

# **GOVERNMENT ARTS COLLEGE (AUTONOMOUS)**

**KUMBAKONAM 612 002**

Re - accredited With 'A' Grade by NAAC & Affiliated to Bharathidasan University

## **DEPARTMENT OF CHEMISTRY**

(Effective for those admitted from 2020-2021 onwards)



## **SYLLABI**

**B.Sc., CHEMISTRY**

# Government Arts College (Autonomous), Kumbakonam-2

## Department of Chemistry

### **B.Sc., Chemistry**

#### **Programme Outcomes**

After successful completion of three year degree program in Chemistry a student should be able to;

1. Demonstrate, solve and an understanding of major concepts in all disciplines of chemistry.
2. Solve the problem and also think methodically, independently and draw a logical conclusion.
3. Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of chemical reactions.
4. Create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.
5. Find out the green route for chemical reaction for sustainable development.
6. To inculcate the scientific temperament in the students and outside the scientific community.
7. The branches of Chemistry such as Organic Chemistry, Inorganic Chemistry, Physical Chemistry and Analytical Chemistry expose the diversified aspects of chemistry where the students experience a broader outlook of the subject.
8. The practical exercises done in the laboratories impart the students the knowledge about various chemical reagents and reactions. Thereby, hone their skills of handling the corrosive, poisonous, explosive and carcinogenic chemicals making themselves employable in any kind of chemical industries.

They are also trained about the adverse effects of the obnoxious chemicals and the first aid treatment.

9. Find out the green route for chemical reaction for sustainable development.

### **Programme Specific Outcomes**

1. Gain the knowledge of Chemistry through theory and practical.
2. To explain nomenclature, stereochemistry, structures, reactivity, and mechanism of the chemical reactions.
3. Identify chemical formulae and solve numerical problems.
4. Know structure-activity relationship.
5. Understand good laboratory practices and safety.
6. Develop research oriented skills.
7. Students will learn to estimate inorganic salt mixtures and organic compounds both qualitatively and quantitatively using the classical methods of analysis in practical classes.
8. Students will learn to synthesize the chemical compounds by maneuvering the addition of reagents under optimum reaction conditions.

**GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM**

**Scheme for the B.Sc. Chemistry Students under Choice Based Credit System from 2020 – 2021**

Semester	Part	Course Title	Hours	Credits	Max.Marks
I	I	PART-I Tamil Paper-I (LC)	6	3	100
	II	PART-II English Paper-I (ELC)	6	3	100
	III	CORE-I General Chemistry-I (CC)	6	5	100
	III	First ALLIED-I Maths-I/Zoo-I (Theory) (AC)	4	4	100
	III	CORE-I Volumetric Analysis (Major Practical)	3	*	-
	III	First ALLIED-III Maths III/ Zoology Practical (Allied Practical)	3	*	-
	IV	COMMON PAPER - Value Education	2	2	100
			<b>Total</b>	<b>30</b>	<b>17</b>
II	I	PART-I Tamil Paper-II (LC)	6	3	100
	II	PART-II English Paper-II (ELC)	6	3	100
	III	CORE-II General Chemistry-II (CC)	6	5	100
	III	First ALLIED II Zoology II / Maths II Theory (AC)	3	4	100
	III	CORE Practical –I Volumetric Analysis	3	3	100
	III	First ALLIED III Maths-III (AC) / Zoology I (Allied Practical)	4	3	100
	IV	COMMON PAPER - Environmental Studies (ES)	2	2	100
			<b>Total</b>	<b>30</b>	<b>23</b>
III	I	PART-I Tamil Paper-III (LC)	6	3	100
	II	PART-II English Paper-III (ELC)	6	3	100
	III	CORE-III Inorganic Chemistry-I (CC)	6	5	100
	III	Second ALLIED I Physics-I (AC)	4	4	100
	III	CORE Inorganic Semimicro Qualitative Analysis (CP)	3	**	-
	III	Second ALLIED III Physics Practical III(AP)	3	**	-
	IV	NON MAJOR EC-1 Domestic Electrical Appliances	2	2	100
			<b>Total</b>	<b>30</b>	<b>17</b>
IV	I	PART-I Tamil Paper-IV (LC)	6	3	100
	II	PART-II English Paper-IV (ELC)	6	3	100
	III	CORE-IV Organic chemistry- I (CC)	4	4	100
	III	Second ALLIED II Physics-II	4	4	100
	III	CORE Practical II Inorganic Semi micro Qualitative Analysis (CP)	3	3	100
	III	Second ALLIED III- Physics Practical (AP)	3	3	100
	IV	NON MAJOR EC-II Clinical Laboratory Techniques	2	2	100
	IV	SKILL BASED EC-I Chemistry of Soil and Water	2	2	100
		<b>Total</b>	<b>30</b>	<b>24</b>	<b>800</b>
V	III	CORE-V Organic Chemistry–II (CC)	5	5	100
	III	CORE-VI Inorganic Chemistry–II (CC)	5	5	100
	III	CORE-VII Physical Chemistry-I (CC)	5	5	100
	III	CORE-Practical III Physical Chemistry Practical (CP)	3	4	100
	IV	Major Based EC-I Physical Methods In Chemistry	5	5	100
	III	CORE Practical-IV Organic Chemistry Practical	3	***	-
	IV	SKILL BASED EC-II Food Chemistry	2	2	100
	IV	SKILL BASED-EC-III Chemistry In Everyday Life	1	2	100
	IV	Soft Skills Development	2	2	100
		<b>Total</b>	<b>30</b>	<b>30</b>	<b>800</b>
VI	III	CORE-VIII Physical Chemistry-II (CC)	5	6	100
	III	CORE-IX Inorganic chemistry-III (CC)	6	6	100
	III	CORE-IV Organic Chemistry & Gravimetric Practical	6	5	100
	III	Major EC-II Selected Topics in Organic Chemistry	6	5	100
	III	Major EC-III Pharmaceutical Chemistry	6	5	100
	IV	GENDER STUDIES	1	1	100
		Extension Activities		1	---
			<b>Total</b>	<b>30</b>	<b>29</b>
		<b>GRAND TOTAL</b>	<b>180</b>	<b>140</b>	<b>3900</b>

\* Exams at the end of II semester.

\*\*\* Exams at the end of VI semester

\*\* Exams at the end of IV semester.

	Internal marks	External marks
1. Theory	25	75
2. Practical	40	60

## SUMMARY

<b>Part</b>	<b>Course</b>	<b>Total No.</b>	<b>Hours</b>	<b>Credits</b>	<b>Marks</b>
<b>I</b>	<b>Tamil</b>	<b>4</b>	<b>24</b>	<b>12</b>	<b>400</b>
<b>II</b>	<b>English</b>	<b>4</b>	<b>24</b>	<b>12</b>	<b>400</b>
<b>III</b>	<b>Core Courses</b>	<b>13</b>	<b>70</b>	<b>63</b>	<b>1300</b>
<b>III</b>	<b>EC -Major</b>	<b>3</b>	<b>17</b>	<b>14</b>	<b>300</b>
<b>III</b>	<b>Allied Courses</b>	<b>6</b>	<b>28</b>	<b>22</b>	<b>600</b>
<b>IV</b>	<b>Skill Based EC</b>	<b>3</b>	<b>6</b>	<b>6</b>	<b>300</b>
<b>IV</b>	<b>Value Education</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>100</b>
<b>IV</b>	<b>Environmental Studies</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>100</b>
<b>IV</b>	<b>Non-Major EC</b>	<b>2</b>	<b>4</b>	<b>4</b>	<b>200</b>
<b>IV</b>	<b>GENDER STUDIES</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>100</b>
<b>V</b>	<b>Soft Skills Development</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>100</b>
	<b>Total</b>	<b>39</b>	<b>180</b>	<b>140</b>	<b>3900</b>

**Extension Activities**

**GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM**  
**DEPARTMENT OF CHEMISTRY**  
**SYLLABUS FOR THE STUDENTS ADMITTED FROM 2020 – 2021**  
**B.SC., CHEMISTRY PROGRAM**

**Title of the Subject: General Chemistry – I**

**Credits: 5**

**Subject Code:**

**Contact Hours: 90**

**Semester: I (CORE COURSE-I)**

**Marks: 100**

**Course Outcome:**

To understand volumetric analysis and problems in calculation of normality.

