# BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI – 620 024.

## B.Sc. Chemistry – Course Structure under CBCS

**(For the candidates admitted from the academic year 2010-2011 onwards)**

| Semester | Part | Course | Title | Instru Hours/ Week | Credit | Exam Hours | Marks | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Int. | Extn. | |
| I | I | Language Course – I (LC) – Tamil*/Other Languages ** # | | 6 | 3 | 3 | 25 | 75 | 100 |
| | II | English Language Course - I (ELC) | | 6 | 3 | 3 | 25 | 75 | 100 |
| | III | Core Course – I (CC) | General Chemistry I | 6 | 5 | 3 | 25 | 75 | 100 |
| | | Core Course – II (CC) | Practical I- Volumetric Analysis | 6 | 4 | 3 | 40 | 60 | 100 |
| | | First Allied Course –I (AC) | - | 6 | 4 | 3 | 25 | 75 | 100 |
| | | | | 30 | 19 | | | | 500 |
| II | I | Language Course – II (LC) - – Tamil*/Other Languages ** # | | 6 | 3 | 3 | 25 | 75 | 100 |
| | II | English Language Course – II (ELC) | | 6 | 3 | 3 | 25 | 75 | 100 |
| | | Core Course – III (CC) | General Chemistry - II | 5 | 4 | 3 | 25 | 75 | 100 |
| | | First Allied Course – II (AC) | Practical | 4 | 2 | 3 | 40 | 60 | 100 |
| | | First Allied Course – III (AC) | -- | 5 | 4 | 3 | 25 | 75 | 100 |
| | IV | Environmental Studies | | 2 | 2 | 3 | 25 | 75 | 100 |
| | IV | Value Education | | 2 | 2 | 3 | 25 | 75 | 100 |
| | | | | 30 | 20 | | | | 700 |
| III | I | Language Course – III (LC) – Tamil*/Other Languages ** # | | 6 | 3 | 3 | 25 | 75 | 100 |
| | II | English Language Course - III (ELC) | | 6 | 3 | 3 | 25 | 75 | 100 |
| | III | Core Course – IV (CC) | General Chemistry - III | **6** | 5 | 3 | 25 | 75 | 100 |
| | | Core Course – V (CC) | Practical II– Semimicro Analysis | **5** | 3 | 3 | 40 | 60 | 100 |
| | | Second Allied Course – I | . - | 5 | 4 | 3 | 25 | 75 | 100 |
| | IV | Non Major Elective I - for those who studied Tamil under Part I a) Basic Tamil for other language students b) Special Tamil for those who studied Tamil upto +2 but opt for other languages in degree programme | Agricultural Chemistry | 2 | 2 | 3 | 25 | 75 | 100 |
| | | | | 30 | 20 | | | | 600 |
| IV | I | Language Course –IV (LC) - Tamil*/Other Languages ** # | | 6 | 3 | 3 | 25 | 75 | 100 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | II | English Language Course – IV (ELC) | | 6 | 3 | 3 | 25 | 75 | 100 |
| | | Core Course – VI (CC) | General Chemistry - IV | 5 | 5 | 3 | 25 | 75 | 100 |
| | | Second Allied Course - II | Practical | 4 | 3 | 3 | 40 | 60 | 100 |
| | | Second Allied Course - III | | 5 | 3 | 3 | 25 | 75 | 100 |
| | IV | Non Major Elective II - for those who studied Tamil under Part I<br>a) Basic Tamil for other language students<br>b) Special Tamil for those who studied Tamil upto +2 but opt for other languages in degree programme | Chemistry of Consumer Products | 2 | 2 | 3 | 25 | 75 | 100 |
| | IV | Skill Based Elective I | | 2 | **4** | 3 | 25 | 75 | 100 |
| | | | | 30 | **23** | | | | 700 |
| V | III | Core Course – VII (CC) | Inorganic Chemistry | 5 | 5 | 3 | 25 | 75 | 100 |
| | | Core Course – VIII (CC) | Organic Chemistry - I | 5 | 5 | 3 | 25 | 75 | 100 |
| | | Core Course – IX (CC) | Physical Chemistry - I | 5 | 5 | 3 | 25 | 75 | 100 |
| | | Core Course – X (CC) | Practical III – Physical Chemistry | 6 | 5 | 3 | 40 | 60 | 100 |
| | | Major based Elective – I | Analytical Chemistry | 5 | 5 | 3 | 25 | 75 | 100 |
| | IV | Skill based Elective –II | | 2 | **4** | 3 | 25 | 75 | 100 |
| | | Skill based Elective – III | | 2 | **4** | 3 | 25 | 75 | 100 |
| | | | | 30 | **33** | | | | 700 |
| VI | III | Core Course – XI (CC) | Practical IV – Gravimetric & Organic Analysis | 6 | 4 | 6 | 40 | 60 | 100 |
| | | Core Course – XII (CC) | Organic Chemistry - II | **6** | 5 | 3 | 25 | 75 | 100 |
| | | Core Course XIII – | Physical Chemistry II | **6** | 5 | 3 | 25 | 75 | 100 |
| | | Major based Elective II | Nuclear and Industrial Chemistry | **6** | 5 | 3 | 25 | 75 | 100 |
| | | Major based Elective III | Optional | **5** | 4 | 3 | 25 | 75 | 100 |
| | IV | Extension activities | | - | 1 | - | - | - | - |
| | | Gender Studies | | 1 | 1 | 3 | 25 | 75 | 100 |
| | | | | 30 | 25 | | | | 600 |
| | | | Total | 180 | 140 | | | | 3800 |

**Note:**

| | **Internal Marks** | **External Marks** |
|---|---|---|
| 1. Theory | 25 | 75 |
| 2. Practical | 40 | 60 |

3. Separate passing minimum is prescribed for Internal and External marks

The passing minimum for CIA shall be 40% out of 25 marks [i.e. 10 marks]
The passing minimum for University Examinations shall be 40% out of 75 marks [ i.e. 30 marks]

* for those who studied Tamil upto +2 (Regular Stream)

** Syllabus for other Languages should be on par with Tamil at Degree level

# those who studied Tamil upto 10th or +2, but opt for other languages in degree level under Part I should study special Tamil in Part IV

*** Examination at the end of the next semester.
Extension activities shall be out side the instruction hours.

**List of allied Courses**

| **Group – I** | **Group- II ( any one of the followings )** |
|---|---|
| 1 Physics | 1. Mathematics |
| | 2. Zoology |
| | 3. Botany |
| | 4. Computer Science |

**செய்முறை பாடங்கள் உள்ள இயைபுப் பாடங்களுக்கு (4+2+4) தரபுள்ளிகள்**

**செய்முறை பாடங்கள் இல்லாத இயைபுப் பாடங்களுக்கு(3+3+4) தரபுள்ளிகள்**

1. Either group of allied courses may be offered in the I year / II year
2. Mark distribution for volumetric analysis- Practical – 55 + Procedure Writing- 10 + Record-10+ Int asst- 25
3. Mark distribution for Physical chem. Practical- Practical – 55 + Procedure Writing- 10 + Record-10+ Int asst- 25
4. Mark distribution for. Practical III ( Org & Grav)- Gravi-30 + Org-35 Record-10+ Int asst- 25
5. Every student shall undertake an industrial visit as a part of the curriculum once in the course period, to industrial units and R and D centres, to give a stress on the applied aspects. Extension and extra curricular activities should also be carried out side the class hours.
6. Under any circumstance the University Practical Questions should not be changed by the Examiners.

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# Core Course – I - General Chemistry

## Unit 1: ATOMIC STRUCTURE AND PERIODIC PROPERTIES

Atomic Orbitals, quantum, numbers - Principal, azimuthal, magnetic and spin Quantum numbers and their significance-Principles governing the occupancy of electrons in various quantum levels-Pauli's exclusion principle, Hund's rule, Aufbau Principle, (n+/) rule, stability of half-filled and fully filled orbitals.

Classification as s, p, d & f block elements, variation of atomic volume, atomic and ionic radii ionisation potential, electron affinity and electronegativity along periods and groups – Variation of metallic characters – Factors influencing the periodic properties.

## Unit 2: PRINCIPLES OF WET CHEMICAL ANALYSIS AND ACID – BASE THEORY

**Qualitative Analysis:** Solubility Product – Principle of Elimination of interfering anions, Common Lon Effect – Complexation reactions including spot tests in qualitative analysis – Reactions involved in separation and identifications of cations and anions in the analysis – Semi Micro Techniques .

**Titrimetry:** Definitions of Molarity normality, Molarity and mole fraction – Primary and Secondary standards – Types of titrimetric reactions – acid-base, redox, precipitation and complex metric titrations – Indicators – Effect of change in pH – Neutralization, redox, adsorption and metal ion indicators.

