# CHEMISTRY SYLLABUS

(For examinations to be held in the years 2015 & 2016)

## SEMESTER-I

**Course No.: CH-101 (Theory)** **Title: Inorganic Chemistry-I**

**Credits: 04** **Maximum Marks: 100**

**Time: 03 Hours** **External Examination: 80 Marks**

**Internal Assessment: 20 Marks**

### Unit-I

**(a) Atomic Structure**

Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbital. Schrodinger wave equation, significance of quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, d orbitals. Aufbau and Pauli's exclusion principles, Hund's multiplicity rule, Electronic configurations of the elements, effective nuclear charge.

**(b) Periodic Properties**

Atomic and Ionic radii, ionization energy, electron affinity and electronegativity – definition, methods of determination of evaluation, trends in periodic table and applications in predicting and explaining the chemical behavior.

### Unit-II

**(a) Chemical Bonding-I**

Covalent Bond. Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory and its applications to $NH_3$, $H_3O^+$,$SF_4$, $CIF_3$, $ICI_2^-$, and $H_2O$.

MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, bond strength and bond energy, calculation of percentage of ionic character from dipole moment and electro negativity difference.

**(b) Chemical Bonding-II**

Ionic solids, Ionic structures, radius ratio effect and coordination number, limitations of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rules.

Metallic bond – free electron, valence bond and band theories. Weak interactions-hydrogen bonding and van der Waals forces.

### Unit-III

**(a) s-Block Elements**

General study, diagonal relationship, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, an introduction to metal alkyls and aryls.

**(b) p-Block Elements-I**

General study (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, oxides, oxyacids and halides of groups 13-16, hydrides of boron-diborane and borazine. Chemistry of fullerenes, carbides, fluorocarbons, silicates (structural principle), tetra sulphur tetranitride, basic properties of halogens and interhalogens.

**(c) Chemistry of Noble Gases**

Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds(oxides and fluorides).

**Unit-IV**

**(a) Acids and Bases**

Arrhenius, Bronsted Lowry, Lux Flood, solvent system and Lewis concepts of acids and bases.

Hard and Soft Acids and Bases (HSAB**):** Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid base strength and hardness and softness, symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness.

**(b) Non- aqueous Solvents**

Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid $NH_3$ and liquid $SO_2$.

**Unit-V**

**(a) Oxidation and Reduction**

Use of redox potential data- analysis of redox cycle, redox stability in water, Latimer diagrams for oxygen, nitrogen, manganese, copper (acidic medium, pH =O ) and for chlorine (acidic/ alkaline medium). Calculation of E- values for skip- step couples using EMF diagrams. Frost diagrams for oxygen and nitrogen, Pourbaix diagrams for iron species in natural waters.

**(b) Inorganic Polymers**

Siloxanes and phosphazenes as example of Inorganic polymers, nature of bonding in phosphazenes.

**Note for Paper Setting**

Internal Assessment: 20 marks for theory paper in a subject reserved for internal assessment shall be distributed as under:

| | | | |
|---|---|---|---|
| (i) | One Class Test | : | 10 marks |
| (ii) | Two written assignments | : | 10 marks (05 marks each) |

External Examination: The question paper will contain three sections A, B & C.

**Section A** will consist of ten very short answers type questions, two from each unit, carrying 2 marks each. All the questions in section A will be compulsory **(20 marks)**.

**Section B** will consist of ten short answers type questions, two from each unit with internal choice. Student will be required to attempt five questions one from each unit, each question carrying 6 marks **(30 marks)**.

**Section C** will have five long answers type questions, one from each unit, carrying 10 marks. Student will be required to attempt any three questions **(30 marks)**.

**BOOKS RECOMENDED**


1. Basic Inorganic Chemistry, F.A.Cotton, G.Wilkinson and PL. Gaus, Wiley.
2. Concise Inorganic Chemistry, J.D.Lee, ELBS.
3. Concepts of Models of Inorganic Chemistry, B.Douglas, S. McDaniel and J. Alexander, John Wiley.
4. Inorganic Chemistry, D.E.Shriver, P.W.Atkins and C.H.Langford, Oxford.
5. Inorganic Chemistry, W.W. Porterfield, Addison-Wesey.
6. Inorganic Chemistry, A.G. Sharpe, ELBS.
7. Inorganic Chemistry, G.L Miessler and D.A. Tarr, Prentice Hall

## CHEMISTRY SYLLABUS

(For examinations to be held in the years 2015 & 2016)

## SEMESTER-I

**Course No.: CH-101 (Practical)** **Title: Inorganic Chemistry-1 (Practical)**

**Credits: 02** **Maximum Marks: 50**

**Time: 4 Hours** **External Examination: 25 Marks**

**Internal Examination: 25 Marks**

**Quantitative and qualitative analysis**

Preparation of standard solutions Dilution -0.1M to 0.001M solutions (NaOH,Oxalic acid, $KMnO_4$,$K_2Cr_2O_7$).

Quantitative Analysis (Volumetric Analysis)

(a) Determination of acetic acid in Commercial vinegar using NaOH.

(b) Estimation of calcium content in Chalk as calcium oxalate by permanganometry.

(c) Estimation of ferrous and ferric ions by dichromate method.

(d) Estimation of hardness of water by EDTA.

(e) Estimation of copper using thiosulphate.

Semi micro Analysis of salt mixtures containing three acidic and three basic radicals

20 marks

**Viva-Voce** 05 marks

**Note for distribution of 25 marks in internal assessment in practical examination:**

Internal Examination: Total marks reserved for internal assessment shall be distributed as under:

| | | | |
|---|---|---|---|
| (i) | Daily assessment in the laboratory | : | 12 marks |
| (ii) | Class test (internal practical test) | : | 08 marks |
| (iii) | Regularity of attendance | : | 05 marks |

External Examination: There shall be two exercises in the external examination of ten marks each.