To study about emulsions and gels in day today life

To acquire knowledge about IUPAC nomenclature

**Semester: I (CORE COURSE-I)**

**Marks: 100**

**Unit – I: Periodic properties:** Atomic and ionic radii - factors influencing the magnitude of ionic radii - periodic variations of atomic and ionic radii - ionization energy - factors affecting the magnitude of ionization potential and its periodic variations - applications - electron affinity - factors influencing the magnitude of electron affinity - electronegativity - definition - periodic variations.

Molecular weight-Definition and calculation of molecular weights of simple compound- Equivalent weight-Definition and calculation of equivalent weight of acids, bases, salts and oxidizing agents - Law of volumetric analysis-statement and problems in calculation of normality.

**Unit – II: Principles of Organic Chemistry and Nomenclature of linear aliphatic hydrocarbons:**

Classification of organic molecules – IUPAC nomenclature of linear aliphatic hydrocarbons-alkanes, alkenes and alkynes- empirical and molecular formula determination of simple organic molecules like ethanol, acetic acid and benzaldehyde. Introduction to hybridization  $sp^3$ ,  $sp^2$  and  $sp$  hybridization - polar effects - inductive and electromeric effects – resonance effect – resonance energy- effect on chemical reactivity –hyper conjugation – spatial effect-steric hindrance and steric activation.

**Unit – III: Aliphatic Saturated Hydrocarbons – Alkanes and Cycloalkanes:** Alkanes - general methods of preparation includes Wurtz – isomerism – types of isomerism- structural isomerism- chain isomerism –reaction of halogens with methane – nitration, sulphonation, oxidation, isomerization and thermal decomposition of alkanes.

Nomenclature of homoannular alicyclic compounds- preparation and properties of alicyclic compounds – Wurtz reaction – Dieckmann ring closure – reduction of aromatic compounds – reaction of small ring compounds – cyclopropane and cyclobutane – Bayer strain theory.

**Unit – IV: Gaseous state:** Ideal Gases - kinetic theory of gases – postulates – kinetic gas equation – derivation of Boyle's law, Charle's law and Avogadro's law – Maxwell's distribution of molecular velocities – collision number - collision frequency and mean free path. Real gases – Deviation from ideal behavior - Van der Waals equation - Clausius equation – Inter molecular forces – types – London forces – interaction energy.

**Unit – V: Liquid and Colloidal states:** Liquid state - properties of liquids – vapor pressure – Trouton's rule – surface tension – surface energy –surface active agents – viscosity – effect of temperature on viscosity – Reynolds number – refractive index –optical activity. Colloidal state - classification of colloids – properties –electrical double layer – zeta potential –flocculation value – electrophoresis – electro osmosis –particle size determination by light scattering method – surfactants – types – micelles. Gels – types, preparation and properties. Emulsion- types, preparation and properties.

**References**

1. Principles of Inorganic Chemistry, B.R.Puri, L.R.Sharma, ShobanLalNagin Chand & Co.,

2. Text Book of Inorganic Chemistry, P.L.Soni, Mohan Katyal, S Chand & Sons, New Delhi.
3. Selected Topics in Inorganic Chemistry U. Malik, G.D. Tuli and R.D.Madan, S.Chand& Sons
4. Text Book of Organic Chemistry, P.L.Soni, H.M.Chawla, Sultan Chand & Sons., New Delhi.
5. Organic Chemistry Vol. I.L.Finar, ELBS.
6. Text Book of Physical Chemistry, P.L.Soni, O.P.Dharmara, U.N. Dash, S Chand & Sons.
7. Principles of Physical Chemistry, B.R.Puri, L.R.Sharma, M.S.Pathania, ShobanLal Nagin Chand & Co., New Delhi.

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**Title of the Subject: General Chemistry – II**

**Credits: 5**

**Subject Code:**

**Contact Hours: 90**

**Semester: II (CORE COURSE-II)**

**Marks: 100**

**Course Outcome:**

To learn about bonding in chemistry

To know about characteristics of s-block elements

To study crystal lattice

**Unit – I: Chemical bonding**

Ionic bond - formation of ionic bonds and factors favoring its formation – characteristics of ionic compounds. Covalent bond - single and multiple bonds – characteristics of covalent compounds. VSEPR theory – shapes of simple inorganic molecules–partial ionic character – determination from electronegativity –Fajan’s rules. Coordinate bond - characteristics of coordinate covalent compounds. Hydrogen bonding - nature, types and effect on properties.

**Unit – II: S- Block elements**

Alkali metals – characteristics diagonal relationship of Li & Mg -manufacture, properties and uses of sodium hydroxide – preparation, properties and uses of washing soda, baking soda, sodium thiosulphate, potassium hydroxide and potassium carbonate. Chemistry of rubidium and cesium. Alkaline earth metals – characteristics diagonal relationship of Be & Al-extraction, properties and uses of calcium – preparation, properties and uses of calcium cyanamide, calcium carbide and superphosphate of lime – Portland cement –manufacture of Portland cement and setting of cement.

**Unit – III: Aliphatic Unsaturated Hydrocarbons:** Alkenes - general methods of preparation – E<sub>1</sub> & E<sub>2</sub> mechanism- E<sub>1</sub>CB mechanism – orientation – Hoffmann & Saytzeff rule –Wittig reaction – addition reactions with hydrogen and hydrogen halides –Markownikoff rule – peroxide effects –isomerization of alkenes. Structure and properties of dienes- electrophilic addition to a conjugated dienes – 1, 2 additions – 1, 4 additions–Diels- Alder reaction - Alkynes- preparation of alkynes – acidity of alkynes – formation of acetylides – vinylation – hydration – polymerization of acetylene- cycloalkene – Bredt's rule.

**Unit – IV: Aromatic hydrocarbons**

Benzene – IUPAC nomenclature of substituted benzenes - effect of substituents in benzene – electrophilic aromatic substitution –nitration, sulphonation, halogenation, Friedel- Crafts acylation and alkylation – ortho-para ratio – alkyl benzenes – toluene, xylenes, mesitylene and cumene – preparation, properties and uses of methyl benzene. Polynuclear aromatic hydrocarbons– nomenclature of substituted naphthalene- preparation, properties and uses naphthalene – structures of phenanthrene, anthracene, phenalene, tetracene, chrysene, triphylene, pyrene and pentacene.

**Unit - V: Solid state chemistry and Photochemistry**

Difference between crystalline and amorphous solids –symmetry in crystal systems- space lattice and unit cell – Bravais lattice –Lattice energy –Miller indices – X-ray diffraction – Bragg’s equation- types of crystals- structures of diamond and graphite –band theory of conductors - semiconductors and insulators – Schottky defects – Frenckle defects.



Photochemistry – Introduction- light absorption by solutions – Beer Lambert's law- Limitations of Beer Lambert's law- Laws of photochemistry Grotthus–Draper law – Stark – Einstein law – quantum yield.

### **References**

1. Principles of Inorganic Chemistry, B.R.Puri, L.R.Sharma, ShobanLalNagin Chand & Co.
2. Text Book of Inorganic Chemistry, P.L.Soni, Mohan Katyal, Sultan Chand & Sons.
3. Selected Topics in Inorganic Chemistry U. Malik, G.D. Tuli, R.D.Madan, S.Chand Company
4. Text Book of Organic Chemistry, P.L.Soni, H.M.Chawla, Sultan Chand & Sons., New Delhi.
5. Organic Chemistry Vol. I.L.Finar, ELBS.
6. Text Book of Physical Chemistry, P.L.Soni, O.P.Dharmara, U.N. Dash, Sultan Chand & Sons,
7. Principles of Physical Chemistry, B.R.Puri, L.R.Sharma, M.S.Pathania, ShobanLalNagin Chand & Co. New Delhi.