**Acids and Bases:** Arrhenius, Protonic and Lewis Theories of Acids and Bases – usnovich's generalized definition – Relative strengths of Acids and Bases – Dissociation constant of Acids and Bases – Levelling effect of water. Hard and soft acids and bases (HSAB)

**Oxidation and Reduction Reactions:** Oxidation number concept – Balancing redox equations by Oxidation number method and lon-electron method – Equivalent weight of oxidizing and reducing agents.

## Unit 3: COVALENT BONDING AND STRUCTURER

Covalent bonding – Concept of hybridization – Structure of organic molecules based on $sp^3$, $sp^2$ and sp hybridization – Covalent bond properties of organic molecules: bond length, bond angle, bond energy, bond polarity, dipolemoment, inductive, mesomeric, electromeric, resonance and hyperconjugative effects – Naming of organic compounds
(up to 10 carbon systems) – Hydrocarbons – Mono functional compounds – Bi-functional compounds – Isomerism – Types of isomerism (structural and stereoisomerisms) with appropriate examples .

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## Unit 4: CHEMISTRY OF ALKANES AND CYCLOALKANES

Petroleum source of alkanes – Methods of preparing alkanes and cycloalkanes - Chemical properties – Mechanism of free radical substitution in alkanes by halogenation – Uses – Conformational study of ethane and n-butane-Relative stability of cycloalkanes from cyclopropane up to cyclooctane – Bayer's Strain theory – Limitations – Cyclohexane and mono – and disubstituted cyclohexanes.

## Unit 5: ATOMIC STRUCTURE AND BASIC QUANTUM MECHANICS

Dualism of light – Wave nature of radiation classical theory of electromagnetic, radiation and classical expression for energy in term of amplitude. Particle nature of radiation – Black body radiation and Planck's quantum theory, photo electric dualism electric effect and Compton effect of matter – de Broglie hypothesis and Davisson and Germer experiment. Heisenberg's uncertainty principle. Schrödinger wave equation – argument in favour of Schrödinger wave equation. Physical significance of (psi) function. Properties of function – well – behaved function. Quantum numbers and their significance. Wave picture of electron – Concept of atomic orbitals. Shapes of s, p and d orbitals. Nodal planes and nodal points in atomic orbitals g and u character of atomic orbitals.

**Books for Reference:**


1. Puri B.R..,Sharma L.R., Kalia K.K.,
   Principles of Inorganic Chemistry, (23rd edition), New Delhi, Shoban Lal Nagin Chand & Co., (1993).
2. Lee J.D.,
   Concise Inorganic Chemistry, UK, Black well science (2006).
3. Puri B.R..,Sharma L.R., Pathania M.S.,
   Principles of Physical Chemistry, (23rd edition), New Delhi, Shoban Lal Nagin Chand & Co., (1993).
4. Glasstone S., Lewis D.,
   Elements of Physical Chemistry, London, Mac Millan & Co. Ltd.
5. Morrison R.T. and Boyd R.N.,
   Organic Chemistry (6th edition), New York, Allyn & Bacon Ltd., (1976).
6. Bahi B.S. and Arun Bahl,
   Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997).
7. Frank J. Welcher and Richard B. Hahn,
   Semi micro Qualitative Analysis, New Delhi, Affiliated East-west Press pvt.Ltd. (1969).


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# Core Course II - Practical – I- Volumetric Analysis

I Titrimetric Quantitative Analysis

1. Estimation of Hcl by NaOH using a standard oxalic acid solution
2. Estimation of Na2Co3 by Hcl using a standard Na2 Co3 solution
3. Estimation of oxalic acid bu KmnO4 using a standard oxalic acide solution
4. Estimation of Iron (II) sulphate by KmnO4 using a standard Mohr's salt solution.
5. Estimation of Ca (II) by KmnO4 using a standard oxalic acid solution.
6. Estimation of KmnO4 by thio using a standard K2Cr2O7 solution.
7. Estimation of Fe (III) by using K2Cr2O7 using a standard Mohr's salt solution using inhternal and external indicators.
8. Estimation of copper (II) sulphate by K2Cr2O7 solution
9. Estimation of Mg (II) by EDTA solution
10. Estimation of Ca (II) by EDTA solution
11. Estimation of As2O3 using I2 solution and standard Arsereoun oxide solution.
12. Estimation of chloride (in reutral and acid media)

II. Applied Experiments

1. Estimation of Total Hardness of water
2. Estimation of Bleaching Powder
3. Estimation of saponification value of an oil
4. Estimation of copper in brass

Scheme of Valuation

Max. marks

Record - 5 (marks)
Procedure Writing – 10 marks
Results

| | |
|---|---|
| < 1 % | - 45 marks |
| 1-2 % | -35 marks |
| 2-3 % | -25 marks |
| 3-4 % | -15 marks |
| > 4 % | - 10 marks |

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# CORE COURSE III - GENERAL CHEMISTRY – II

## Unit 1: Chemical Bonding

**lonic bond** – Lattice Energy – Born – Haber Cycle – Pauling and Muliken's Scales of electro negativity – Polarizing power and Polarisability – partial ionic character from electro negativity – Transitions from ionic to covalent character and vice versa – Fajan's rule.

**VESPR Theory** – Shapes of simple inorganic molecules ( $Becl_2$, $Sicl_4$, $Pcl_5$, $SF_6$,$IF_7$, $NH_3$, $XeF_6$, $BF_3$,$H_2O$ ) - VB Theory – Principles of hybridization – $Becl_2$ – MO Theory – Bonding and antibonding orbitals – Application of MO Theory to $H_2$,$He_2$,$N_2$,$O_2$,HF and CO – Comparison of VB and MO Theories.

## Unit 2: CHEMISTRY OF s-BLOCK ELEMENTS

Position of Hydrogen in the Periodic Table, atomic hydrogen, nascent hydrogen, occluded hydrogen, uses of hydrogen. General characteristics of s-block elements – General characteristics of Group IA – diagonal relationship between Li and Mg – Extraction of Lithium – Physical and Chemical properties of Lithium – Uses – Extraction of Sodium – Physical and Chemical properties – Uses – Preparation of NaOH (Laboratory and Industrial methods) – Properties – Uses – Preparation of $Na_2CO_3$ (Laboratory and Industrial methods) – Properties – Uses – Extraction of Potassium – Properties – Uses – Chemistry of KOH, KBr and K1.

General characteristics of Elements of Group 11A – diagonal relationship between Be and AI – Extraction of Beryllium – Physical and Chemical properties of Be – Uses Extraction of Mg – Physical and Chemical properties – Uses – Chemistry of some compounds of Mg: $MgCO_3$, $MgSO_4$,$MgCl_2$, Mg $(NH_4)$ $PO_4$ $6H_2O$ – Extraction of Ca – Physical and Chemical properties – Uses – Cement manufacture – Types – Chemistry of setting of cement.

## Unit 3: CHEMISTRY OF ALKENES, ALKYNES AND DIENES

Nomenclature – Geometrical Isomerism – Petroleum source of alkenes and aromatics – General methods of preparation of alkenes – Chemical properties – Uses – Elimination mechanisms ($E_1$,$E_2$,$E_1cB$**) –** Electrophilic, Free radical additions – Ziegler – Natta Catalytic polymerization of ethylene – polymers of alkene derivatives.

Nomenclature General methods of preparation of alkynes – Physical properties – Chemical properties – Uses – Types of alkadienes – General methods of preparation of Dienes – Physical properties – Chemical properties – Uses – Mechanisms of electrophilic and Free radical addition reactions – Polymers – Rubber as a natural polymer – Types of polymerization reactions – Mechanisms of lonic and Free radical polymerization reactions – Chemistry of Vulcanization of rubber – Chemistry of manufacture of Film sheets, Rayon and Polycyclic fibres – Uses of Polymers.

## Unit 4: CHEMISTRY OF BENZENE AND OTHER BENZENOID COMPOUNDS

General methods of preparation of benzene – Chemical properties – Uses – Electrophillic substitution mechanism – Orientation and reactivity in substituted benzenes. Types of

Polynuclear Aromatic compounds – Nomenclature – Naphthalene from coal tar and petroleum – Laboratory preparation Structure of Naphthalene – Aromatic character – Physical properties – Chemical properties – Uses – Mechanism of Aromatic electrophilic substitution – Theory of orientation and reactivity – Anthracene, Phenanthrene from tar and petroleum – Laboratory preparation- Molecular Orbital structures – Aromatic Characters – Physical Properties - Chemical properties – Uses – Preparation of biphenyls – Physical and Chemical properties – Uses.