**BOOKS RECOMENDED**

1. Vogel's Qualitative Inorganic Analysis revised, Svehla, Orient Longman.
2. Vogel's Textbook of Quantative Inorganic Analysis, revised, Svehla, Orient Longman.
3. Vogel's Textbook of Quantative Inorganic Analysis (revised), J.Bassett, R.C.Denney, G.H.Jeffery and J.Mendham, ELBS.
4. Experimental Inorganic Chemistry, W.G.Palmer, Cambridge.

# CHEMISTRY SYLLABUS

(For examinations to be held in the years 2016 & 2017)

## SEMESTER-II

**Course No.: CH-201 (Theory)** **Title: Physical Chemistry - I**

**Credits: 04** **Maximum Marks: 100**

**Time: 03 Hours** **External Examination: 80 Marks**

**Internal Assessment: 20 Marks**

### Unit I

**(a) Mathematical concepts**

Differentiation of functions like $e^x$, $x^n$, sin x, cos x, log x; Maxima and Minima, Partial differentiation and Euler's reciprocity relations, Integration of some useful/relevant functions; Factorials, Theorems of Probability.

**(b) Solutions and Colligative properties**

Ideal and non- ideal solutions, Methods of expressing concentration of solutions, Activity and activity coefficient. Dilute solution, Colligative properties, Raoult's law, Relative lowering of vapour pressure, Molecular weight determination. Osmosis and osmotic pressure and its measurement, Determination of molecular weight from osmotic pressure, Elevation of boiling point and Depression of freezing point.

Abnormal molar mass, Degree of dissociation and association of solutes.

### Unit II

**(a) Gaseous State**

Postulates of kinetic theory of gases, Deviations from ideal behaviour, van der Waals equation of state.

**Molecular Velocities**: Root mean square, average and most probable velocities, Qualitative discussion of the Maxwell's distribution of molecular velocities, Collision number, Mean free path and Collision diameter, Liquefaction of gases, Linde's method and Claude's method.

**Critical Phenomena**: PV isotherms of real gases, Continuity of states, Isotherms of van der Waals equation, Relationship between critical constants and van der Waals constants, Law of corresponding states, Reduced equation of state, Numericals.

**(b) Solid State**

Definition of space lattice, unit cell.

Laws of crystallography: Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry, Symmetry elements in crystals.

X-ray diffraction by crystals, Derivation of Bragg's equation, Determination of crystal structure of NaCl and KCl (Laue's method and Powder method), perfect and imperfect crystals, Frenkel and Schottky defects.

**Unit III**

**Thermodynamics-I**

Definition of thermodynamic terms: System, Surroundings, etc., Types of systems, Intensive and extensive properties, State and path functions and their differentials, Thermodynamic process, Concept of heat and work.

**First law of thermodynamics**: Statement, Definition of internal energy and enthalpy, Heat capacity, Heat capacities at constant volume and pressure and their relationship, Joule's law, Joule-Thomson coefficient and inversion temperature, Calculation of w, q, dU and dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process, Application to cyclic process (The Carnot Theorem), Carnot cycle and its efficiency.

**Thermochemistry**: Standard state, Standard enthalpy of formation, Hess's law of constant heat summation and its applications, Heat of reaction at constant pressure and at constant volume, Enthalpy of neutralization, Bond dissociation energy and its calculation from thermo-chemical data, Temperature dependence of enthalpy, Kirchhoff's equation, Numericals.

**Unit IV**

**Thermodynamics –II**

Second law of thermodynamics, Need for the law, Different statements of the law, Concept of entropy, Mathematical treatment of entropy concept, Combined form of the first and second laws of thermodynamics, Entropy as a state function, Entropy as function of V and T, Entropy as function of P and T, Entropy change in ideal gases and mixing of gases, Calculation of entropy changes of physical processes (Phase changes, Reversible isothermal expansion of ideal gas, Heating or cooling of substance, Reversible adiabatic change), Numerical.

**Thermodynamics –III**

Third law of thermodynamics, Nernst heat theorem, Definition of third law, Evaluation of absolute entropy of solids, liquids and gases from heat capacity data, Residual entropy.

**Free energy functions**: Purpose of new functions, Helmholtz (A) and Gibbs (G) free energy function, Significance of A and G, Variation of A and G with P, V and T; A and G as criteria for thermodynamic Equilibrium and spontaneity.

Relation between A and G, Gibbs – Helmholtz equation and its application, Clausius-Clapeyron equation and its applications, Integrated form of Clausius-Clapeyron equation, Numerical.

**Unit V**

**Chemical Kinetics**

Chemical Kinetics and its scope, Rate of reaction, Factors influencing the rate of reaction: concentration, temperature, pressure, solvent, light, catalyst and surface area.

Concentration dependence of rates, Mathematical characteristics of simple chemical reactions: zero order, first order, second order, pseudo order, half life and mean life period, Determination of the

order of reaction: differentiation method, method of integration, method of half life period and isolation method, Radioactive decay as a first order phenomenon.

Effect of temperature on rate of reaction, Arrhenius equation, Concept of activation energy.

Parallel, Consecutive and Opposing reactions, Potential energy Surfaces

**Note for Paper Setting**

Internal Assessment: 20 marks for theory paper in a subject reserved for internal assessment shall be distributed as under:

| | | | |
|---|---|---|---|
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| (ii) | Two written assignments | : | 10 marks (05 marks each) |

External Examination: The question paper will contain three sections A, B & C.

**Section A** will consist of ten very short answers type questions, two from each unit, carrying 2 marks each. All the questions in section A will be compulsory **(20 marks)**.

**Section B** will consist of ten short answers type questions, two from each unit with internal choice. Student will be required to attempt five questions one from each unit, each question carrying 6 marks **(30 marks)**.