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**B.SC., CHEMISTRY PROGRAM**

**Title of the Subject: Volumetric Analysis**  
**Subject Code:**  
**Semester: II (Core Practical-I)**

**Credits: 3**  
**Contact Hours: 90**  
**Marks: 100**

**Course outcome:**

- To know the accuracy of estimation of various chemical compounds
- To understand the basic knowledge of volumetric laws and principles
- To get knowledge about the hardness of water from various ground water
- To get the knowledge about assign the assay of drugs in pharma industries

**I. Acidimetry- Alkalimetry**

Estimation of Sodium carbonate  
Estimation of Oxalic acid

**II. Permanganometry**

Estimation of Ferrous ammonium sulphate  
Estimation of Oxalic acid

**III. Iodometry**

Estimation of Copper  
Estimation of Potassium dichromate

**IV. Dichrometry**

Estimation of Zinc  
Estimation of Ferrous ion

**V. Complexometric titrations**

Determination of  $Mg^{2+}$ ,  $Zn^{2+}$  by EDTA  
Estimation of hardness of water by EDTA

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**B.SC., CHEMISTRY PROGRAM**

**Title of the Subject: Inorganic Chemistry – I**  
**Subject Code:**  
**Semester: III (CORE COURSE -III)**

**Credits: 5**  
**Contact Hours: 90**  
**Marks: 100**

**Course outcome:**

- To know the compounds of p, d block and inner transition elements and their properties
- To understand the modern concept of acid and bases

**Unit – I: *p* – Block elements**

Nitrogen compounds - chemistry of hydrazine, hydroxylamine, hydrazoic acid and sodium bismuthate. Detection of arsenic. Comparative study of oxygen family elements - Preparation, properties and uses of thionic acids and per acids of sulphur. Oxides and oxyacid's of halogens – basic nature of iodine – chemistry of astatine – pseudo halogens – preparation and properties of cyanogens and thiocyanogen and uses – comparison with halogens - position of inert gases in periodic table - structures of XeF<sub>4</sub>, XeF<sub>6</sub>, XeOF<sub>4</sub> and XeO<sub>3</sub>.

**Unit – II: *d* - Block elements**

Definition-electronic configuration - general characteristics - metallic and magnetic behavior (spin contribution only) of transition elements - comparison of the elements of first transition series (3d) with those of second(4d) and third(5d) series. Commercial forms of iron -manufacture of cast iron, wrought iron and steel - heat treatment of steels - classification of steels - passivity - rusting of iron - prevention of rusting (principles only).

**Unit – III: Compounds of transition elements**

Preparation, properties, structure and uses of the following inorganic compounds titanium (IV) chloride – Ziegler Natta catalyst – vanadium pentoxide –potassium dichromate – potassium permanganate – Wilkinson's catalyst –potassium ferrocyanide – potassium ferricyanide – sodium nitro pruside – cuprous chloride – cupric chloride – auric chloride –mercurous chloride – mercuric chloride.

**Unit – IV: Inner transition elements**

Lanthanides – comparative study of lanthanide elements with respect to electronic configuration – atomic and ionic radii – oxidation states – complex formation and magnetic properties – lanthanide contraction – position in the periodic table -occurrence – principles of separation methods. Actinides – comparative study of actinide elements – comparison of lanthanides and actinides – position in the periodic table – extraction of thorium and uranium.

**Unit – V: Modern concepts of acids and bases**

Arrhenius concept – Bronsted Lowry definition – Lux Flood definition – solvent system definition – Lewis definition – Usanovich definition – A generalized Acid Base concept – Hard and Soft Acids and Bases (HSAB) – classification – theoretical basis of hardness and softness of acids and bases – symbiosis - classification of solvents – nonaqueous solvents – liquid ammonia – liquid sulfur dioxide.

**References**

1. Principles of Inorganic Chemistry, B.R.Puri and L.R.Sharma,ShobanLalNagin Chand & Co.
2. Text Book of Inorganic Chemistry, P.L.Soni, Mohan Katyal, Sultan Chand & Sons.
3. Selected Topics in Inorganic Chemistry, RD.Madan, WU.Malik,G.D.Tuli, S.Chand Ltd.
4. Inorganic Chemistry, James E.HuheyE.A.Keiter, R.L.Keiter,Addison-Wesley Company.
5. Concise Inorganic Chemistry, Fifth Edition, J.D.Lee, Blackwell Science Ltd.
6. Inorganic Chemistry, Third Edition, D.F.Shriver, P.W.Atkins, Oxford University Press.
7. Basic Inorganic Chemistry, Third Edition, F.A.Cotton and G.Williamson, John Wiley & Sons.

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM

DEPARTMENT OF CHEMISTRY

SYLLABUS FOR THE STUDENTS ADMITTED FROM 2020 – 2021

B.SC., CHEMISTRY PROGRAM

**Title of the Subject: ORGANIC CHEMISTRY I**

**Credits: 4**

**Subject Code:**

**Contact Hours: 90**

**Semester: IV (CORE COURSE-IV)**

**Marks: 100**

**Program Purpose:**

The purpose of this syllabus is to provide the key knowledge on preparation of aliphatic and aromatic molecules and their chemical properties by means of the functional group presented on them.

**Learning Outcomes:**

From this syllabus the student can easily learn the derivatives of aliphatic and aromatic molecules and how the reactions were varied by means of functional groups like halides, alcoholic, phenolic and carbonyl groups in both aliphatic and aromatic core.

**Unit – I: Halogenated Hydrocarbons:** Introduction – preparation, properties and uses of alkyl halides – reactivity of alkyl, vinyl and aryl halides – Grignard reagents and its synthetic uses – aliphatic nucleophilic substitution – mechanisms of  $S_N1$ ,  $S_N2$  and  $S_Ni$  reactions – effect of structure on substrate, solvent, nucleophile and leaving group – elimination reactions – Hoffmann and Saytzeff eliminations – E1 and E2 mechanisms – stereochemistry of E2 reactions in acyclic systems – elimination versus substitution. Aromatic nucleophilic substitution – benzyne mechanism and intermediate complex mechanism.

**Unit – II: Alcohols and Ethers:** Classification alcohols-comparative study of dehydration, oxidation, substitution and esterification of primary, secondary and tertiary alcohols – polyhydric alcohols - chemistry of glycol and glycerol – cleavage reactions with periodic acid, lead tetra acetate and osmium tetroxide – unsaturated alcohols - preparation and properties of allyl alcohol- General methods of preparation of thioalcohols – properties and uses of ethyl mercaptan. Ethers and thioethers - Nomenclature of ethers and methods of their formation, physical properties - Chemical reactions - cleavage and autoxidation, Ziesel's method - synthesis of epoxides -acid and base catalyzed ring opening of epoxides, reactions of organolithium reagents with epoxides– general methods of preparation of thioethers – ethyl sulphide – mustard gas.

**Unit – III: Phenolic Compounds:** Nomenclature- structure and bonding –preparation- physical properties - acidic character of phenols -comparative acidic strength of alcohols acids and phenols- explanation on the basis of resonance stabilization- reactions of phenols - electrophilic aromatic substitution, acylation and carboxylation – Kolbe's reaction – Riemer - Tiemann reaction - Gattermann reaction – Laderer-Manese reaction – Hoesh reaction- catechol, resorcinol, quinol, pyrogallol, phloroglucinol and hydroxyquinol -  $\alpha$ - and  $\beta$ -naphthol – preparation and properties.

**Unit – IV: Carbonyl Compounds:** Carbonyl group – polarization of C=O bond – reactivity of carbonyl group – acidity of  $\alpha$ -hydrogen – nucleophilic addition to carbonyl bond – HCN,  $\text{NaHSO}_3$ ,  $\text{NH}_3$  and alcohols - condensation with hydrazine, phenyl hydrazine and semi carbazide – mechanism of aldol – Perkin - Knoevenegal - benzoin condensation – mechanism of Claisen – Reformatsky – Wittig - Cannizarro - Dieckmann reactions – mechanism of reduction with sodium borohydride,  $\text{LiAlH}_4$ , Wolff-Kishner and MPV reductions – mechanism of halo-form reaction and Michael addition.