## Unit 5: GASEOUS STATE

Maxwell's distribution of Molecular velocities (Derivation not required). Types of Molecular velocities – Mean, Most probable and root mean square velocities. Graphical representation and its significance – Collision diameter, Mean free path and collision number – Transport properties – Thermal conductivity, Viscosity and Diffusion – Law of equipartition of energies – Degree of freedom. Molecular basis of Heat capacity – Real gases – vander. Waals equation of states – derivation – significance of critical constants – Virial equations of state – Law of corresponding states – Compressibility factor.

**Books for Reference:**


1 Puri B.R..,Sharma L.R., Kalia K.K.,
Principles of Inorganic Chemistry, (23rd edition), New Delhi, Shoban Lal Nagin Chand & Co., (1993).

2. Lee J.D.,
Concise Inorganic Chemistry, UK, Black well science (2006).

3 Puri B.R..,Sharma L.R., Pathania M.S.,
Principles of Physical Chemistry, (23rd edition), New Delhi, Shoban Lal Nagin Chand & Co., (1993).

4 Glasstone S., Lewis D.,
Elements of Physical Chemistry, London, Mac Millan & Co. Ltd.

5 Morrison R.T. and Boyd R.N.,
Organic Chemistry (6th edition), New York, Allyn & Bacon Ltd., (1976).

6 Bahi B.S. and Arun Bahl,
Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997).


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# CORE COURSE IV – GENERAL CHEMISTRY III

## Unit I: Chemistry of p-Block Elements – B,C and N Families

General characteristics of p-block elements – general characteristics of elements of Group III A- diagonal relationship between B and Si-extraction of boron – Physical and chemical properties of B- uses – chemistry of some compounds of boron: Boric acid, Borax, Diborane, Boron nitride – Extraction of Al – physical and chemical properties – uses – chemistry of some compounds of Al: $Al2O_3$, $AICI_3$, Alums – Alloys of aluminum.

General characteristics of elements of Group IVA – difference of carbon and silicon form the rest of the family- allotropic forms of carbon – Chemistry of charcoal – Chemistry of oxides of carbon (CO & $CO_2$) – use of $CO_2$ in fire extinguishers – fuel gases – preparation of silicon – physical and chemical properties of Si – uses - oxides of silicon – structures of silicates – chemistry of silicones – manufacture of glass – type of glasses – extraction of lead – physical and chemical properties – uses – lead pigments.

General characteristics of elements of V A Group – the unique features of nitrogen from the rest of the family – preparation of nitrogen – physical and chemical properties of $N_2$ – uses – industrial preparation of ammonia – physical and chemical properties – uses – chemistry of some compounds of nitrogen: Hydrazine, Hydroxylamine, Hydrazoic acid, Nitric acid – nitrogen cycle – artificial fixation of nitrogen – preparation of phosphorous – physical and chemical properties – uses – chemistry of $PH_3$, $PCI_3$, $PCI_5$, $POCI_3$, $P2O_5$ and oxyacids of phosphorus – fertilizers.

## Unit 2: Chemistry of p-Block elements – O,X and Noble Gas Families

Anomalous behaviour of oxygen – paramagnetic nature of oxygen, Preparation, properties, structure and uses of oxyacids of sulphur, classification of oxides based on their chemical behaviour – acidic oxide, amphoteric oxide and neutral oxides. Classification of oxides based on oxygen content – normal oxides, peroxides, super oxides, dioxides, sub oxides and mixed oxides. Chemistry of selenium and tellurium.

General characteristics of halogen with reference of electro negativity, electron affinity, oxidation states and oxidizing power. Peculiarities of fluorine, Hydrides, oxides and oxo acids of halogens. Inter halogen compounds and pseudo halogens – basic nature of iodine.

Noble gases : Position in the periodic table – isolation from atmosphere – General characteristics – structure and shape of xenon compounds – $XeF_4$, $SeF_6$, $XeO_3$ and $XeOF_4$ – uses of noble gases

## Unit 3: Organohalogen Compounds

Nomenclature – general methods of preparation of haloalkanes – physical and chemical properties – uses – nucleophillic substitution mechanisms ($S_N1$, $S_N2$ and $S_N3$) – evidences – stereochemical aspects of nucleophillic substitution mechanisms – general methods of preparation of halobenzenes – physical properties – chemical properties – uses mechanisms of electrophillic and nucleophillic substitution reactions – theory of orientation and reactivity.

## Unit IV: Stereochemistry

Stereoisomerism – types – optical isomerism – chirality's based on symmetry elements (Cn, 5, i and Sn) – idea of asymmetry and dissymmetry – optical activity – measurement of optical activity – concept of enantiomerism, diastereomerism – axial chirality in substituted allenes and spiranes – atropisomerism in substituted biphenyls – R,S and D, L notations to express configurations – erythro, thero conventions – meso and dl – forms of tartaric acid – stereoselectivity and stereospecificity in organic reactions with suitable examples – resolution of racemic mixture using chiral reagent – Walden inversion – asymmetric synthesis – asymmetric induction.

## Unit V – Solidstates, Liquid Crystals and Colloids

Classification of solids – Isotropic and anisotropic crystals. Laws of crystallography – representation of planses – Miller indices, space lattice, crystal systems – seven primitive, unit cells – X – ray diffraction – derivation of Bragg's equation – determination of structure of NaCl by Debye Scherrer (powder method) and rotating crystal method – determination of Avogadro's number – discussion of structure of KCl & CsCl – defects in crystals – stoichiometric and non stoichiometric – methods of growing crystals – from melt and from solution (hydrothermal method, Gel method – packing of ions in crystals – radius ration rules and its limitations. Liquid crystals – types, theories and applications.

Definitions – types of colloids – sols – preparation, purification and properties – Kinetic, Optical and electrical stability of colloids, gold number, associated colloids, Emulsion – types of emulsions, preparation, properties and application, Gels – types of gels, preparation, properties and applications. Donnan membrance equilibrium –osmosis, reverse osmosis, dialysis and desalination – macromolecules – molecular weight of macro – molecules – determination of molecular weight by osmotic pressure method and light scattering methods.

**Books for Reference:**


1. Puri B.R. Sharma, L.R., Kalia K.K. Principles of Inorganic Chemistry, (23rd edition), New Delhi, Shoban Lal Nagin Chand & Co., 1993
2. Lee. J.D. Concise Inorganic Chemistry, UK, Black well science (2006)
3. Puri B.R. Sharma L.R. Pathania M.S. Principles of Physical Chemistry
4. Glasstone S., Lewis D., Elements of Physical Chemistry, London, Mac Millan & Co. Ltd
5. Morrilson R.T. and Boyd R.N. Organic Chemistry (6th edition), New York, Allyn & Bacon Ltd., (1976)
6. Bahl B.S. and Arun Bahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997)


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# Core Course V – Practical II-Semimicro Analysis

## Semimicro Inorganic Qualitative analysis

Analysis of a mixture containing two cations and two anions of which one will be an interferring ion. Semimicro methods using the conventional scheme with hydrogen sulphide may be adopted.

**Cations to be Studies:** lead, copper, bismuth, cadmium, antimony, tin, iron, aluminium, zinc, manganese, cobalt, nickel, barium, calcium, strontium, magnesium and ammonium

**Anions to be studies:** Carbonate, Sulphide, Sulphate, nitrate, chloride, bromide, fluoride, borate, oxalate, arsenite, arsenate and phosphate

**Reference:**


1. Venkateswaran V. Veerasamy R. Kulandaivelu A.R., Basic principles of Practical Chemistry, 2nd edition, New Delhi, Sultan Chand & sons (1997)


Note:

Internal Marks: 40 External marks : 60

| | | | | |
|---|---|---|---|---|
| Marks Distribution for external | : | Practical | - | 55 marks |
| | | Record | - | 5 marks |
| | | Total | - | 60 marks |

| | | |
|---|---|---|
| 4 radicals correct with suitable tests | : | 55 marks |
| 3 radicals correct with suitable tests | ; | 40 marks |
| 2 radicals correct with suitable tests | : | 30 marks |
| 1 radical correct with suitable tests | : | 15 marks |
| Spotting | : | 5 marks |

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# NON MAJOR ELECTIVE – I-AGRICULTURAL CHEMISTRY

**UNIT – I : ORIGIN OF SOIL**

Origin of soils, their properties, acid, alkali and saline soils- diagnosis – remediation of acid and salt affected soils – methods of reclamation and after care.

**UNIT – II : CHEMISTRY ASPECTS OF SOIL**

Soil testing – concept, objectives and basis – soil sampling, tooks, collection processing, despatch of soil samples – soil organic matter – its decomposition and effect on soil fertility.