**Section C** will have five long answers type questions, one from each unit, carrying 10 marks. Student will be required to attempt any three questions **(30 marks)**.

**BOOKS RECOMMENDED:**

1. Mathematics for Chemists by Bhupendra singh, Pragati Prakashan.
2. An introduction to Chemical Thermodynamics by R. P. Rastogi and R. R. Misra, Vikas Publishing Co. Limited.
3. Text Book of Physical Chemistry by S. Glasstone, MacMillan India limited.
4. A Text Book of Physical Chemistry by K. L. Kapoor (Volumes 1 to 4), MacMillan India limited.
5. Chemical Kinetics by K. Laidler, Tata McGraw Hill Publishing Co. Limited.
6. Principles of Physical Chemistry by Maron and Prutton, Oxford and IBH Publishing Co. Pvt. Limited.

## CHEMISTRY SYLLABUS

(For examinations to be held in the years 2016 & 2017)

## SEMESTER-II

**Course No.: CH-201 (Practical)** **Title: Physical Chemistry (Practical)**

**Credits: 02** **Maximum Marks: 50**

**Time: 4 Hours** **External Examination: 25 Marks**

**Internal Examination: 25 Marks**

**Chemical Kinetics**

1. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at room temperature.
2. To study the effect of acid strength on the hydrolysis of an ester.
3. To compare the strength of HCl and $H_2SO_4$ by studying the Kinetics of hydrolysis of ethyl acetate.

**Distribution law**

1. To study the distribution of benzoic acid between benzene and water.
2. To study the distribution of iodine between carbon tetrachloride and water.

**Colloids**

To prepare arsenious sulphide sol and compare the precipitating power of mono-, bi- and trivalent anions.

**Viscosity and Surface Tension**

1. To determine the percentage composition of a given mixture (non interacting systems) by viscosity method.
2. To determine the viscosity of amyl alcohol in water at different concentrations and calculate the excess viscosity of these solutions.
3. To determine the percentage composition of a given binary mixture by surface tension method (acetone & ethyl methyl Ketone).
4. To determine the density of the liquid.

To determine the transition temperature by thermometric/dialatometric method.

To study the effect of a solute on the critical solution temperature of two partially miscible liquids (e.g., Phenol-Water system) and to determine the concentration of that solute in the given Phenol-Water system.

To determine the solubility of given inorganic salt (KCl, NaCl, $KNO_3$, $NaNO_3$ & $NaSO_4$) at different temperatures and obtain the solubility curves.

20 marks

**Viva-Voce** 05 marks

**Note for distribution of 25 marks in internal assessment in practical examination:**

Internal Examination: Total marks reserved for internal assessment shall be distributed as under:

| | | | |
|---|---|---|---|
| (i) | Daily assessment in the laboratory | : | 12 marks |
| (ii) | Class test (internal practical test) | : | 08 marks |
| (iii) | Regularity of attendance | : | 05 marks |

External Examination: There shall be two exercises in the external examination of ten marks each.

**BOOKS RECOMMENDED:**

1. Advanced Practical Physical Chemistry by J. B. Yadav, Goel Publications, Meerut.
2. Advanced Practical Chemistry by J.Singh, L.D.S.Yadav and J. Srivastava, Pragati Parkashan
3. Practical Physical Chemistry by B. Viswanathan and P.S. Raghavan, Viva Books Pvt. Ltd.

# CHEMISTRY SYLLABUS

(For examinations to be held in the years 2015, 2016 & 2017)

## SEMESTER-III

**Course No.: CH-301 (Theory)** | **Title: Organic Chemistry-I**

**Credits: 04** | **Maximum Marks: 100**

**Time: 03 Hours** | **External Examination: 80 Marks**

**Internal Assessment: 20 Marks**

### Unit-I

**a) Structure and Bonding**

$sp^3$, $sp^2$ and sp hybridization of carbon compounds; bond lengths, bond angles and bond energy; localized and delocalized chemical bond; inductive and field effects, resonance and hyperconjugation.

**b) Organic Reaction Mechanism**

Homolytic and heterolytic bond breaking; formation of covalent bond; electrophilic and nucleophilic reagents; reaction intermediates-carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples); methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies).

**c) Stereochemistry of Organic compounds**

Newman projection, Sawhorse, Fischer projection and Flying-Wedge formulae, Optical isomerism – elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, meso compounds, resolution of racemic mixtures; relative and absolute configurations – D&L and R&S systems of nomenclature, sequence rules; geometrical isomerism – cis-trans isomerism, E&Z system of nomenclature of alkenes.

### Unit-II

**Alkanes, Cycloalkanes, Alkenes and Alkynes**

IUPAC nomenclature of alkanes; classification of carbon atoms in alkanes, methods of formation of alkanes with special reference to Wurtz reaction, Kolbe's reaction, Corey-House reaction and decarboxylation of carboxylic acids; physical properties and chemical reactions of alkanes; mechanism of free radical halogenation of alkanes.

Cycloalkanes – nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations; ring strain in small rings (cyclopropane and cyclobutane); theory of strainless rings; banana bonds.

Nomenclature of alkenes; methods of formation of alkenes – mechanism of dehydration of alcohols and dehydrohalogenation of alkyl halides; regioselectivity in alcohol dehydration, the Saytzeff rule, Hofmann elimination; physical properties and chemical reactions – mechanisms involved in

hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration-reduction, epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$; polymerization and industrial applications of alkenes.

Nomenclature, methods of formation and chemical reactions of alkynes (acidic nature of terminal alkynes, electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization).

**Unit-III**

**(a) Arenes:** Nomenclature of substituted mononuclear aromatic hydrocarbons; structure of benzene – Kekule structure, stability and carbon-carbon bond lengths of benzene, resonance structure and molecular orbital structure; aromaticity – Huckel's rule and its applications to polycyclic aromatics.