**Unit –V: Carboxylic Acids and Derivatives:** Nomenclature – preparation and properties of formic, acetic and benzoic acid - ionization of carboxylic acids – acidity constants – comparison of acid strength of substituted aliphatic acids – acid strength of substituted benzoic acids – Hammett and Taft equation -

dicarboxylic acids – preparation and properties of oxalic, malonic, succinic, glutaric and adipic acids – phthalic acid - substituted carboxylic acids – crotonic acid – lactic acid– tartaric acid and salicylic acid.

**References:**

1. B.S.Bahl and ArunBahl, Advanced Organic chemistry.
2. P.L.Soni and H.M. Chawla, Textbook of organic chemistry.
3. Text Book of Organic chemistry, Tewari.
4. Principles of reaction mechanism in organic chemistry, V.S.Parmar and M.Chawla.
5. Chemistry of Natural Products, O.P.AgarwalVoll. I&II.
6. Organic Synthesis, Dr. Jagadamba Singh, Dr. L.D.S.Yadav, PragatiPrakashan, New Delhi.

**GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM**  
**DEPARTMENT OF CHEMISTRY**  
**SYLLABUS FOR THE STUDENTS ADMITTED FROM (2020 – 2021)(CBCS)**  
**B. Sc., CHEMISTRY PROGRAM**

**Title of the Subject: Inorganic Semi micro qualitative analysis**  
**Subject Code:**  
**Semester: IV (Core Practical-II)**

**Credits: 3**  
**Contact Hours: 03**  
**Marks: 60 + 40 = 100**

1. Training sessions for first three classes. Mixture containing two anions and two cations will be given. Among the two anions one is interfering anion and its elimination technique will be practiced.
2. In the cation analysis, separation of cations according to their group and analysis of individual cations will be performed.
3. **Simple anions:** Carboate, Nitrate, Sulphate, Sulphide, Chloride, Iodide and Bromide.
4. **Interfering anions:** Borate, Fluoride, Oxalate, Phosphate, Arsenate and Chromate
5. **Cations:**

**Group I:** Lead and Silver

**Group II:** Mercury, Copper, Cadmium, Bismuth, Antimony, Tin

**Group III:** Aluminium, Ferrous, Ferric, Chromium

**Group IV:** Cobalt, Nickel, Manganese, Zinc

**Group V:** Barium, Strontium, Calcium

**Group VI:** Magnesium, Ammonium

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**B.SC., CHEMISTRY PROGRAM**

**Title of the Subject: ORGANIC CHEMISTRY II**

**Credits: 5**

**Subject Code:**

**Contact Hours: 90**

**Semester: V (CORE COURSE-V)**

**Marks: 100**

**Program Purpose:**

The purpose of this syllabus is to provide the key knowledge on preparation of nitrogen containing compounds, importance of active methylene groups in organic synthesis, mechanism of basic molecular rearrangements and the broad spectrum of heterocyclic molecules.

**Learning Outcomes:**

From **Unit-I** the student can able to classify the nitrogen containing organic molecules like amines, amides and nitro compounds, their structure, preparation and properties.

From **Unit-II** the student can enrich the knowledge with the importance of active methylene groups in organic synthesis.

From **Unit-III** the student can understand about the other classification of organic molecule called heterocyclic compounds, the electrophilic substitution reactions, comparison of structure and the properties.

From **Unit-IV** the student will gain the knowledge about carbohydrates their structure and how the properties of them varied from other class aliphatic molecules.

From **Unit-V** the student can gain the idea of molecular rearrangements.

**Unit – I: Nitrogen Containing Compounds**

General methods of preparation and properties Aliphatic and aromatic nitro compounds- reduction of nitrobenzene in acidic, neutral and alkaline media - conversion of nitrobenzene to ortho, para and meta - dinitro benzenes – TNT. Aliphatic and aromatic amines- relative basic characters-ring substitution in aromatic amines- diazotisation and its mechanism – coupling – synthetic uses of diazonium salt - phenylenediamines- sulphanilic acid and sulphanilamide- saccharin-550 -chloramine-T. Amino acids and proteins.

**Unit – II: Active Methylene Compounds**

Malonic and Acetoacetic esters -characteristic reactions of active methylene group -preparation and synthetic applications of ethyl acetoacetate and diethyl malonate. Diazomethane and Diazoacetic ester – preparation, structure and synthetic uses. Tautomerism – definition- keto-enol tautomerism (identification, acid and base catalyzed, inter-conversion mechanism, preparation and characteristics) – amido-imido and nitro-acinitro tautomerisms.

**Unit – III: Heterocyclic Compounds**

Introduction – molecular-orbital structure and aromatic characteristics of pyrrole, furan, thiophene and pyridine – methods of synthesis - chemical reactions with particular emphasis on the mechanism of electrophilic substitution – comparison of basicity of pyridine, piperidine and pyrrole. Condensed five and six membered heterocycles – preparation of indole, quinoline and isoquinoline with special reference to Fisher Indole, Skraup and Bischler Napieralski synthesis.

**Unit – IV: Carbohydrates (NA)**

Classification- chemistry and constitution of glucose and fructose – determination of ring size – Haworth projection formula – configuration of monosaccharides – epimerization - chain lengthening and chain shortening of aldose and ketose – inter conversion of aldoses and ketoses - disaccharides – chemistry and

structure of maltose, lactose and sucrose – poly sacrides - starch and cellulose (structural elucidation not necessary).

### **Unit – V: Molecular Rearrangements and Reagents for Synthesis (CE)**

Pinacol-pinacolone - wagner-meerwein – beckmann–benzidine – hoffmann – curtius - benzilic acid –claisen – fries - cope and oxy cope rearrangements.Reagents in organic synthesis - lithium aluminium hydride - sodium borohydride – reduction of carbonyl compounds and carboxylic acids -selenium dioxide – oxidation of carbonyl compounds - aluminium isopropoxide (MPV reduction) - wilkinson catalyst – hydrogenation of alkenes and alkynes - tetra carbonyl nickel – carbonylation of alkenes - alkynes.

### **References**

1. B.S.Bahl and ArunBahl, Advanced Organic chemistry.
2. P.L.Soni and H.M. Chawla, Textbook of organic chemistry.
3. Organic chemistry, I.L.Finar, Volume I & II, ELBS.
4. Text Book of Organic chemistry, Tewari.
5. Chemistry of Natural Products, O.P.AgarwalVoll. I&II.
6. Organic Synthesis, Dr. Jagadamba Singh, Dr. L.D.S.Yadav, PragatiPrakashan, New Delhi.
7. Organic reaction mechanism, Jerry March.



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**B.SC., CHEMISTRY PROGRAM**

**Title of the Subject:**Inorganic Chemistry – II  
**Subject Code:**  
**Semester:** V (CORE COURSE-VI)

**Credits:** 5  
**Contact Hours:** 90  
**Marks:** 100

**Course outcome:**

- To understand the basic concept of coordination chemistry
- To study the various theories and reaction mechanism of coordination complexes
- To learn radioactivity of periodic elements and determinations
- To study the nuclear chemistry, isotopes and their separation process

**Unit – I: Basic Concepts of Coordination Chemistry**

Definition-detection of complexes in solution – types of ligands with examples – IUPAC nomenclature of coordination complexes – structural and stereoisomerism – geometrical isomerism in 4 and 6-coordinate complexes – optical isomerism. Stability of complexes – stepwise formation of complexes – relationship between stepwise and overall formation constants - factors affecting the stability of complexes – Irving William's order of stability.

**Unit – II: Theories of Coordination Chemistry**

Theories of coordination complexes – valence bond theory – limitations of valence bond theory – crystal field theory of octahedral (high spin and low spin) and tetrahedral complexes – crystal field stabilization energies (CFSE) – evidence in favor of crystal field stabilization energies - measurement of crystal field splitting factor  $10Dq$  – factors affecting crystal field splitting factor  $10Dq$  – spectrochemical series – magnetic properties of coordination complexes (spin contribution only) – molecular orbital theory (an elementary approach only).