**UNIT – III : PLANT NUTRIENTS**

Plant nutrients – macro and micro nutrients – their role in plant growth – sources - forms of nutrient absorbed by plants – factors affecting nutrient absorption - deficiency symptoms in plants – corrective measures – chemicals used for correcting nutritional deficiencies – nutrient requirement of crops – their availability fixation and release of nutrients.

**UNIT – IV FERTILIZERS**

Fertilizers – classification of NPK fertilizers – sources - natural and synthetic – straight – complex – liquid fertilizers, their properties, use and relative efficiency secondary and micronutrient fertilizers – mixed fertilizers.

**UNIT – V : PESTICIDES AND FUNGICIDES :**

Pesticides : definition – Classification – organic and inorganic pesticides – mechanism of action – charecteristics safe handling of pesticides – impact of pesticides on soil, plants and environment.
Fungicides : Definition – Classification – mechanism of action – sulphur, copper, mercury compounds, dithanes, dithiocarbamate.

## Books for Reference :


1. Biswas T.D and Mukherjee S.K. Text book of soil science 1987.
2. Daji A.J. A text book of soil science, Asia publishing House, Madras – 1970.
3. Tisdale S.L. Nelson W.L. and Beaton J.D.
   Soil fertility and fertilizers, Macmillon Pub Co New York 1990.
4. Hesse P.R, A text book of soil chemical analysis John Murray, NewYork, 1971.
5. Buchel K.H, Chemistry of Pesticides, John Wiley & Sons New York 1983.
6. Sree Ramulu V.S Chemistry of Insecticides and Fungicides, Oxford and IBH Publishing Co., New Delhi 1979.


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# CORE COURSE VI – GENERAL CHEMISTRY IV

## Unit I: Metallurgy and d-Block elements

Occurrence of metals – concentration of ores – froth floatation, magnetic separation, calcinations, roasting, smelting, flux, aluminothermic process – purification of metals – electrolysis, zone refining, van Arkel de Boer methods – chemistry of transition elements – electronic configuration – general periodic trend – group study of titanium, vanadium, chromium, manganese and iron group's coinage metals - comparative study and chemistry of photography – comparative study of zinc group metals – galvanization, evidences for the existence of mercurous ion as $Hg_z^{2+}$

## Unit II: Chemistry of f- Block Elements

General characteristics of f-block elements – comparative account of lanthanides and actinides – occurrence, oxidation states, magnetic properties, colour and spectra – lanthanides and actinides – separation by ion exchange and solvent extraction methods – lanthanide contraction – chemistry of thorium and uranium – occurrence, ores, extraction and uses – preparation, properties and uses of ceric ammonium sulphate, thorium dioxide, thorium nitrate, uranium hexafluoride, uranylacetate

## Unit III: Chemistry of Organometallic compounds

Introduction – preparation of organo magnesium compounds – physical and chemical properties – uses – preparation of ogranozinc compounds – physical and chemical properties – uses preparation of organolithium compounds – physical and chemical properties – uses chemistry of organo copper, organolead, organophosphorus and organo boron compounds

## Unit IV: Chemistry of Alcohols, Phenols and Ethers

Nomenclature – laboratory preparation of alcohols – industrial source of alcohols – physical properties – chemical properties – uses – chemistry of glycols and glycerols – uses – preparation of phenols including di and tri hydric phenols – physical and chemical properties – uses – aromatic elctrophilic substitution mechanism – theory of orientation and reactivity, laboratory preparation of ethers, epoxides – physical properties – chemical properties – uses – introduction to crown ethers – structures – applications

## Unit V: Chemical Kinetics and Catalysis

Rate of reaction, average and instantaneous rates, rate equation, order of reaction. Rate laws: rate constants – derivation of rate constants and characteristics for zero, first order, second and third order (equal initial concentration) – derivation of time for half change with examples. Methods of determination of order of reactions – experimental methods of determination of rate constant of a reaction – volumetry, manometry, polarimetry, Mechanism of complex reactions – equilibrium and steady state approximations.

Effect of temperature on reaction rate – concept of activation energy, energy barrier Arrbenius equation. Theories of reaction rates – collision theory – derivation of rate constant of bimolecular gases reaction – failure of collision theory – Lindemann's theory of unimolecular reaction. Theory of absolete reaction rates – derivation of rate for a bimolecular reaction – significance of entropy and free energy of activation. Comparison of collision theory and ARRT. Kinetics of fast reaction – flow methods and pulse methods.

Catalysis – homogeneous and heterogeneous – homogeneous catalysis – kinetic of acid – base and enzyme catalysis. Heterogeneous catalysis – adsorption – types – chemical and physical. Characteristics of adsorption. Different types of isotherms – Freundlich and Langmuir

**Books for Reference:**


1. Puri B.R., Sharma L.R., kalia K.K., Principls of Inorganic Chemistry, (23rd edition), New Delhi, Shoban Lal Nagin Chand & Co., (1993)
2. Lee J.D. Concise Inorganic Chemistry, UK, Black well Science (2006)
3. Puri. B.R., Sharma L.R., Pathania M.S., Principles of Physical Chemistry 23 rd edition) New Delhi, Shoban Lal, Nagin Chand & Co., (1993)
4. Glasstone S. Lewis D., Elements of Physical Chemistry, London, Mac Milan & Co.
5. Morrison R.T. and Boyd R.N., Organic Chemistry (6th edition), New york, Allyn & Bacon Ltd., (1976)
6. Bahl B.S. and Arun Bahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997)


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# NON MAJOR ELECTIVE – II-CHEMISTRY OF CONSUMER PRODUCTS

## UNIT – I SOAPS AND DETERGENTS :-

Manufacture of soaps, formulation of toilet soaps – different ingradients used- Soft soaps, shaving soaps and creams. Anionc detergents – manufacture and applications - cationic detergents – manufacture and applications.

## UNIT – II : COSMETICS

Shampoos – different kinds of shampoos – anti – dandruff, anti – lice, herbal and baby shampoos hair dye – manufacture of conditioners - skin preparation – skin powder, nail polish, lipsticks.

## UNIT III : PAINTS AND VARNISHES :-

Constivents and their functin – types and applications.

## .UNIT IV : DYES

Classification – preparation and uses of alizarin, Indigo, Methul orange, Phenolphthalein and Malachite green.

## UNIT – V : Plastics – Resins and Rubber

Synthetic resins and plastics, synthetic polymers – important basic plastics and uses - rubber, vulcanisation.

**Reference :**


1) A Text Book of Applied Chemistry for Home Science and Allied Sciences Thangamma Jacop.
2) Chemical process Industries – R. Norris Shreve.
3) Industrial Chemistry by B.K.Sharma, Goel Publishing my House 1995.
4) Fundamental Concept of Applied Chemistry by Jayashree Ghosh, 1st Edition (2006) S. Chand Company Ltd., New Delhi.


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# Core Course VII : Inorganic Chemistry I

## UNIT 1: COORDINATION CHEMISTRY I :

Types of ligands - IUPAC nomenclature - Isomerism - theories of coordination compounds - Werner, Sidgewick, valence bond, crystal field and molecular orbital theories.

## UNIT 2: COORDINATION CHEMISTRY II :

Stability of complexes - factors affecting the stability of complexes - unimolecular and bimolecular nucleophilic substitution reactions in octahedral and square planar complexes - trans effect - magnetic properties of transition metal complexes - elementary idea of electronic spectra of transition metal complexes.

## UNIT 3: APPLICATION OF COORDINATION COMPOUNDS :

Application of coordination compounds - estimation of nickel using DMG and aluminium using oxine - estimation of hardness of water using EDTA - biologically important coordination compounds - chlorophyll, haemoglobin, vitamin $B_{12}$ - Their structure and application - metal carbonyls - mono and poly nuclear carbonyles of Ni, Fe, Cr, Co and Mn - synthesis and structure - nitrosyl compounds - classification, preparation and properties - structure of nitrosyl chloride and sodium nitroprusside.

## UNIT 4: METALLIC BONDING :

Metallic state - packing of atoms in metal (BCC, FCC, HCP and Simple cube) - theories of metallic bonding - electron gas, Pauling and band theories - semi conductors - n-type and p-type, transistors - uses - structure of alloys - substitutional and interstitial solid solutions - Hume Rothery ratio.