Mechanism of aromatic electrophilic substitution reactions – nitration, halogenations, sulphonation and Friedel-Craft's reaction; role of σ– and π– complexes and energy profile diagrams; orientation in the aromatic electrophilic substitution reaction – effects of substituents on orientation and reactivity, ortho/para ratio.

**(b) Alkyl and Aryl Halides:** Nomenclature and classification of haloalkanes; methods of formation and chemical reactions of haloalkanes; mechanism of nucleophilic substitution reactions of alkyl halides – $S_N2$ and $S_N1$ reactions with energy profile diagrams.

Formation and reactions of aryl halides, nuclear and side chain reactions, the addition–elimination and the elimination–addition mechanisms of aromatic nucleophilic substitution reactions; relative reactivities of alkyl halides v/s aryl halides.

**Unit-IV**

**Alcohols and Phenols**

Classification and nomenclature.

Monohydric alcohols – nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, hydrogen bonding, acidic nature. Reaction of alcohols. Alkoxide as nucleophilic and non-nucleophilic bases.

Dihydric alcohols – nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and $HIO_4$] and Pinacol-Pinacolone rearrangement.

Nomenclature, structure and bonding. Preparation of phenols, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols-electrophilic aromatic substitutions: acylation and carboxylation. Mechanism of Fries rearrangement, Claisen rearrangement, Gattermann synthesis, Houben-Hoesch reaction and Lederer-Mannase reaction.

**Unit-V**

**(a) Aldehydes and Ketones**

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids, Physical properties.

Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, Wittig reaction, Mannich reaction.

Oxidation of aldehydes, Baeyer-Villiger oxidation of Ketones, Cannizzaro reaction, MPV, Clemmensen, Wolf-Kishner, $LiAlH_4$ and $NaBH_4$ reductions.

**(b) Carboxylic Acids & Derivatives**

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength, Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Reduction of carboxylic acids. Mechanism of decarboxylation.

Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution, Preparation of Carboxylic acid derivatives, chemical reactions, mechanism of esterification and hydrolysis (acidic and basic).

**Note for Paper Setting**

Internal Assessment: 20 marks for theory paper in a subject reserved for internal assessment shall be distributed as under:

| | | | |
|---|---|---|---|
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**Section B** will consist of ten short answers type questions, two from each unit with internal choice. Student will be required to attempt five questions one from each unit, each question carrying 6 marks **(30 marks)**.

**Section C** will have five long answers type questions, one from each unit, carrying 10 marks. Student will be required to attempt any three questions **(30 marks)**.

**BOOKS RECOMMENDED:**

1. Organic Chemistry, Morrison and Boyd, Prentice-Hall.
2. Organic Chemistry, O.G. Wade Jr., Prentice Hall.
3. Fundamentals of Organic Chemistry, Solomons, John Wiley.

4. Organic Chemistry, Vol. I, II & III, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International).
5. Organic Chemistry, F.A. Carey (McGraw Hill, Inc.).
6. Introduction to Organic Chemistry, Streitwieser, Heathcock and Kosover (Macmilan).
7. Stereochemistry Conformation and Mechanism, 6th Ed., P.S. Kalsi (New Age International (P) Ltd.).
8. Stereochemistry of Carbon Compounds, Ernest L. Elich, (McGraw Hill Publishing Company Ltd.).
9. Stereochemistry of Organic Compounds- Principles and Applications, D. Nassipuri (New Age International Publishers).

## CHEMISTRY SYLLABUS

(For examinations to be held in the years 2015, 2016 & 2017)

## SEMESTER-III

**Course No.: CH-301 (Practical)** **Title: Organic Chemistry (Practical)**

**Credits: 02** **Maximum Marks: 50**

**Time: 4 Hours** **External Examination: 25 Marks**

**Internal Examination: 25 Marks**

**Purification of organic solids by**

i) Sublimation (Naphthalene, camphor etc.)

ii) Hot water (Benzoic acid, acetanilide etc.)

Checking purity of organic solids by melting point/mixed melting point.

**Identification of Organic Compounds**

The preliminary examination of physical and chemical characteristics (physical state, colour, odor and ignition tests), elemental analysis (nitrogen, sulphur, chlorine, bromine, iodine), solubility tests including acid-base reactions. Functional group tests of following classes of compounds

– phenols, carboxylic acids

– carbonyl compounds – ketones, aldehydes

– carbohydrates

– aromatic amines

– amides, ureas and anilides

– aromatic hydrocarbons and their halo- derivatives

**Preparations**

i) Acetylation of salicylic acid, aniline

ii) Benzoylation of salicylic acid, aniline

iii) Preparation of iodoform from ethanol and acetone

iv) Preparation of 4-nitroacetanilide from acetanilide

v) Preparation of 4-bromoacetanilide from acetanilide

20 marks

**Viva-Voce** 05 marks

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| (ii) | Class test (internal practical test) | : | 08 marks |
| (iii) | Regularity of attendance | : | 05 marks |

External Examination: There shall be two exercises in the external examination of ten marks each.

**BOOKS RECOMMENDED:**

1. Experimental Organic Chemistry – Principles and practice by Laurence M. Harwood and Christopher J. Moody (Blackwell Scientific Publications).
2. Laboratory Manual of Organic Chemistry by Raj K. Bansal (New Age Publications).
3. Advanced Practical Chemistry by Jagdamba Singh and others (Pragati Prakashan).
4. Practical Organic Chemistry by N.K. Vishnoi (New Age Publications).
5. Experimental Organic Chemistry, Vol. I & II, P.R. Singh, D.S. Gupta and K.S. Bajpai, Tata McGraw Hill.
6. Laboratory Manual in Organic Chemistry, R.K. Bansal, Wiley Eastern.
7. Vogel's Textbook of Practical Organic Chemistry, B.S. Furniss, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell, ELBS.
8. Experiments in General Chemistry, C.N.R. Rao and U.C. Agarwal, East-West Press.