**Unit – III: Reaction Mechanisms in Coordination Chemistry**

A closer look at reaction mechanisms – lability, inertness, stability and instability – kinetic vs thermodynamic stability – substitution in octahedral cobalt (III) complexes – unimolecular and bimolecular ( $S_N1$ ,  $S_N2$  and  $S_N1CB$ ) mechanisms – evidence in favor of  $S_N1CB$  mechanism – redox reactions – outer sphere and inner sphere reactions - substitution in square planar complexes – trans effect – mechanism of trans effect – polarization theory – pi-bonding theory – applications in synthesis.

**Unit – IV: Nuclear Chemistry**

Nuclear forces – packing fraction – binding energy - n/p ratio – nuclear bonding and stability – nuclear shell structure theory – nuclear liquid drop model – magic numbers – isotopic constitution of elements – separation of isotopes – gaseous diffusion, electromagnetic, distillation, electrolytic and chemical exchange methods – whole number rule and packing fraction – atomic masses – deviation of atomic masses from whole number – isobars, isotones and isomers.

**Unit – V: Radioactivity and Nuclear Transformations**

Natural radioactivity – radioactive emanations – disintegration theory – rate of disintegration – half-life period – average life period – modes of decay – group displacement law – detection and measurement of radioactivity – Geiger-Muller counter – radioactive equilibrium – radioactive disintegration series – Geiger-Natta rule – age of earth. Nuclear transformation – artificial transmutation of elements – classification of nuclear reactions – nuclear fission – atomic bomb – nuclear fusion – hydrogen bomb – nuclear reactors – radioactive waste disposal - atomic power projects in India.

**References**

1. Principles of Inorganic Chemistry, B.R.Puri and L.R.Sharma, ShobanLalNagin Chand & Co.
2. Text Book of Inorganic Chemistry, P.L.Soni, Mohan Katyal, Sultan Chand & Sons.
3. Selected Topics in Inorganic Chemistry, Seventh Edition, R.D.Madan, W.U.Malik and G.D.Tuli, S.Chand & Company Ltd.
4. Inorganic Chemistry, Fourth Edition, James E.Huhey, E.A.Keiter, R.L.Keiter, Addison-Wesley Publishing Company.
5. Concise Inorganic Chemistry, Fifth Edition, J.D.Lee, Blackwell Science Ltd.
6. Essentials of Nuclear Chemistry, Fourth Edition, H.J.Arnika, Newage Publishers.
7. Source Book on Atomic Energy, Krieger Pub. Co. 1979.

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**B.SC., CHEMISTRY PROGRAM**

**Title of the Subject: Physical Chemistry – I**

**Credits:5**

**Subject Code:**

**Contact Hours:90**

**Semester: V (CORE COURSE-VII)**

**Marks: 100**

**Course Outcomes:**

- **To study the thermodynamic laws and its significance**
- **To study the physical and chemical equilibrium**
- **To identify the behavior of solutions by studying various laws of solutions**
- **To understand the phase equilibrium of various systems**
- **To study the photochemical reactions and its types**

**Unit – I: Thermochemistry and First Law of Thermodynamics.**

Introduction- enthalpy of reactions - enthalpy at constant volume and pressure - enthalpy of solution - thermochemical laws (Hess law of heat of summation, Kirchhoff's law) - bond energies. Definition of thermodynamic terms - zeroth law of thermodynamics - first law of thermodynamics – concept of heat, work, internal energy and enthalpy – heat capacity - relation between  $C_p$  and  $C_v$  – reversible isothermal and adiabatic expansion of an ideal gas – reversible isothermal expansion of a real gas – Joule-Thomson effect.

**Unit – II: Ionic and Chemical Equilibria.**

Ionic equilibria: Introduction to ionic equilibria - concepts of  $K_a$ ,  $K_b$ ,  $pK_a$ ,  $pK_b$  – Ionic product of water – pH – common ion effect – buffer solutions, buffer index, buffer mixture of a weak acid and its salt, buffer mixture of a weak base and its salt- calculation of pH of buffer mixtures – Hydrolysis of salts (Salts of SA & SB, WA & SB, SA & WB and WA & WB) – Acid –base indicators – Theory of acid-base indicators – solubility product – applications.

Chemical equilibria: Introduction to chemical equilibria- Law of mass action – Thermodynamic treatment of law of mass action (Vant Hoff reaction isotherm) –Relation between  $k_p$ ,  $k_c$  and  $k_x$ – study of heterogenous equilibria – Lechatlier's principle and its applications to chemical and physical equilibrium.

**Unit – III: Solutions.**

Introduction to solutions – types of solutions – concentration of solution – methods for expressing concentration – molality, molarity, mole fraction, normality, mass fraction, parts per million.

Ideal solutions: Raoult's law – vapour pressures of ideal solutions – completely miscible liquid systems – benzene and toluene.

Non-ideal solutions: Vapour pressures of non-ideal solutions – Theory of fractional distillation – Azeotropes – HCl-water system – solutions of gases in liquids – Henry's law – activity and activity coefficient – Duhem-margules equation.

Dilute solutions – colligative properties (Derivation not needed) – Determination of molecular masses using colligative properties – Abnormal molecular masses – Vant Hoff factor.

**Unit – IV: Phase Equilibrium.**

Definition of phase rule- equilibrium between phases - thermodynamic derivation of phase rule – one component systems – water and sulphur system – two component systems –lead-silver system - zinc and magnesium system – sodium and potassium system –  $FeCl_3$  and water system - freezing mixtures - liquid-liquid-equilibrium – partially miscible and immiscible liquid systems– CST –steam distillation – distribution law and its thermodynamic derivation – applications.

**Unit – V: Photochemistry.**

Introduction to photochemistry – Photochemical reactions – primary and secondary reactions – quantum yield – high and low quantum yield reactions – Determination of quantum yield – uranyl oxalate actinometer- consequences of light absorption – The Jablonski diagram – Fluorescence, phosphorescence, Luminescence, chemiluminescence – Biochemiluminescence – Photosensitization reactions – kinetics of photochemical reaction such as formation of HCl, HBr and decomposition of HI – Anthracene reaction.

**References**

1. Puri, Sharma, Pathania, Principles of Physical Chemistry, Vishal Publishing Cogear.
2. P.L.Soni & Dharmarha, Text book of Physical Chemistry, S.Chand & Co.
3. Gurtu & Snehi, Physical Chemistry.
4. Gurdeep Raj, Advanced Physical Chemistry, Goel Publishing House.
5. Glasstone & Lewis, Elementary Physical Chemistry, Macmillan.

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**Title of the Subject: Physical Chemistry Practical**  
**Subject Code:**  
**Semester: V (CORE PRACTICAL -III)**

**Credits: 4**  
**Contact Hours: 90**  
**Marks: 100**

**Course outcome:**

- To understand the concept of kinetics of catalyzed reaction
- To get knowledge about to determination of molecular weight
- To know the determination of the strength of acid by electrical methods

**I. Kinetics:**

Acid catalysed hydrolysis of an ester (Methyl acetate or Ethyl acetate)

**II. Molecular weight determination:**

Rast's method: Naphthalene, m-dinitrobenzene and diphenyl as solvents.

**III. Heterogeneous equilibrium**

1. Critical solution temperature of phenol-water system- effect of impurity on C.S.T. (2% NaCl or 2 % succinic acid solutions).
2. Simple eutectic system: Naphthalene – Biphenyl, NaphthaleneDiphernylamine.
3. Determination of transition temperature: Sodium acetate..H<sub>2</sub>O, Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.5H<sub>2</sub>O, SrCl<sub>2</sub>.6H<sub>2</sub>O&MnCl<sub>2</sub>.4H<sub>2</sub>O.

