment sampling, sample preparation for trace organics. (P-3)

Ref-2 Pages 213 to 223 (Chapter 26).

References:-

Ref:-1 Vogel's Text Book of Quantitative Chemical analysis (Sixth Edition)

By- J. Mendham, R.C. Denny, J.D. Barnes, M.J.K. Thomas
(Pearson Education- Low Price Edition).

Ref:-2 Analytical Chemistry (Sixth Edition)

Wiley International Edition.By- Gary D. Christian
John Wiley and Sons INC.

SECTION-III

Instrumental Methods of Analysis

Chapter:-1. Voltametry and electrochemical sensors:- (P-08)

Voltametry, voltametric cell, current voltage curve, stepwise reduction of oxidation Amperometry- Amperometric titration, chronopotentiometry, the oxygen electrode, Electrochemical sensor, ultramicroelectrodes, Ion selective electrodes, Anodic stripping voltametry.

Chapter:-2. Radioactivity as Analytical Tools:- (P-04)

Scintillation counter, pulse height analyzer, counting errors,

Ref- 2,8

Chapter:-3. Photo acoustic spectroscopy (PAS):- (P-08)

Introduction, PAAS spectrometer, applications.

Ref. 4

Chapter:-4. Atomic spectroscopy based on flame and Electro Thermal atomization- (P-10)

Theory, sources, burners, atomic emission spectrum, atomic absorption spectrum, effect of temperature on emission, absorption and fluorescence, electro thermal atomizers, radiation sources, atomic absorption methods, instrumentation for AAS, spectral interferences, standard addition and internal standard method of analysis comparison of atomic absorption and emission methods, inductively coupled plasma and direct current plasma emission spectroscopy, atomic and molecular mass spectrometry, including ICP-MS and tandem mass spectrometry, MS-MS principle.

References:-

1. Introduction to instrumental analysis by R.D. Brown, Mc. Graw Hill (1987).
2. Instrumental methods of chemical analysis by H. Willard, L Merritt, J.A. Dean and F. A. Settle, 16th edition CBS (1986).
3. Instrumental methods of chemical analysis by Chatwal and Anand.
4. Fundamentals of Analytical chemistry 6th edition. D. A. Skoog, D. M. West and F. J. Holler, Saunders, College publishing.
5. Principles of Practice of Analytical Chemistry by F. W. Fifield and D. Kealey 3rd edition. Blackie and sons Ltd.
6. Analytical Chemistry 5th Ed. Gary D. Christian, John Wiley, Sons Inc.
7. Practical clinical biochemistry by Harold Vavley 4th Ed. CBS Publication, New Delhi.
8. Essentials of Nuclear Chemistry H. S. Arnikar, Revised 11th Edition New Age International Publishers.