# CHEMISTRY SYLLABUS

(For examinations to be held in the years 2016, 2017 & 2018)

## SEMESTER-IV

**Course No.: CH-402 (Theory)** **Title: Inorganic Chemistry-II**

**Credits: 04** **Maximum Marks: 100**

**Time: 03 Hours** **External Examination: 80 Marks**

**Internal Assessment: 20 Marks**

### Unit-I

**(a) Chemistry of Transition Elements**

General characteristic properties of d-block elements. Properties of the elements of the first transition series, relative stability of their oxidation states with reference to their binary compounds (oxides, halides and sulphides), coordination number and geometry of complexes of 3d transition elements. Chemistry of Elements of Second and Third Transition Series - General characteristics, comparative treatment with their 3d- analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.

**(b) Coordination Compounds**

Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds.

### Unit-II

**(a) Bonding in Coordination Compounds**

Metal-ligand bonding in Transition Metal Complexes-Valence bond theory and its applications to transition metal complexes. Limitations of valence bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, Crystal Field Stabilization Energy (CFSE), Effects of CFSE on hydration energy, factors affecting the crystal – field parameter.

**(b) Thermodynamic and Kinetic Aspects of Metal complexes**

A brief outline of thermodynamic and kinetic stability of metal complexes, stepwise and overall stability constants, factors affecting the stability of complexes, chelate effect.

### Unit-III

**(a) Magnetic Properties of Transition Metal Complexes**

Types of Magnetic behaviour, methods of determining magnetic susceptibility( Guoy's and Faraday's methods) spin only formula, L-S coupling and correlation of values, orbital contribution to magnetic moments, application of magnetic moment data for structure analysis of 3d-metal complexes.

**(b) Electronic Spectra of Transition Metal Complexes**

Types of electronic transition, selection rules for d- d transitions, spectroscopic ground states, spectro-chemical series, Orgel-energy level diagram for $d^1$ and $d^9$ states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complex ion.

**Unit-IV**

**(a) Chemistry of Lanthanide elements**

Position of lanthanides in the periodic table, electronic structure, oxidation states , ionic radii and lanthanide contraction, magnetic and spectral properties, complex formation, chemical reactivity, occurrence and isolation, applications of lanthanides.

(b) **Chemistry of Actinides**

Position of actinides in the periodic table, electronic structure, oxidation states , ionic radii and actinide contraction, magnetic and spectral properties, complex formation, chemistry of separation of Np, Pu and Am from U, applications of actinides, Comparison between the later actinides and the later lanthanides.

**Unit-V**

**(a) Organometallic Chemistry**

Definition, nomenclature and classification of organometallic compounds. Preparation, properties, bonding and applications of alkyls and aryls of Li, Al and Ti, a brief account of metal –ethylenic complexes and homogeneous hydrogenation, mononuclear carbonyls and the nature of bonding in metal carbonyls.

**(b) Bio-Inorganic Chemistry**

Essential and Trace elements in biological processes. Metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to $Ca^{2+}$ and $Mg^{2+}$ ions, Biological nitrogen fixation.

**Note for Paper Setting**

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**BOOKS RECOMENDED:**


1. Basic Inorganic Chemistry, F.A.Cotton, G.Wilkinson and PL. Gaus, Wiley.
2. Concise Inorganic Chemistry, J.D.Lee, ELBS.
3. Concepts of Models of Inorganic Chemistry, B.Douglas, S. Mc Daniel and J. Alexander, John Wiley.
4. Inorganic Chemistry, D.E.Shriver, P.W.Atkins and C.H.Langford, Oxford.
5. Inorganic Chemistry, W.W.Porterfield, Addison,Wesey.
6. Inorganic Chemistry, A.G. Sharpe, ELBS.
7. Inorganic Chemistry, G.L Miessler and D.A. Tarr, Prentice Hall.
8. Inorganic Chemistry, $4^{th}$ ed., Shriver & Atkins, Oxford.

## CHEMISTRY SYLLABUS

(For examinations to be held in the years 2016, 2017 & 2018)

## SEMESTER-IV

**Course No.: CH-402 (Practical)** **Title: Inorganic Chemistry-II (Practical)**

**Credits: 02** **Maximum Marks: 50**

**Time: 4 Hours** **External Examination: 25 Marks**

**Internal Examination: 25 Marks**

**Synthesis and Analysis**

(a) Preparation of sodium trioxalato ferrate (III), $Na_3$ Fe $(C_2O_4)_3$ and determination of its composition by permaganometry.

(b) Preparation of Ni-DMG complex, Ni $(DMG)_2$.

(c) Preparation of copper tetra-amine complex, $Cu(NH_3)_4SO_4$.

(d) Preparation of cis-and trans-bisoxalato diaquachromate (III) ion.

(e) Analysis of Cu as CuSCN and Ni as Ni (dimethylglyoxime).

**Instrumentation**

**Colorimetry**

(a) Job's method (b) Mole-ratio method

**Solvent Extraction**

Separation and estimation of Mg(II) and Fe(II)

**Ion Exchange Method**

Separation and estimation of Mg(II) and Zn(II).

**Qualitative Inorganic Analysis**

Semi micro Analysis of salt mixtures containing three acidic and three basic radicals with interfering ions.

20 marks

**Viva-Voce** 05 marks

**Note for distribution of 25 marks in internal assessment in practical examination:**

Internal Examination: Total marks reserved for internal assessment shall be distributed as under:

| | | | |
|---|---|---|---|
| (i) | Daily assessment in the laboratory | : | 12 marks |
| (ii) | Class test (internal practical test) | : | 08 marks |
| (iii) | Regularity of attendance | : | 05 marks |

External Examination: There shall be two exercises in the external examination of ten marks each.