**IV. Electrochemistry**

1. Conductometric titrations by Strong acid by strong base
2. Conductometric titrations by Weak acid by strong base

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**Title of the Subject: PHYSICAL METHODS IN CHEMISTRY**

**Credits: 5**

**Subject Code:**

**Contact Hours: 90**

**Semester: V (Major Elective Course - I)**

**Marks: 100**

**Course Outcomes:**

- **To make students to evaluate the analytical data**
- **To study about the significance of thermal and electro analytical techniques**
- **To inculcate the separation methods through chromatographic techniques**
- **To understand the basic concepts in molecular spectroscopy**
- **To make awareness about the basic laboratory techniques**

**Unit I: Evaluation of Analytical Data**

Definition of Terms – Mean Median, Precision, accuracy - Errors in chemical analysis, determinate and random errors - Average deviation and standard deviation, variance and confidence limit- Least square method. Students test and F test, Q test, significant figures and computation rules - least square analysis.

**Unit II: Thermal & Electro Analytical Methods**

Principle and applications of thermogravimetry analysis [TGA], differential thermal analysis [DTA], differential scanning calorimetric [DCS]. Principle, instrumentation and applications of conductometric titrations, potentiometric titrations, coulometric titrations. Measurement of pH - glass electrode.

**Unit III: Chromatographic Separation Methods**

General principle, classification of chromatographic methods. Paper chromatography - ideal separation – retention parameters. Thin layer chromatography: preparative TLC. Preparation of the column - solvents used and methods of detection column chromatography - Column efficiency and resolution - Solvent systems and detection methods.

**Unit IV: Molecular Spectroscopy**

Introduction to EMR - interaction of EMR with matter - photo electric effect - measurement of transmittance and absorbance – beer's and lambert's law - principles of UV, visible, IR and Raman spectroscopy – instrumentation and applications.

**Unit V: Fundamental Laboratory Techniques**

Basic principles, Health and safety - safety equipments, personal protective equipments, compressed gas safety, safety practices for disposal of broken glass wares, centrifuge safety, treated biomedical wastes and scientific ethics, working with liquids, Basic laboratory procedures I & II.

**Reference**

1. Vogel, Text Book of Quantitative Inorganic Analysis, 1990
2. Instrumental methods of chemical analysis by Chatwal. K, Anand, 5th edition.
3. Instrumental Methods of Chemical Analysis – B. K. Sharma - 9th Edition.

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**Title of the Subject: FOOD CHEMISTRY**  
**Subject Code:**  
**Semester: V (Skill Based Elective Course-II)**  
**Course Outcomes:**

**Credits:2**  
**Contact Hours:**  
**Marks: 100**

- ❖ To know the importance of nutritional foods.
- ❖ To study the impact of food Adulteration.

**Unit I: Nutritional Classification**

Food groups and nutritive values of foods – Nutritional classification of foods – cereals, nuts and oil seeds, vegetables, fruits, eggs, meat, fish and other animal foods – planning of balanced diet – recommended dietary allowances (RDA) – calories, proteins, fat, calcium, phosphorous, iron, vitamin A, folic acid, vitamin B<sub>12</sub>, vitamin D – Deficiency diseases – anemia caused by dietary deficiencies.

**Unit II: Nutritive Values**

Fluid and electrolyte balance – sources of water for the body – mineral elements – trace elements – role of kidney – regulation of fluid and electrolyte balance- heat processing on the nutritive value of foods. Food spoilage and food preservation – microbial food spoilage – preservation and nutritive value – food poisoning – food hygiene. Food additives – classification – risks and benefits of food additives.

**Unit III: Therapeutic Nutrition – I**

Therapeutic nutrition and diets – needs for modification of diets in different diseases nutrition for children and teenagers – nutrition in later maturity – peptic ulcer, diarrhea, constipation, jaundice, cardiovascular diseases, diabetes mellitus, rheumatoid arthritis, fevers and diets in surgery and injury. Nutrition during pregnancy and lactation, infancy.

**Unit IV: Therapeutic Nutrition – II**

Obesity definition – occurrence, complication due to obesity. Diet and dental health. Under nutrition – causes, signs of under nutrition, nutritional requirements. Milk and milk products – common dairy processes, market milk, Pasteurization, dairy products (cheese, ice cream, condensed milk, butter milk).

**Unit V: Food Adulteration**

Food adulteration and detection – definition of adulterated food – food standards – common food adulterants – contamination of food with harmful micro organisms – chemical contaminants – detection of adulterants in milk, honey, chili powder, edible oils, ghee. Beverages – coffee, tea, cocoa, carbonated non-alcoholic beverages. Fermented foods and its therapeutic values.

**References**

1. Fundamentals of Nutrition, Corinne H. Robinson, Macmillan Publishing Co., Inc.
2. Milk and Milk Products, Clarence Henry Eckles, Willes Barnes combs, Harold Macy, Tata McGraw-Hill Publishing Co. Ltd.
3. Food Science and Experimental Foods, M.Swaminathan, Ganesh & Co.
4. Food Science – A Chemical Approach, Brain A Fox, Allen G Cameron, Holders and Stoughton.
5. Food and Nutrition Vols 1&2, M.Swaminathan, BAPCO.

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**B.Sc., CHEMISTRY PROGRAM**

**Title of the Subject: CHEMISTRY IN EVERYDAY LIFE**

**Credits:2**

**Subject Code:**

**Contact Hours:**

**Semester: V (Skill Based Elective Course-III)**

**Marks: 100**

**Course Outcomes:**

- ❖ To learn the Textile chemistry other materials.
- ❖ Such as soaps, detergent, cosmetics & polymers dyes.

**Unit – I: Textile Fiber**

Definition, Classification of textile fibers – vegetable fibers, animal fibers, properties, uses and features of cotton, wool, silk and jute fibers. Genetically modified cotton: Its merit and demerits. Viscose fiber, chemical structure, production of viscose fiber, properties and uses.

**Unit – II: Soaps**

Introduction, cleaning action of soap. Toilet soap, bathing bars, washing soaps, liquid soap manufacture – Batch process, cold process, hot process – semi boiled process, boiled process. Additives, fillers and flavors. Significances of acidity and alkalinity.

**Unit – III: Detergents**

Introduction, Detergent action, types of detergents – cationic, anionic, amphiphilic detergents. Common detergent chemicals. Additives, excipients colors and flavors . Enzymes used in commercial detergents. Environmental Hazards.

**Unit – IV: Cosmetics**

Introduction, classification – bathing oils. Face creams, Face powder, skin products, dental cosmetics, hair dyes, shaving cream, shampoo. General formation for each types. Toxicology of cosmetics.

**Unit – V: Material Chemistry**

Lubricants- Definition, classification, properties application of each type – synthetic lubricants. Adhesive- Definition, adhesive action- important adhesives- epoxy resin (Araldite)  
Dyes and Dyeing process: Difference between dye and pigment -Witt's colour theory, classification of dyes based on application (Direct, Vat, Acid, Reactive, Mordant and Disperse). Important food dyes.

**References**

1. T.P. Coultate, Food – The Chemistry of its components. Royal Society of Chemistry London.
2. Shashi Chowls, Engineering Chemistry, Darpat Rai Publication, Meerut, India.
3. B.K. Sharma, Industrial Chemistry, Goel Publications, Meerut, India.
4. CNR Rao, Understanding Chemistry, Universities Press. Hyderabad, India.
5. Engineering Chemistry by Jain & Jain.

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**B.SC., CHEMISTRY PROGRAM**

**Title of the Subject: Physical Chemistry – II**

**Credits: 6**

**Subject Code:**

**Contact Hours: 90**

**Semester: VI (CORE COURSE-VIII)**

**Marks: 100**

**Course Outcomes:**

- **To study the thermodynamic laws and its significance**
- **To know the basics of quantum mechanics and quantum theory**
- **To know the kinetics of unimolecular and bimolecular reactions theories**
- **To understand the basics of electrochemistry and its significance to various electrochemical reactions**
- **To study the concepts of surface chemistry and various isotherm relations**

**Unit – I: Second and third law of thermodynamics**

Second law of thermodynamics – limitations of first law and need for second law –Carnot cycle – efficiency of a heat engine – Carnot theorem – concept of entropy – entropy changes in isothermal expansion of an ideal gas –Maxwell relationships –Gibbs–Helmholtz equation –concept of chemical potential – Gibbs - Duhem equation – ClausiusClapeyron equation –Concept of fugacity and concept of activity and activity coefficient. Third law of thermodynamics –statement of third law – concept of residual entropy –absolute entropies.