## UNIT 5: SOME SPECIAL TYPE OF COMPOUNDS :

Organo metallic compounds of alkenes, alkynes and cyclopenta diene - binary compounds - hydrides, borides, carbides and nitrides - classification, preparation, properties and uses.some special classes of compounds - clathrates - examples and structures - Interstitial and non - stoichiometric compounds - silicones - composition, manufacture, structure properties and uses - silanes and their polymers - applications of phosphozenes and phosphazenes – silicates and their polymers - classification into discrete anions - one, two and three dimensional structures with examples - composition, properties and uses of beryl, asbestos, tale, mica, zeolites and ultramarines.

### Books for Reference :


1. Soni P.L.,
   Text Book of Inorganic Chemistry, S, Chand & Co, New Delhi (2006).
2. Puri B.R., Sharma L.R. and Kalkithar,
   Principles of Inorganic Chemistry, New Delhi (2002).
3. Madan R.D., Juli G.D and Malik S.M.,
   Selected Topics in Inorganic Chemistry, S. Chand & Co, New Delhi (2006)
4. Lee J.D.,
   Concise Inorganic Chemistry , ELBS Edition.

# Core Course VIII : Organic Chemistry I

## UNIT 1: CHEMISTRY OF CARBONYL COMPOUNDS :

Introduction - nomenclature - laboratory preparation of aliphatic carbonyl compounds - physical properties - chemical properties - uses - molecular orbital picture of carbonyl group - nucleophilic addition mechanism at carbonyl group - acidity of alpha - hydrogen - general methods of preparation of aromatic carbonyl compounds - physical and chemical properties - uses - effect of aryl group on the reactivity of carbonyl group.

## UNIT 2: CHEMISTRY OF CARBOXYLIC ACIDS :

Nomenclature - general methods of preparation of carboxylic acids - physical properties - structure and acidity - Hammett equation - chemical properties - uses - preparation of dicarboxylic acid - physical and chemical properties - uses - Introduction to derivatives of carboxylic acids - physical and chemical properties - uses - Intruduction to derivatives of carboxylic acids - nucleophilic substitution mechanism at acyl carbon - preparation, physical and chemical properties of the compound: acyl chlorides, anhydrides, esters, amides - chemistry of compounds containing active methylene group - Introduction to oils and fats - fatty acids - manufacture of soap - mechanism of cleaning action of soap.

## UNIT 3: CHEMISTRY OFNITROGEN COMPOUNDS :

Nitrogen compounds - nomenclature - nitro alkanes - alkyl nitrites - differences - aromatic nitro compounds - preparation and reduction of nitro benzene under different conditions. Amino compounds - effect of substitutents on basicity, reaction of amino compounds (primary, secondary, tertiary and quaternary amine compounds). mechanism of carbylamine reaction, diazotization, and comparison of aliphatic and aromatic amines - diazonium compounds - preparation and synthetic importance of diazomethane, benzene diazonium chloride and diazo acetic ester.

## UNIT 4: CHEMISTRY OF HETEROCYCLIC COMPOUNDS :

Heterocyclic compounds - nomenclature - preparation and properties of furan, pyrrole, thiophen - comparison of the basicities of pyrrole, pyridine and piperidine with amines -synthesis and reactions of quinoline, isoquinoline and indole with special reference to Skraup, Fischer Napieraloki and Ficher - indole syntheses – structural elucidation of quinoline and isoquinoline.

## UNIT 5: INDUSTRIAL ORGANIC CHEMISTRY :

Dyes - theory of color and constitution - chromophore, auxochrome, classification according to application and structure - preparation and uses of nitro dyes - naphthol yellow, nitroso fast green O, azo dyes - methyl orange, triphenyl methane dyes - malachite green, indigo dyes - Indigotin, anthraquinone dyes - alizarin, phthalein dyes - fluorescein - sulphonic acid and derivatives - preparation and properties of benzene sulphonic acid - saccharin, chloramines – T , sulphonamides.

Polymers-definition-types of polymers-mechanism of cationic, anionic and free radical polymerisation –thermo setting polymers – preparation of caprolactam, Nylon 66, polyester, epoxide resin- molecular weight of polymers ( elementary treatment )

**Book for Reference :**


1. Finar I.L,
   Organic Chemistry, Vol 1&2, (6th edition) England, Addison Wesley. Longman Ltd. (1996)
2. Morrison R.T., Boyd R.N.,
   Organic Chemistry, (6th edition) New York, Allyn & Bacon Ltd., (2006)
3. Bahl B.S, Arun Bahl,
   Advanced Organic Chemistry , (12th edition) New Delhi, Sultan Chand and Co., (1997).
4. Pines S.H.,
   Organic Chemistry, (4th edition) New Delhi, Mc Graw - Hill International Book company .(1986)
5. Seyhan N. Ege.,
   Organic Chemistry, New York, Houthton Mifflin Co., (2004)


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# Core Course IX : Physical Chemistry I

## UNIT 1: TERMODYNAMICS I :

System and surrounding – isolated, closed and open systems - state of the system - Intensive and extensive variables. Thermodynamic processes - reversible and irreversible, isothermal and adiabatic processes - state and path functions - exact and inexact differentials. work of expansion at constant pressure and free expansion.
First law of thermodynamics - statement - definition of internal energy (E), enthalpy (H) and heat capactiiy. Relation between Cp and Cv. calculation of w, q, dE and dH for expansion of ideal and real gases under isothermal and adiabatic conditions of reversible and irreversible processes. Definition of joule - thomson coefficient ($\mu_{J.J}$) - calculation of ($\mu_{J.J}$) for ideal and real gases - Inversion temperature.

Thermochemistry - relation between enthalpy of reaction at constant volume ($q_V$) and at constant pressure ($q_p$) - temperature dependence of heat of reaction - Kirchoffs equation - bond energy and its calculation from thermochemical data - Integral and differential heats of solution and dilution.

## UNIT 2: THERMODYNAMICS II

Second law of thermo dynamics - need for the law - different statements of the law - Carnot's cycle and efficiency of heat engine - Carnot's theorem - thermodynamic scale of temperature - concept of entropy - definition and physical significance of entropy - entropy as a function of P, V and T - entropy changes during phase changes - entropy of mixing - entropy criterion for spontaneous and equilibrium processes in isolated system - Gibb's free energy (G) and Helmholtz free energy (A) - variation of A and G with P, V and T- Gibb's - Helmholtz equation and its applications - thermodynamic equation of state - Maxwell's relations - $\Delta A$ and $\Delta G$ as criteria for spontaneity and equilibrium - advantage of $\Delta G$ over entropy change.

## UNIT 3: THERMODYNAMICS III

Equilibrium constant and free energy change - thermodynamic derivation of law of mass action - equilibrium constants in terms of pressure and concentration - $NH_3$, $PCl_5$, $CaCO_3$ - thermodynamic interpretation of Lechatelier's principle (Concentration, temperature, pressure and addition of inert gases.) systems variable composition - partial molar quantities - chemical potential - variation of chemical potential with T, P and X (mole fraction ) - Gibb's Duhem equation. van't Hoff's reaction isotherm - van't Hoff's isochore - Clapeyron equation and Clausius –

Clapeyron equation-applications-third law of thermodynamics –Nernst heat theorem-
statement of III law and concept of residual entropy - evaluation of absolute entropy from heat capacity data. Exception to III law (ortho and para hydrogen, CO, $N_2O$ and ice).

## UNIT 4: SOLUTIONS

Ideal and non-ideal soultions, methods of expressing concentrations of solutions - mass percentage, volume percentage, normality, molarity, molality, mole fraction. concept of activity and activity coefficients - completely miscible liquid systems - benzene and toluene. Raoult's law and Henry's law. deviation from Raoult's law and Henry's law. Duhem - Margules equation, theory of fractional distillation. azeotropes - HCl - water and ethanol - water systems - partially miscibe liquid systems - phenol - water, triethanolamine - water and nicotine - water

systems. lower and upper CSTs - effect of impunities on CST - completely immiscible liquids - principle and applications of steam distillation. Nernst distribution law – derivation.

applications –determination of formula of a complex ( $KI + I_2 = KI_3$ ).solvent extraction- principle and derivation of a general formula of the amount unextracted - dilute solutions: colligative properties, relative lowering of vapour pressure, osmosis, law of osmotic pressure, thermodynamic derivation of elevation of boiling point and depression in freezing point. determination of molecular masses using the above properties. abnormal molecular masses, molecular dissociation - degree of dissociation - molecular association.

## UNIT 5: THERMODYNAMICS OF PHASE CHANGES

Definition of terms in the phase rule - derivation and application to one component systems - water and sulphur - super cooling, sublimation. two component systems - solid liquid equilibria, simple eutectic (lead-silver, Bi-Cd), desilverisation of lead - compound formation with congruent melting point. (Mg-Zn) and incongruent melting point (Na-K). solid solutions - (Ag-Au) - fractional crystallisation. freezing mixtures - $FeCl_3$ - $H_2O$ systems, $CuSO_4$-$H_2O$ system.