**BOOKS RECOMENDED:**

1. Vogel's Qualitative Inorganic Analysis, revised, Svehla, Orient Longman.
2. Vogel's Textbook of Quantative Inorganic Analysis, revised, Svehla, Orient Longman.

3. Vogel's Textbook of Quantative Inorganic Analysis (revised), J.Bassett, R.C.Denney, G.H.Jeffery and J.Mendham, ELBS.
4. Experimental Inorganic Chemistry, W.G.Palmer, Cambridge.
5. Handbook of Preparative Inorganic Chemistry, Vol.I &II, Brauer, Academic Press.
6. Inorganic Synthesis, McGraw Hill

# CHEMISTRY SYLLABUS

(For examinations to be held in the years 2016, 2017 & 2018)

## SEMESTER-V

**Course No.: CH-502 (Theory)** **Title: Physical Chemistry - II**

**Credits: 04** **Maximum Marks: 100**

**Time: 03 Hours** **External Examination: 80 Marks**

**Internal Assessment: 20 Marks**

### Unit I

**Equilibrium Phenomenon**

**Chemical Equilibrium:** Law of mass action, Thermodynamic derivation of law of mass action (van't Hoff equation and its integrated form**)**, Relation between $K_p$, $K_c$ and $K_x$, Distinction between $\Delta G$ and $\Delta G^0$.

**Phase Equilibrium**: Statement and meaning of the terms: Phase, component and degree of freedom, Derivation of Gibbs phase rule, Phase equilibrium of one component system: water, $CO_2$ and Sulphur system, Phase equilibrium of two component systems: solid liquid equilibria, Simple eutectic: Bi-Cd, Pb-Ag systems, Desilverisation of lead.

Solid solutions: Compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-$H_2O$), ($FeCl_3$-$H_2O$) and $CuSO_4$-$H_2O$ system, Freezing mixtures, acetone- dry ice freezing mixture

### Unit II

**Electrochemistry-I**

Specific conductance and equivalent conductance, Measurement of equivalent conductance, Variation of equivalent conductance and specific conductance with dilution.

Migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations, Weak and strong electrolytes , Ostwald's dilution law, its uses and limitations. Transport number, Definition and determination by Hittorf method and Moving boundary method.

Applications of conductivity measurements, Determination of degree of dissociation, Determination of *Ka* of acids, Determination of solubility product of sparingly soluble salt, Conductometric titrations.

**Electrochemistry-II**

Types of reversible electrodes: gas metal ion, metal-metal ion, metal- insoluble salt-anion and redox electrodes, Electrode reaction, Nernst equation, derivation of cell E.M.F and single electrode potential, Standard hydrogen electrode, Reference electrodes. Standard electrode potential, Sign convention, Electrochemical series and its significance. Electrolytic and Galvanic cells, reversible and irreversible cells, Conventional representation and electrochemical cells, E.M.F of a cell and its measurements, Computation of cell E.M.F, Calculation of thermodynamic quantities of cell reaction

(G, H, and K), Concentration cells with and without transport, Liquid junction potential, Applications of concentration cells, Valency of ions, Solubility product and activity coefficient. Definition of *pH* and *pKa*, Determination of *pH* using hydrogen quinhydrone and glass electrodes by potentiometric methods.

**Unit III**

**Quantum Mechanics-I**

Black- body radiation, Planck's radiation law, Photoelectric effect, Heat capacity of solids, Bohr's model of hydrogen atom and its defects, Compton effect, Zeeman effect, de Broglie hypothesis, Heisenberg's uncertainty principle.

**Quantum Mechanics-II**

Schrodinger wave equation and its importance, Physical interpretation of the wave function, Concept of operators, Hamiltonian operator, Postulates of quantum mechanics, Discussion of solutions of the Schrodinger equation to some model systems viz; Particle in one dimensional box, Particle in three dimensional box, Concept of degeneracy.

**Unit IV**

**Spectroscopy**

**Introduction:** Electromagnetic radiation, Regions of spectrum, Basic features of different spectrometers, statement of the Born-Oppenheimer approximation, Degrees of freedom.

**Rotational Spectrum:** Diatomic molecules, Energy levels of a rigid rotor (Semi-classical principles), Selection rules, Spectral intensity, Distribution using population distribution (Maxwell-Boltzmann distribution) Determination of bond length, Isotope effect.

**Vibrational Spectrum:** Infrared spectrum, Energy levels of simple harmonic oscillator, Selection rules, Pure vibrational spectrum, Intensity, Determination of force constant and bond energies, Effect of anharmonic motion and isotope on the spectrum.

**Raman Spectrum**: Concept of polarizability, Pure rotational and pure vibrational Raman spectra of diatomic molecules.

**Electronic Spectrum**: Concept of potential energy curves for bonding and anti-bonding molecular orbitals, Qualitative description of selection rules and Franck-Condon principle.

**Unit V**

**Photochemistry:** Interaction of radiation with matter, Difference between thermal and photochemical processes, Laws of photochemistry: Grothus-Drapper law, Stark- Einstein law, Jablonski diagram depicting various processes occurring in the excited state, Qualitative description of fluorescence, Phosphorescence, Quantum yield, Photosensitized reactions, energy transfer processes (simple examples).

**Physical properties and Molecular Structure:** Optical activity, Polarization – (Clausius-Mossotti equation), Orientation of dipoles in an electric field, Dipole moment, Iinduced dipole moment,

Measurement of dipole moment: temperature method and refractivity method, Dipole moment and structure of molecules, Magnetic properties: paramagnetism, diamagnetism and ferromagnetism.