**Unit – II: Basics of Quantum mechanics and Group Theory**

**Quantum mechanics:** Introduction to quantum mechanics –photoelectric effect – Compton effect – de-broglie equation (Davission – Germer experiment) – Heisenberg's uncertainty principle – Schrodinger wave equation(Introduction) – postulates – physical significance of  $\psi$ ,  $\psi^2$ .

Group theory: Elements of symmetry of molecules – identity – proper axis of rotation - reflection plane - inversion center - improper axis of rotation – groups – point groups – point groups of simple molecules such as  $\text{NH}_3$ ,  $\text{H}_2\text{O}$ ,  $\text{CH}_4$ ,  $\text{H}_2\text{O}_2$ ,  $\text{BF}_3$  and  $\text{PCl}_3$ .

**Unit – III: Chemical Kinetics**

Rate of reaction, rate laws, rate constant, order and molecularity of reactions – Derivation of first, second and zero order reactions – Experimental methods of determining reaction rates – Experimental methods of determining the order of reactions – (Integration, graphical, half-life, differential rate expression and oswald's isolation methods)- Influence of temperature on reaction rates – Arrhenius equation – determination and significance of arrhenius parameters.

Theories of reaction rates – simple collision bimolecular theory – collision theory of unimolecular reactions – Lindemann Theory – ARRT (elementary treatment and its advantages) – Steady State approximations.

**Unit – IV: Electrochemistry**

Faraday's laws – specific, molar and equivalent conductance – Arrhenius theory of electrolytic dissociation – Ostwald's dilution law - Kohlrausch's law - Transport number and its determination by Hittorf and moving boundary methods – applications of conductance measurements — conductometric titrations — ionic strength – Debye-Huckel limiting law – equations only. Electrochemical cells - galvanic cells – types of reversible electrodes – reference electrodes – standard hydrogen electrode - calomel electrode – standard electrode potential – electrochemical series – Nernst equation - application of Gibbs-Helmholtz equation to galvanic cells- liquid junction potential -Application of emf – determination of transport number, determination of solubility product.

**Unit – V: Surface chemistry**

Adsorption on surfaces – Adsorption, absorption, desorption, sorption, occlusion – Differences between adsorption and absorption – characteristics of adsorption – mechanism of adsorption – adsorption of gases on solids – affecting factors, types – physical adsorption, chemical adsorption, differences between physical adsorption and chemical adsorption – Types of adsorption curves – adsorption isotherm, adsorption isobar, adsorption isotere – types of adsorption isotherms – derivation of Langmuir adsorption isotherm – adsorption of solutes from solutions – derivation of freundlich adsorption isotherm – applications of adsorption.

**References**

1. Puri, Sharma, Pathania, Principles of Physical Chemistry, Vishal Publishing Cogear.
2. P.L.Soni&Dharmarha, Text book of Physical Chemistry, S.Chand& Co.
3. Gurtu&Snehi, Physical Chemistry.
4. Gurdeep Raj, Advanced Physical Chemistry, Goel Publishing House.
5. Glasstone& Lewis, Elementary Physical Chemistry, Macmillan.
6. Essentials of physical chemistry - ArunBahl& B.S. Bahl, G.D. Tuli
7. Surface Chemistry (adsorption) – Gurdeep Raj

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**B.SC., CHEMISTRY PROGRAM**

**Title of the Subject: Inorganic Chemistry - III**  
**Subject Code:**  
**Semester: VI (CORE COURSE-IX)**

**Credits: 6**  
**Contact Hours: 90**  
**Marks: 100**

**Course outcome:**

- To acquire knowledge about boron cage compounds and to the chemistry of boranes
- To study the various inorganic polymer and their applications
- To understand the concept of organometallic chemistry and their compounds
- To study role of elements in biological system
- To develop the knowledge of chemistry to industrial applications

**Unit – I: Boron Cage Compounds and Metal Clusters**

Hydrides of boron – preparation and properties of boranes – structure and bonding in diborane  $B_2H_6$  – borohydride anions – types, structure and bonding in higher boranes – closo, nido, and arachno nomenclature – carboranes – structure of carboranes. Metal clusters – occurrence of metal-metal bonds – binuclear compounds – structure and bonding in octachlorodirhenate (III) ion – elementary aspects of tri nuclear and tetra nuclear clusters.

**Unit –II: Inorganic Polymers**

Introduction to inorganic polymers-catenation – hetero catenation – preparation, properties, structure and uses of borazines – silicones – polymeric sulfur nitride – phosphonitrile compounds - phosphazenes. Silicates – classification of silicates – examples and structure of one, two and three dimensional silicates – beryls – asbestos – talc - mica – feldspar – zeolites and ultramarines.

**Unit –III: Organometallic Chemistry**

Nomenclature and classification of organometallic compounds – preparation- properties-bonding and applications of organometallic compounds with Mg, Zn, Li, Cu, B & P – anion of Zeiss's salt – structure and bonding in ferrocene - Metal carbonyls – preparation and properties of mononuclear carbonyls – EAN rule – 18-electron rule – structure and bonding in carbonyls – metal nitrosyls – classification – preparation, properties and bonding in metal nitrosyls.

**Unit – IV: Bio-Inorganic Chemistry**

Essential and trace elements in biological process – biological role of alkali and alkaline earth metal ions - nitrogen fixation – metallophorphyrines – properties and structure of haemoglobin – myoglobin – vitamin  $B_{12}$  – chlorophyll – ferridoxin and cytochrome-c (elementary treatment only)– toxicity of nickel, lead, zinc, cadmium and mercury.

**Unit – V: Industrial Chemistry**

Gaseous fuels –Industrial gases - LPG – manufacture and industrial uses of  $H_2$ ,  $O_2$ , acetylene,  $N_2$  and dry ice. Fossil fuels – varieties of coal – petroleum refineries in India – petroleum – petrol –diesel – kerosene - petrochemicals – manufacture of petrochemicals from methane –bio diesel - manufacture and industrial uses of heavy water, sulphuric acid, nitric acid, ammonia and urea.

**References**

1. Inorganic Chemistry, Fourth Edition, James E.HuheyE.A.Keiter, R.L.Keiter, Addison-Wesley Publishing Company.
2. Principles of Inorganic Chemistry, B.R.Puri and L.R.Sharma, ShobanLalNagin Chand & Co.
3. Text Book of Inorganic Chemistry, P.L.Soni, Mohan Katyal, Sultan Chand & Sons.
4. Selected Topics in Inorganic Chemistry, Seventh Editionn,R.D.Madan, W.U.Malik and G.D.Tuli, S.Chand& Company Ltd.
5. Concise Inorganic Chemistry, Fifth Edition, J.D.Lee, Blackwell Science Ltd.
6. Principles of biochemistry, Albert L. Lehninger, David L. Nelson, Michael M. Cox, Worth Publishers.
7. Industrial Chemistry, B.KSharma, Goel Publishing House, Meerut.



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**B.SC., CHEMISTRY PROGRAM**

**Title of the Subject: Organic Chemistry and Gravimetric Practical**  
**Subject Code:**  
**Semester: VI (CORE PRACTICAL -IV)**

**Credits: 5**  
**Contact Hours: 90**  
**Marks: 100**

**Course outcome:**

- To know the accuracy of estimation of compounds
- To check the purity of organic compound experimentally
- To understand the mechanism and procedure to prepare simple organic compound
- To get knowledge about the characteristic of organic compound

**I. Gravimetric Analysis**

1. Estimation of Lead as Lead sulphate
2. Estimation of Lead as Lead Chromate
3. Estimation of Barium as Barium sulphate
4. Estimation of Barium as Barium chromate
5. Estimation of Nickel as Nickel-DMG
6. Estimation of Calcium as Calcium sulphate

**II. Determination of boiling point of an organic compound**

**III. Preparation of organic compound simple reaction methods**

1. Hydrolysis
2. Benzoylation
3. Nitration
4. Bromination
5. Oxidation
6. Osazone formation

**IV. Study of characteristic of organic compound by qualitative analytical method**

1. Carboxylic Acid
2. Aldehyde
3. Ketone
4. Ester
5. Phenol
6. Carbohydrate
7. Amide
8. Amine

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**B.SC., CHEMISTRY PROGRAM**

**Title of the Subject: Selected topics in Organic Chemistry**

**Credits: 5**

**Subject Code:**

**Contact Hours: 90**

**Semester: VI (Major Elective Course – II)**

**Marks: 100**

**Program Purpose**

The purpose of this program is to provide the key knowledge base and laboratory resources to prepare students for careers as professionals in the field of chemistry, biological chemistry and related fields.