## Book for Reference :


1. Puri B.R., Sharma L.R., Pathania M.S.,
   Principles Of Physical Chemistry, (23rd edition), New Delhi,

   Shoban Lal, Nagin Chand & Co., (1993)

2. Maron and Prutton,

   Physical Chemistry, London, Mac Millan.

3. Atkins P.W.,

   Physical Chemistry, (5th edition) Oxford Uiversity Press. (1994)

4. Castellan G.V.,
   Physical Chemistry, New Delhi, Orient Longmans.


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**CORE COURSE X- PRACTICAL –III -PHYSICAL CHEMISTRY PRACTICALS**

**LIST OF EXPERIMENTS :**

1. Critical Solution Temperature
2. Effect of impurity on Critical solution Temperature
3. Transition Temperature
4. Rast Method
5. Phase Diagram (Simple eutectic system)
6. Kinetics of Ester Hydrolysis
7. Partition Co-efficient of iodine between water and carbon tetrachloride.
8. Conductometric Acid-Base Titration
9. Potentiometic Redox Titration
10. Determination of cell constant

**MARK DISTRIBUTION :**

Internal : 40 Ext. Evaluation :60
Record :5
Procedure Writting with formula : 10
Practicals :45

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# CORE COURSE XI - PRACTICAL IV
# (GRAVIMETRIC & ORGANIC ANALYSIS)

**GRAVIMETRIC ANALYSIS :**

1. Estimation of Lead as lead chromate.
2. Estimation of Barium as barium chromate.
3. Estimation of Nickel as Nickel - DMG complex.
4. Estimation of Copper as copper (I) thiocyanate
5. Estimation of Magnesium as magnesium oxinate
6. Estimation Calcium as calcium oxalate monohydrate
7. Estimation of Barium as barium sulphate.
8. Estimation of Iron as Iron (III) oxide.

## Organic Qualitative Analysis and Organic Preparation :

**ORGANIC ANALYSIS**

Analasis of Simple Organic compounds (a) characterization of functional groups (b) confirmation by preparation of solid dervatives / characteristic colour reactions.
Note : Mono –functional compounds are given for analysis. Incase of bi-functional compounds, students are required to report any one of the functional groups.

**ORGANIC PREPARATION :**

Preparation of Organic Compounds involving the following chemical conversions

1. Oxidation 2. Reduction 3. Hydrolysis 4. Nitration 5. Bromination 6. Diazotization 7. Osazone formation

**DETERMINATION OF PHYSICAL CONSTANTS**

Determination of boiling /melting points by semimicro method.

**MARK DISTRIBUTION :**

Internal : 40 Ext. Evaluation : 60

Record : 5+5 = 10
Gravimetry : 25

org. preparation & org Analysis : 25

Org. preparation : 6
Phy Contant : 4

Org. analysis :15

Armatic/ Alphatic –2
Sat/Unsat – 2
Spl. Element –3
functinonal group –5
Derivatives - 3

## Book for Reference :

1. Venkateswaran V, Veeraswamy R., Kulandaively A.R.,

Basic principles of practical chemistry, 2nd edition, New Delhi, sultan chand & sons, (1997)

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# Major Based Elective I : Analytical Chemistry

## UNIT 1: INTRODUCTION TO ANALYTICAL CHEMISTRY

Types of analytical methods : Importance of analytical methods in qualitative and quantitative analysis : chemical and instrumental methods - advantages and limitations of chemical and instrumental methods.

**Laboratory Hygiene and safety :** Storage and handling of corrosive, flammable, explosive, toxic, carcinogenic and poisonous chemicals.

Simple first aid procedures for accidents involving acids, alkalies, bromine, burns and cut by glass. Threshold vapour concentration - safe limits. Waste disposal and fee me disposal.

Evaluation of analytical data : Idea of significant figures - its importance. Accuracy - methods of expressing accuracy . error analysis –types of errors-minimizing errors. precision-methods of expressing precision - mean, median, mean deviation, standard deviation and confidence limit. Method of least squares - problems involving straight line graphs.

## UNIT 2: QUANTITATIVE ANALYSIS :

Estimations of commercial samples - determination of percentage purity of samples – pyrolusite, Iron ore, washing soda and Bleaching power - estimation of glucose and phenol.

gravimetric analysis - principle - theories of precipitation - solubility product and precipitation – conditions of precipitations-types of precipitants-specific and selective precipitants- organic and inorganic precipitants - types of precipitation - purity of precipitates – co precipitation - post precipitation - precipitation from homogeneous solution - use of sequestering agents

## UNIT 3: THERMO AND ELECTRO ANALYTICAL TECHNIQUES

**Thermo analytical methods :** Principle of thermo gravimetry, differential thermal analysis, differential scanning calorimetry - Instrumentation for TGA, DTA and DSC - Characteristics of TGA and DTA curves - factors affecting TGA and DTA curves. applications - TGA of calcium oxalate monohydrate DTA of calcium acetate monohydrate - determination of purity of pharmaceuticals by DSC.

Electro analytical techniques - electro gravimetry -theory of electro gravimetric analysis - determination of copper (by constant current procedure) - electrolytic separation of metals : Principle - separation of copper and nickel, coulometry : principle of coulometric analysis - coulometry at controlled potential - apparatus and technique - separation of nickel and cobalt.

## UNIT 4: SPECTRO ANALYTICAL TECHNIQUES

Colorimetry and spectrophotometry - Beer – Lambert's law - principle of colorimetric analysis - visual colorimetry - standard series method - balancing method -estimation of $NI^{+2}$ and $Fe^{+3}$ colorimetrically - photoelectric photometer method - spectro photometric determination of chromium and manganese in alloy steel. infra red spectroscopy (Instrumentation only)-block diagram- source-monochromator-cell-detectors and recorders-sampling techniques-NMR spectroscopy(instrumentation only)

## UNIT 5: CHROMATOGRAPHY TECHNIQUES

Column chromatography - principle, types of adsorbents, preparation of the column, elution, recovery of substances and applications. thin layer chromatography - principle, choice of adsorbent and solvent, preparation of chromatoplates, Rf-values, factors affecting the Rf-values,

Significance of Rf-values. Paper chromatography - principle, solvents used, development of chromatogram, ascending, descending and radial paper chromatography. paper electrophoresis - separation of amino acids and other applications. Ion - exchange chromatography - principle - types of resins -requirements of a good resin -action of resins - experimental techniques - separation of Na-K, Ca-Mg, Co-Ni and chloride - bromide mixture. analysis of milk and apple juice - gas chromatography - principle - experimental techniques - instrumentation and applications. High Pressure Liquid Chromatography (HPLC)-principle -experimental techniques - instrumentation and advantages.

**Book for Reference :**


1. Douglas A. Skoog and Donald M. West, F.J. Holler,
   Fundamentals of Analytical Chemistry, 7th edition, Harcourt College Publishers.
2. Mendham J., Denney R.C., Barnes J.D., Thomas M.,
   Vogel's Text book of Quantitative Chemical analysis 6th edition Pearson education.
3. Sharma, B.K., Instrumental Methods of Chemical Analysis, Coel Publishing House, Merrut, (1997)
4. Gopalan. R., Subramaniam P.S. and Rengarajan K.,
   Elements of Analytical Chemistry, Sultan Chand and Sons.
5. Usharani S., Analytical Chemistry, Macmillian.


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# Core Course XII : Organic Chemistry II

## UNIT 1: CHEMISTRY OF CARBOHYDRATES :

Carbohydrate - classification, properties of mono saccharide (glucose and fructose), structure and configuration of mono saccharide, interconversion, ascending and descending series, muta rotation, epimerisation- cyclic structure - determination of size of sugar rings - disaccharide - sucrose, maltose - structure elucidation - polysaccharide - starch and cellulose (elementary treatment).

## UNIT 2: CHEMISTRY OF PROTEINS AND VITAMINS

Amino acids - classification, general methods of preparation and reactions of amino acids, zwitter ion - isoelectric points, action of heat on $\alpha$,$\beta$ and $\gamma$ amino acids. Peptides and proteins - Peptide linkage - polypeptide - classification of proteins - synthesis of peptides - Merrifield synthesis - primary structure - end group analysis - Dangyl chloride, Edman method - secondary structure - tertiary structure - denaturation - colour reactions of proteins - nucleic acids - elementary treatment of DNA and RNA . vitamins (structural elucidation not needed) - classification, biological importance of vitamins A, $B_1$, $B_2$, $B_6$, $B_{12}$ and C.