**Note for Paper Setting**

Internal Assessment: 20 marks for theory paper in a subject reserved for internal assessment shall be distributed as under:

| | | | |
|---|---|---|---|
| (i) | One Class Test | : | 10 marks |
| (ii) | Two written assignments | : | 10 marks (05 marks each) |

External Examination: The question paper will contain three sections A, B & C.

**Section A** will consist of ten very short answers type questions, two from each unit, carrying 2 marks each. All the questions in section A will be compulsory **(20 marks)**.

**Section B** will consist of ten short answers type questions, two from each unit with internal choice. Student will be required to attempt five questions one from each unit, each question carrying 6 marks **(30 marks)**.

**Section C** will have five long answers type questions, one from each unit, carrying 10 marks. Student will be required to attempt any three questions **(30 marks)**.

**BOOKS RECOMMENDED:**

1. Text Book of Physical Chemistry by S. Glasstone, MacMillan India limited
2. An Introduction to Electrochemistry by S. Glasstone, Affiliated East West Press Pvt. Limited.
3. Introductory Quantum Chemistry by A. K. Chandra, Tata Mc Graw Hill Publishing Co. Limited.
4. Fundamentals of Molecular Spectroscopy by C. N. Banwell amd E. M. McCash, Tata Mc Graw Hill Publishing Co. Limited.
5. Quantum Chenistry by I.N.Levine, Pearson Educatio, Inc.

# CHEMISTRY SYLLABUS

(For examinations to be held in the years 2016, 2017 & 2018)

## SEMESTER-V

**Course No.: CH-502 (Practical)** **Title: Physical Chemistry-II (Practical)**

**Credits: 02** **Maximum Marks: 50**

**Time: 4 Hours** **External Examination: 25 Marks**

**Internal Examination: 25 Marks**

**Molecular Weight Determination**

(a) Determination of molecular weight of a non-volatile solute by Rast method/Beckmann point method.

(b) Determination of the apparent degree of dissociation of an electrolyte (e.g NaCl) in aqueous solution at different concentrations by ebullioscopy.

**Refractometry and Polarimetry**

(a) To verify law of refraction of mixture (e.g of glycerol and water ) using Abbe's refractrometer.

(b) To determine the specific rotation of a given optically active compound.

**Conductometric Titrations**

(a) To determine the strength of the given acid conductometrically using standard alkali solution.

(b) To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically.

(c) To study the saponification of eythyl acetate condutctometricllay

(d) To determine the ionisation constant of a weak acid condutctometrically.

(e) To titrate potentiometrically the given ferrous ammonium sulphate solution using $KMnO_4/K_2Cr_2O_7$ as titrant and calculate the redox potential of $Fe^{++}/Fe^{+++}$ system on the hydrogen scale.

**Colorimetry**

To verify Beer-Lambert law for $KMnO_4/K_2Cr_2O_7$ and determine the concentration of the given solution of the substance.

**Thermochemistry**

To determine the heat of neutralization of strong acid (HCl, $H_2SO_4$) and weak acid (acetic acid).

Determination of equilibrium constant for the system $I_2 + KI \rightarrow KI_3$ and to determine the concentration of given KI solution.

20 marks

**Viva-Voce** 05 marks

**Note for distribution of 25 marks in internal assessment in practical examination:**

Internal Examination: Total marks reserved for internal assessment shall be distributed as under:

(i) Daily assessment in the laboratory : 12 marks

(ii) Class test (internal practical test) : 08 marks

(iii) Regularity of attendance : 05 marks

External Examination: There shall be two exercises in the external examination of ten marks each.

**BOOKS RECOMMENDED:**

1. Advanced Practical Physical Chemistry by J. B. Yadav, Goel Publications, Meerut.
2. Advanced Practical Chemistry by J.Singh, L.D.S.Yadav and J. Srivastava, Pragati Parkashan
3. Practical Physical Chemistry by B. Viswanathan and P.S. Raghavan, Viva Books Pvt. Ltd.

# CHEMISTRY SYLLABUS

(For examinations to be held in the years 2017, 2018 & 2019)

## SEMESTER-VI

**Course No.: CH-602 (Theory)** | **Title: Organic Chemistry-II**

**Credits: 04** | **Maximum Marks: 100**

**Time: 03 Hours** | **External Examination: 80 Marks**

**Internal Assessment: 20 Marks**

### Unit-I

**a) Electromagnetic spectrum**

Ultraviolet (UV) absorption spectroscopy – absorption laws (Beer Lambert law), molar absorptivity, types of electronic transitions, effect of conjugation. Concept of Chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts, effect of solvents. UV spectra of conjugated enes and enones (Woodward - Fieser rules).

Infrared (IR) absorption spectroscopy – molecular vibrations. Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds (benzaldehyde, benzoyl chloride, acetophenone, benzamide, salicylic acid, p-hydroxybenzoic acid, p-nitroaniline, p-nitrophenol, benzonitrile, α,β-unsaturated ketones).

**b) Spectroscopy**

Nuclear magnetic resonance (NMR) spectroscopy. Proton magnetic resonance ($^1$H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone.

### Unit-II

**a) Organometallic compounds of Mg, Li & Zn, Organosulphur compounds**

Organomagnesium compounds: Grignard reagents – formation, structure and chemical reactions.

Organozinc compounds: formation and chemical reactions.

Organolithium compounds: formation and chemical reactions.

Organosulphur compounds: nomenclature, structural features, methods of formation and chemical reactions of thiols, thioethers and sulphonic acids.

**b) Organic Synthesis via enolates**

Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1,3-dithianes, alkylation and acylation of enamines.

**c) Synthetic polymers**

Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step growth polymerization.

**Unit-III**

**a) Nitroalkanes/arenes, cyanides and amines**

Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes, mechanism of nucleophilic substitution in nitroarenes and their reduction in acidic, neutral and alkaline media. Halonitroarenes: reactivity.