**Learning Outcomes**

Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in analytical Organic and Physical Chemistries.

Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.

**Unit – I: Natural Products**

Terpenes – isolation-classification – isoprene rule – structure and synthesis of geraniol, nerol and menthol. Alkaloids - general methods of isolation and general methods of structural determination – structure and synthesis of piperine and nicotine. Vitamins and Hormones - chemical constitution and biological importance of vitamins A<sub>1</sub>, B<sub>1</sub> and C - structural elucidation of Vitamin C - chemical constitution of thyroxine and estrone.

**Unit- II: Organic photochemistry and Pericyclic reaction**

Introduction – singlet and triplet states – laws of photochemistry - Grothuss-Draper law - Stark-Einstein law - Jablonski diagram – fluorescence and phosphorescence – photosensitization – photochemical reactions of carbonyl compounds and olefins - Norrish type-I and type-II reactions - pericyclic reaction – introduction to electrocyclic reactions – a brief outline of Woodward Hoffman rules.

**Unit – III: Stereo Chemistry**

Elements of symmetry and conditions for optical activity – asymmetric center – chirality – achiral molecule – meaning of (+) and (-) - D and L notations – racemization, resolution, Walden inversion – asymmetric synthesis - Projection formulae – Fischer, flying wedge, sawhorse and Newman projection formulae – Cahn-Ingold-Prelog rules – R and S notations of optical isomers with one asymmetric carbon – erythro and threo representations - optical activity in biphenyls, allenes and spiranes. Geometrical isomerism – cis-trans, syn-anti, E-Z notations – maleic and fumaric acid - ketoximes – methods of distinguishing geometrical isomers (Dipole moment, dehydration, Cyclization) – method determining the configuration of geometrical isomers.

**Unit – IV: Organic Spectroscopy**

Ultraviolet (UV) - visible spectroscopy- Principle - types of electronic transitions in organic molecules - effect of conjugation. Infrared (IR) spectroscopy - molecular vibrations - measurement of IR spectrum- functional group region - fingerprint region - characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds. Nuclear magnetic resonance (NMR) spectroscopy - proton magnetic resonance (<sup>1</sup>H NMR) spectroscopy - chemical shift - spin-spin splitting and coupling constants - interpretation of NMR spectra of simple organic molecules such as ethyl alcohol - benzyl alcohol – benzene - isopropyl benzene. Mass Spectrometry - basic principles – molecular ion - fragment ions - mass spectra of methyl alcohol.

**Unit – V: Organic Polymers**

Polymers – degree of polymerization – nomenclature – tacticity – functionality – types of polymerization – addition, condensation and co-polymerization – mechanisms of addition polymerization – free radical, ionic and Ziegler-Natta polymerization. Plastics – classification – thermo plastics – cellulose derivatives, poly amides -

thermosetting – bakelite, polyester and epoxy resins. Rubber – natural rubber – vulcanization – synthetic rubber – styrene rubber and nitrile rubber.

### **References**

1. B.S.Bahl and ArunBahl, Advanced Organic chemistry.
2. P.L.Soni and H.M. Chawla, Textbook of organic chemistry.
3. P.S.Kalsi, Stereochemistry, Conformation and Mechanism.
4. Organic chemistry, I.L.Finar, Volume I & II, ELBS.
5. Text Book of Organic chemistry, Tewari.
6. Chemistry of Natural Products, O.P.AgarwalVoll. I & II.
7. Organic Synthesis, Dr. Jagadamba Singh, Dr. L.D.S.Yadav, PragatiPrakashan, New Delhi.
8. Organic spectroscopy, Y.R.Sharma.
9. Organic spectroscopy, William Kemp.

**GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM**  
**DEPARTMENT OF CHEMISTRY**  
**SYLLABUS FOR THE STUDENTS ADMITTED FROM 2020 – 2021**  
**B.Sc., CHEMISTRY PROGRAM**

**Title of the Subject: PHARMACEUTICAL CHEMISTRY**

**Credits: 5**

**Subject Code:**

**Contact Hours: 90**

**Semester: VI (Major Elective Course - III)**

**Marks: 100**

**COURSE OUTCOMES:**

- ❖ To study the principles & functioning of drug.
- ❖ To know the importance of antibiotics.
- ❖ To study the impact of clinical chemistry.

**Unit I: Important Terminologies**

Introduction - important terminologies used and their meaning – anti-metabolites, chemotherapy - mechanism of action of drugs and metabolism - absorption of drugs – routes of administration. Causes of some common diseases and their treatment: malaria, diphtheria, common cold, tuberculosis, cholera, typhoid, jaundice, and leprosy. Important inorganic compounds of Al, and Fe – their therapeutic uses - biological role of Na, K and Ca, I and Zn – deficiency and sources.

**Unit II: Antibiotics, Anti-cancer and anti-neoplastic Drugs**

Antibiotics –SAR and therapeutic uses of chloramphenicol, penicillin, streptomycin, erythromycin. Sulpha drugs - mechanism of action of sulpha drugs – preparation and uses of sulphanilamide, sulphadiazine, sulphapyridine and prontosil. Anti-cancer and anti-neoplastic drugs - tumor – types – causes of cancer – spread of cancer – treatment – structure and uses of anti-neoplastic drugs – chlorambucil, melphalan, and methotrexate.

**Unit III: Analgesics, Antiseptics and Anesthetics**

Analgesics, antipyretics and anti-inflammatory agents - definition – types – morphine and its analgesic action – SAR – preparation, structure and uses of aspirin, paracetamol, and brufen. Antiseptics and disinfectants - use of phenols, chlorinated phenols, and halogen compounds. Anesthetics – intravenous anesthetics - local anesthetics - preparation, structure and uses of ethers, cyclopropane, chloroform, thiopental sodium and methohexitone. - Structure and uses of cocaine and benzocaine.

**Unit IV: Alkaloids, Anti-psychotic drugs**

Alkaloids - sources, isolation and purification of alkaloids - color reactions and detection – quinoline and morphine – sources, extraction, structure, uses and SAR. Anti-psychotic drugs; chloromarine – structure, therapeutic uses and adverse effects - AIDS - sources of infection HIV virus – general symptoms – prevention and treatment. Organic pharmaceutical aids: role as preservatives - anti-oxidants, coloring, flavoring, sweetening and emulsifying agents – ointments bases.

**Unit V: Clinical Chemistry**

Clinical chemistry - determination of sugar in serum-o-toluidine method - diagnostic test for sugar in urine - benedict's test - detection of diabetes - tolerance test - test for salts in serum and urine - determination of serum cholesterol - socket's method - estimation of hemoglobin. Hypoglycemic drugs - diabetes – types – control of diabetes – insulin and sulphonyl urea. Indian medicinal plants: medicinal values of adadoda, tulsi, neem, tuduvalai, kizhanelli, arugampillu.

**References**

1. Pharmacology and Pharmacotherapeutics, Vol I & II, R.S.Satoskar and S.D.Bhandarkar, Popular Prakashan, Bombay, 1980.
2. Pharmaceutical Chemistry, S. Lakshmi, Sultan Chand & Co., New Delhi.
3. A Textbook of Pharmaceutical Chemistry, Jayashree Ghosh, S.Chand & Co Ltd., New Delhi.