## UNIT 3: CHEMISTRY OF ALKALOIDS AND TERENOIDS

Chemistry of natural products - alkaloids - isolation, classification, general methods of elucidating structure - structural elucidation and synthesis of coniine, piperine, nicotine and ephedrine. terpenes - classification - isoprene, special isoprene rule, general methods of structural elucidation - structural elucidation and synthesis of citral, limonene, menthol, camphor.

## UNIT 4: MOLECULAR REARRANGEMENTS

Molecular rearrangements - types of rearrangement (nucleophilic and electrophilic) – mechanism with evidence for the following re-arrangements : pinacol - pinacolone, benzil - benzilic acid, benzidine, Claisen, Fries, Hofmann, Curtius, Lossen, Beckmann, dienone - phenol and Orton - photochemical reactions of ketones - Norrish type I and II.

## UNIT 5: ORGANIC SPECTROSCOPY

UV - VIS spectroscopy - types of electronic transitions - solvent effects on $\lambda$ max - Woodward - Fieser rules - calculation of $\lambda$max : dienes and $\alpha$, $\beta$ unsaturated carbonyls.

IR spectroscopy - number and types of fundamental vibrations - modes of vibrations and their energies, position of IR absorption frequencies for functional groups like aldehyde, ketone, alcohol, acid and amide- factors affecting the frequency absorption - conjugation, inductive effect and hydrogen bonding.

NMR spectroscopy - principle - equivalent and non equivalent protons - shielded and deshielded protons, anisotropy, chemical shift - TMS, tau and delta scales, integral, splitting of signals - spin -spin coupling, NMR spectrum of EtOH, n - propyl bromide and isopropyl bromide.

**Books for Reference :**

1. Finar I.L.,
Organic Chemistry, Vol 1&2, (6th edition) England, addison Wesley Longman Ltd. (1996).

2. Morrison R.T., Boyd R.N.,
Organic Chemistry, (4th edition) New York, Allyn & Bacon Ltd., (1976)

3. Bahl B.S, Arun Bahl,
Advanced Organic Chemistry, (12th edition) New Delhi, Sultam Chand and Co., (1986)

4. Pine S.H., Organic Chemistry, (4th edition) New Delhi, McGraw - Hill International Book Company (1986)

5. Seyhan N. Ege,
Organic Chemistry, New York, Houghton Mifflin Co., (2004)

6. William Kemp,
Organic Spectroscopy, 3rd edition, ELBS.

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# Core Course XIII : PHYSICAL CHEMISTRY II

## UNIT 1: ELECTRICAL CONDUCTANCE :

Electrical transport and conducatnce in metal and in electrolytic solution.- specific conductance and equivalent conductance. measurement of equivalent conductance. using Kohlraush's bridge. Arrhenius theory of electrolytic dissociation and its limitation. weak and strong electrolyte according to Arrhenius theory. Ostwald's dilution law - applications and limitation. variation of equivalent conductance with concentration- migration of ion- ionic mobility. Kohlrausch's law and its applications. The elementary treatment of the Debye – Huckel-Onsager equation for strong electrolytes. evidence for ionic atmosphere. The conductance at high fields (Wein effect) and high frequencies (Debye - Falkenhagen effect). Transport number & Hittorfs rule. determination by Hittorf's method and moving boundary method application of conductance measurements - determination of strong electrolytes and acids. Determination of Ka of acids. determination of solubility product of a sparingly soluble salt. common ion effect. conductometric titrations.

## UNIT 2: ELECTROCHEMICAL CELLS

Electrolytic & galvanic cells - reversible and irreversible cells. conventional representation of electrochemical cells. Electromotive force of a cell and its measurement- computation of E.M.F- calculation of thermodynamic quantities of cell reactions ($\Delta G$. $\Delta H$, $\Delta S$ and K)- application of Gibbs Helmholtz equation. concentration and E.M.F- Nernst equation,

Types of reversible electrodes - gas/metal ion - metal/metal ion; metal/insoluble salt/ anion and redox electrodes. electrode reactions - Nernst equation – derivation of cell. E.M.F and single electrode potential- standard hydrogen electrode - reference electrodes - standard electrode potentials - sign convention - electrochemical series and its significance.

concentration cell with and without transport- liquid junction potential. application of EMF of concentration cells. Valency of ion- solubility product and activity co-efficient. Potentiometric titrations. Determination of pH using hydrogen and quinhydrone electrodes- determination of pKa of acids by potentiometric method. Corrosion - general and electrochemical theory - passivity - prevention of corrosion.

## UNIT 3: PHOTO CHEMISTRY AND GROUP THEORY

Consequences of light absorption - Jablonski diagram- radiative and non - radiative transitions. laws of photo chemistry - Lambert – Beer, Grothus - Draper and Stark - Einstein. quantum efficiency. photo chemical reactions - rate law - kinetics of

$H_2$-$Cl_2$, $H_2$-$Br_2$ and $H_2$-$I_2$ reactions. comparison between thermal and photochemical reactions. photo sensitization and quenching. Fluorescence, phosphorescence and chemiluminescence. Laser and uses of lasers - population inversion and optical pumping.

Group theory: symmetry elements and symmetry operation-group postulates and types of groups-Abelian and non Abelian- symmetry operation of $H_2O$ molecule-illustration of group postulates using symmetry operations of $H_2O$ molecule-construction of multiplication table for the operation of $H_2O$ molecule-point group-definition –elements (symmetry operations) of the following point groups: Cn ($C_2$, $C_3$)

Sn ($S_1$, $S_2$) , $C_{1V}$ ( $C_{2V}$, $C_{3V}$ ) and $C_{2R}$ . group theory and optical activity

## UNIT 4: SPECTROSCOPY I

Electromagnetic spectrum - The regions of various types of spectra. Microwave spectroscopy: Rotational spectra of diatomic molecules treated as rigid rotator, condition for a molecule to be active in microwave region, rotational constants (B), and selection rules for rotational transition. Frequency of spectral lines, calculation of inter - nuclear distance in diatomic molecules.
Infrared spectroscopy : Vibrations of diatomic molecules - harmonic and anharmonic oscillators, zero point energy, dissociation energy and force constant, condition for molecule to be active in the IR region, selection rules for vibrational transition, fundamental bands, overtones and hot bands, diatomic vibrating rotator - P,Q,R branches. Determination of force constant. UV visible spectroscopy : conditions - theory of electronic spectroscopy - types of electronic transitions - Franck - Condon principle – pre dissociation - applications.

## UNIT 5: SPECTROSCOPY II

**Raman spectroscopy :** Rayleigh scattering and Raman scattering. Stokes and antistokes lines in Raman spectra, Raman frequency, quantum theory of Raman effect, condition for a molecule to be Raman active. comparison of Raman and IR spectra- structural determination from Raman and IR spectroscopy, rule of mutual exclusion.
**NMR spectroscopy :** Nuclear spin and conditions for a molecule to give rise to NMR spectrum-theory of NMR spectra, number of NMR signals, equivalent and non - equivalent protons, position of NMR signals, shielding, de-shielding, chemical shift, □δ □and□ τ □scales. Peak area and number of protons. Splitting of NMR signals - spin - spin coupling.

**Books for Reference :**


1. Maron S.H. and Lando J.B.,
   Fundamentals of Physical Chemistry, Macmillan.
2. Puri B.R., Sharma L.R., and Pathania B.K.,
   Principles of Physical Chemistry, Vishal publishing company.
3. Glasstone S. and Lewis D.,
   Elements of physical Chemistry, macmillan
4. Rajaram and Keeriacose,
   Thermodynamics for students of chemistry.
5. Khterpal S.C. Pradeeps,
   Physical Chemistry, Volume I & II, Pradeep publications Jalandhur, (2004).
6. Jain D.V.S and Jainhar S.P.,
   Physical chemistry, Principles and problems, Tata Mc Graw Hill, New Delhi, (1988).


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# Major Based Elective II : Nuclear and Industrial Chemistry

## UNIT 1: NUCLEAR CHEMISTRY I

Introduction - composition of nucleus and nuclear forces (meson field theory)- nuclear stability - mass defect - binding energy - packing fraction - N/P ratio, magic numbers - nuclear models - liquid drop - shell and collective model - Isotopes - detection and separation - deviation of atomic weights from whole numbers - isobars isotones and isomers.

## UNIT 2: NUCLEAR CHEMISTRY II

Radioactivity – discovery, detection and measurements, laws of radioactivity - rate of disintegration - half life and average life, group displacement law - radio active series - nuclear transformation - use of projectiles - nuclear reactions - fission and fusion - nuclear reactors, applications of nuclear science in agriculture and medicine- carbon dating - rock dating - radioactive waste disposal.