Structure and nomenclature of amines, physical properties. Separation of mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. Amine salts as phase-transfer catalysts (Principles and mechanisms). Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel-phthalimide reaction, Hofmann-bromamide reaction. Reactions of amines as nucleophiles, electrophilic aromatic substitution in aryl amines, Preparation and synthetic transformations of aryl diazonium salts, azo coupling.

**b) Conformations and stereochemistry**

Conformational analysis of butane, cyclohexane and mono-substituted cyclohexanes. Stereochemistry of $E_2$ Anti-elimination reaction and addition reactions to alkenes (bromination, hydroboration/oxidation, hydration).

**Unit-IV**

**a) Heterocyclic compounds**

Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine. Comparison of basicity of pyridine, piperidine and pyrrole.

Introduction to condensed five and six-membered heterocycles. Preparation and reactions of indole, quinoline with special reference to Fisher indole synthesis and Skraup synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline.

**b) Synthetic dyes**

Colour and constitution (electronic concept), synthesis of Methyl orange, Malachite green. Crystal violet, Phenolphthalein, chemistry and synthesis of Indigo.

**Unit-V**

**a) Amino acid, peptides, proteins, nucleic acid**

Classification, structure and stereochemistry of amino acids, acid- base behaviour, isoelectric point and electrophoresis, preparation and reactions of α-amino acids.

Structure and nomenclature of peptides and proteins. Classification of proteins, peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solid-phase peptide synthesis. Structures of proteins. Levels of protein structure. Protein Nucleic acids: introduction. Constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.

**b) Carbohydrates**

Classification, Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses, configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into mannose. Formation of glycoside, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D(+)– glucose. Mechanism of mutarotation.

An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

**Note for Paper Setting**

Internal Assessment: 20 marks for theory paper in a subject reserved for internal assessment shall be distributed as under:

| | | | |
|---|---|---|---|
| (i) | One Class Test | : | 10 marks |
| (ii) | Two written assignments | : | 10 marks (05 marks each) |

External Examination: The question paper will contain three sections A, B & C.

**Section A** will consist of ten very short answers type questions, two from each unit, carrying 2 marks each. All the questions in section A will be compulsory **(20 marks)**.

**Section B** will consist of ten short answers type questions, two from each unit with internal choice. Student will be required to attempt five questions one from each unit, each question carrying 6 marks **(30 marks)**.

**Section C** will have five long answers type questions, one from each unit, carrying 10 marks. Student will be required to attempt any three questions **(30 marks)**.

**BOOKS RECOMMENDED:**

1. Organic Chemistry, Morrison and Boyd, Prentice-Hall.
2. Organic Chemistry, L.G. Wade Jr. Prentice-Hall.
3. Fundamentals of Organic Chemistry, Solomons, John Wiley.

4. Organic Chemistry Vol. I, II & III, S.M. Mukerji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International).
5. Organic Chemistry, F.A. Carey, McGraw Hill Inc.
6. Introduction to Organic Chemistry, Stritwieser, Healthcock and Kosover, Macmilan.
7. Organic Spectroscopy, William Kemp, Mcmillan.
8. Spectroscipic Methods in Organic Chemistry, 4th ed., Dudley H. Williams and Ian Fleming (Tata McGraw-Hill Publishing Company Ltd.).
9. Spectroscopic Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler and T.C. Morriel (John-Wiley).

## CHEMISTRY SYLLABUS

(For examinations to be held in the years 2017, 2018 & 2019)

## SEMESTER-VI

**Course No.: CH-602 (Practical)** **Title: Organic Chemistry-II (Practical)**

**Credits: 02** **Maximum Marks: 50**

**Time: 4 Hours** **External Examination: 25 Marks**

**Internal Examination: 25 Marks**

**Column Chromatography**

Separation of fluorescein and methylene blue

Separation of leaf pigments from spinach leaves

Resolution of racemic mixture of (±) Mandelic acid

**Preparations**

i) p-Nitroaniline from acetanilide
ii) p-Bromoaniline from acetanilide
iii) m-Nitroaniline from nitrobenzene
iv) Synthesis of di-benzalacetone from benzaldehyde (Claisen-Schmidt condensation)
v) Synthesis of benzyl alcohol and benzoic acid from benzaldehyde (Cannizaro reaction)

**Extraction of organic compounds from natural resources**

i) Isolation of casein from milk
ii) Isolation of lactose from milk
iii) Isolation of lycopene from tomatoes
iv) Isolation of caffeine from tea leaves

20 marks

**Viva-Voce** 05 marks

**Note for distribution of 25 marks in internal assessment in practical examination:**

Internal Examination: Total marks reserved for internal assessment shall be distributed as under:

| | | | |
|---|---|---|---|
| (i) | Daily assessment in the laboratory | : | 12 marks |
| (ii) | Class test (internal practical test) | : | 08 marks |
| (iii) | Regularity of attendance | : | 05 marks |

External Examination: There shall be two exercises in the external examination of ten marks each.

**BOOKS RECOMMENDED:**

1. Experimental Organic Chemistry – Principles and practice by Laurence M. Harwood and Christopher J. Moody (Blackwell Scientific Publications).
2. Laboratory Manual of Organic Chemistry by Raj K. Bansal (New Age Publications).
3. Advanced Practical Chemistry by Jagdamba Singh and others (Pragati Prakashan).

4. Practical Organic Chemistry by N.K. Vishnoi (New Age Publications).
5. Experimental Organic Chemistry, Vol. I & II, P.R. Singh, D.S. Gupta and K.S. Bajpai, Tata McGraw Hill.
6. Laboratory Manual in Organic Chemistry, R.K. Bansal, Wiley Eastern.
7. Vogel's Textbook of Practical Organic Chemistry, B.S. Furniss, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell, ELBS.
8. Experiments in General Chemistry, C.N.R. Rao and U.C. Agarwal, East-West Press.