## UNIT 3: INORGANIC SOLID STATE CHEMISTRY

Radius ratio rule its application in determination of structure of solids like Zones, Wurzite, fluorite, anti-fluorite, $CdI_2$ and $NiH_2$ - crystal defects - Schotty and Frenkel defects- group theories and its applications - symmetry elements - symmetry operations - mathematical group multiplication tables - point group of simple molecules ($H_2$, HCl, $CO_2$, $H_2O$, $BF_3$, $NH_3$)

## UNIT 4: INDUSTRIAL INORGANIC CHEMISTRY

Fossil fuels - varieties of coal and petroleum - petroleum refineries in India- fuel gases - calorific value - composition and preparation of water gas, semi water gas, carburetted water gas, producer gas, natural gas, LPG and biogas.

Fertilizers - manufacture of N-P-K and mixed fertilizers - micronutrients and their role in plant life- safety matches, fire works and explosives - manufacturing details paints and varnishes - manufacture and uses.

## UNIT 5: ENVIRONMENTAL CHEMISTORY

Soil, water and air pollution - control measures - ozone hole - green house effect - acid rain - global warming. effluents and their treatment from various industries like dyeing, cement, tannery and distillery units.

**Books for Reference :**


1. Soni P.L.,
   Text book of Inorganic Chemistry, S.Chand & Co, New Delhi (2006)
2. Lee J.D.,
   concise Inorganic Chemistry ELBS edition.
3. Puri B.R. and Sharma L.R.,
   Principles of Inorganic Chemistry, soban Lal Nagin Chand & Co.
4. Satyaprakash, Tuli, G.D., Basu, S.K., and Madan, R.D,]
   Advanced Inorganic chemistry (vol I & II ), S. Chand, New Delhi (2006)


**Major based Elective III**

## Any one of the following courses :

1. Polymer Chemistry, 2. Food Chemistry, 3. Metirial Chemistry and Nano Technolagy

# 1. Polymer Chemistry

## UNIT 1 : INTRODUCTION TO POLYMERS :

Importance of polymers : basic concept-monomers and polymers-definition. Classification of polymers on the basis of microstructures, macrostructures and applications (thermosetting and thermoplastics) Distinction among plastics, elastomers and fibers. Homo and heteropolymers. Copolymers.
Chemistry of polymerization- chain polymerization, free radical, ionic, coordination step polymerization
Polyaddition and polycondensation- miscellaneous ring-opening & group transfer polymerization. (15Hrs)

## UNIT 2 : PHYSICAL PROPERTIES AND REACTIONS OF POLYMERS

Properties : Glass transition temperature (Tg) – Definition – Factors affecting Tg-relationships between Tg and molecular weight and melting point. Importance of Tg. Molecular weight of polymers: number average, weight average, sedimentation and viscosity average molecular weights. Molecular weights and degree of polymerization. Reactions : hydrolysis - hydrogenation – addition – substitutions-cross-liking vulcanization and cyclisations reaction. Polymer degradation. Basic idea of thermal, photo and oxidative degradation of polymers

## UNIT 3 : POLYMERIZATION TECHNIQUES AND PROCESSING

Polymerisation techniques : Bulk, solution, suspension, emulsion, melt condensation and interfacial polycondensation polymerizations. Polymer processing: Calendering –die casting, rotational casting –compression. Injection moulding. (15Hrs)

## UNIT 4 : CHEMISTRY OF COMMERCIAL POLYMERS

General methods of preparation, properties and uses of the following
Polymers: Teflon, polymethylmethacrylate. Polyethylene, polystyrene, PAN, polyesters, polycarbonates, polyamides, (Kevlar), polyurethanes, PVC, epoxy resins, rubber –styrene and neoprene rubbers, Phenol – formaldehydes and urea-formaldehyde resins (15Hrs)

## UNIT 5 : ADVANCES IN POLYMERS

Biopolymers-biomaterials. Polymers in medical field. High temperature and fire-resistant polymers. Silicones. Conducting polymers-carbon Fibers. (basic idea only). (15Hrs)

## TEXT BOOK :

Billmeyer F.W., Text book of polymer science, Jr. John Wiley and Sons, 1984.

**Books for Reference :**

1. Gowariker V.R., Viswanathan N.V. and Jayader Sreedhar, Polymer Science, Wiley Eastern Ltd., New Delhi, 1978.
2. Sharma, B.K., Polymer Chemistry, Goel Publishing House, Meerut, 1989.
3. Arora M.G., Singh M. and Yadav M.S., Polymer Chemistry, 2nd Revised edition, anmol Publications Private Ltd., New Delhi, 1989.

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# 2. Food Chemistry

## UNIT 1 : FOOD ADULTERATION :

Sources of food, types, advantages and disadvantages. Food adulteration – contamination of Wheat, Rice, Alial, Milk, Butter etc. with clay stones, water and toxic chemicals – Common adulterants. - ghee adulterants and their detection. Detection of adultered food by simple analytic techniques.

## UNIT 2 : FOOD POISON

Food poisons – natural poisons (alkaloids – nephrotoxing) – pesticides. (DDT, BHC, Malathion) – Chemical poisons – first aid for poison consumed victims. (15Hrs)

## UNIT 3 : FOOD ADDITIVES

Food additives –artificial sweetners – saccharin – cyclomate and aspartate. Food flavours – esters, aldehydes and heterocyclic compound. Food colours – nestricte use spurious colours – Emulsifying agents – preservatives learning agents. Baking powder yeast – taste makers – MSG vinegar. (15Hrs)

## UNIT 4 : BEVERAGES :

Beverages – Soft drinks – soda – fruit juices – alcoholic beverages examples. Carbonation – addiction to alcohol – cirrhosis of liver and social problems.

## UNIT 5: EDIBLE OILS :

Fats, Oils, - Sources of oils – production of refined vegetable oils – preservation. Saturated and unsaturated fatty acids – iodine value – role of MUFA and PUFA in preventing heart diseases – determination of iodine value and RM value, saponification values and their significance. Estimation of iodine and RM values in edible oils.

**Books for Reference :**


1. Swaminathan M., Food Science and Experimental foods, Ganesh and Company.
2. Jayashree Ghosh, Fundamental concepts of appliced chemistry, S. Chand & Co. Publishers.
3. Thanlamma Jacob, text books of applied chemistry for home science and allied science, Macmillan.


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# 3.Material Chemistry and Nanotechnology

## UNIT 1: IONIC CONDUCTIVITY AND SOLID ELECTROLYTES :

Types of ionic crystals – alkali halides – silver chloride-alkali earth fluovider –simple stoichiometric oxides. Types of ionic conductors – halide ion conductors – oxide ion conductors – solid electrolytes – applications of solid electrolytes. Electrochemical cell – principles – batteries, sensors and fuel cells – crystal defects in solids – line and plane defects – point defects - schottky and frenkel defects. Electronic properties and band theory; metals, semiconductors – Inorganic solids – colour, magnetic and optical properties, luminescence (15h)

## UNIT 2 : MAGNETIC MATERIALS

Introduction – types of magnetic materials – diamagnetism – paramagnetism, ferromagnetism. Ferrites : Preparation and their applications in microwave –floppy disk – magnetic bibble memory and applications. Insulating Materials: Classification on the basis of temperature – Blymer insulating materials and ceramic insulating materials. Ferro electric materials: examples – applications of ferroelectries. (15h)

## UNIT 3 : MODERN ENGINEERING MATERIALS :

Metallic glasses – introduction –composition, properties and applications. Shape memory alloys: introduction – examples – application of SMA – advantages and disadvantages. Biomaterials : Introduction –metals and alloys in biomaterials –ceramic biomaterials, composite biomaterials-polymer biomaterials. (15h)

## UNIT 4: NANOPHASE MATERIALS :

Introduction – techniques for synthesis of nanophase materials –sol-gel synthsis-electrodeposition –inert gas condensation-mechanical alloying –properties of nanophase mateials –applications of nanophase materials, composite materials: Introduction –types. (15h)

## UNIT 5: NANO TECHNOLOGY

Introduction –importance –various stages of nanotechnology –nanotube technology – nanoparticles –fullerenes-nanodendrimers –nanopore channels, fibres and scaffolds – CVD dismond technology –FCVA technology and its applications – nanoimaging techniques. (15h)

## Books for Reference :


1. Aathony R. West,
   Solidstate chemistry and its applications, john wiley & Sons(1989).

2. Raghavan V.R.,
   Materials Science and Engineering, Printice Hall (India) Ltd., (2001).

3. Kenneth J. Klabunde,
   Nanoscale materials in chemistry, A. John Wiley and Sons Inc. Publication.


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