



# SAIVA BHANU KSHATRIYA COLLEGE

(Aruppukottai Nadargal Uravinmurai Pothu Abiviruthi Trustukku Pathiyapattathu)

(Affiliated to Madurai Kamaraj university)

(Re-accredited with B+ Grade (3rd Cycle) by NAAC)

ARUPPUKOTTAI - 626 101

VIRUDHUNAGAR DISTRICT, TAMIL NADU

DEPARTMENT OF CHEMISTRY

## SYLLABUS

### B.Sc., Chemistry

Year: First Year

Semester: V

#### CORE SUBJECT PAPERS

Core Subject	Semester	Subject / Title of the Paper
CS1	I	General Chemistry
CS2	II	Organic Chemistry I
CS3	III	Physical Chemistry I
CS4	IV	Inorganic Chemistry
CS5	V	Organic Chemistry II
CS6	V	Physical Chemistry II
CS7	V	Inorganic, Analytical and Applications of Computers in Chemistry
CS8	VI	Organic Chemistry III
CS9	VI	Physical Chemistry III
CS10	VI	Applied Chemistry

Semester	Part	Course	Title	Hours/Week	Credits
V	III	Core Course-V	Organic Chemistry-II	4	4
		Core Course-VI	Physical Chemistry-II	4	4
		Core Course-VII	Inorganic, Analytical & application of computers in Chemistry	4	4
		Core practical-III	Organic preparation & gravimetric Estimation	3	
		Core practical-IV	Organic analysis & Estimation	3	
		Core practical-V	Physical Chemistry	2	
		Allied course – II*		6	4
	IV	Skill Based-V	Nanotechnology and Green Chemistry	2	2
		Environmental studies	Environmental studies	2	2
<b>Total</b>				<b>30</b>	<b>20</b>



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## DEPARTMENT OF CHEMISTRY

V SEMESTER

CORE PAPER –V

ORGANIC CHEMISTRY II

Credits –4

Max. Marks 100

Hours/Week: 4

Ext: 75 + Int: 25

### OBJECTIVES

1. To study the preparation and reactions of hydroxyl compounds
2. To learn the chemistry of ethers, aldehydes and ketones
3. To understand the chemistry of carboxylic acids
4. To know the properties and structure of carbohydrates
5. To learn about nitrogen containing compounds.

### UNIT I: HYDROXY COMPOUNDS

- a. Alcohols: Preparation of alcohols from Grignard reagent, by reduction of carbonyl compounds, by ester hydrolysis, and by hydroboration - Reactions: with metals, HX, dehydration, oxidation reactions.
- b. Phenols: Classification and nomenclature, Preparation: From sulphonic acids and Diazonium salts. Reactions: Acidity, effect of substituents on the acidity of phenol - Reimer-Tiemann reaction, Electrophilic Substitution reactions: Nitration, halogenation, sulphonation - Hoesch reaction, Kolbe reaction, Schotten-Baumann reaction.
- c. Preparation and properties of Naphthols and alizarin

### UNIT II: ETHERS, ALDHYDES AND KETONES

- a. Aliphatic and aromatic ethers: Preparation by Williamson's synthesis (mechanism), Reactions: cleavage by acids.
- b. Aliphatic and aromatic aldehydes and ketones: Preparation from acid chloride and nitrile, Reactions: with HCN, ROH, and Iodoform test
- c. Mechanism of Cannizzaro, Perkins, Claisen, Benzoin condensation, Knoevengal MPV reduction.
- d. Preparation and uses of Cinnamaldehyde and Vanillin.
- e. Keto-enol tautomerism (Acid and base catalyzed mechanism)

### UNIT III: CARBOXYLIC ACIDS

- a. Carboxylic acids (aliphatic and aromatic): Preparation: from carbonyl compounds, hydroxyl compound and cyanide. Reactions: decarboxylation, substitution in alkyl group of aliphatic and aromatic acids.
- b. Effect of substitution on acidity of aromatic acids
- c. Preparation of oxalic, malonic, succinic, glutaric, adipic and phthalic acids.
- d. Preparation of cinnamic acid, coumarin, salicylic acid, anthranilic acid and mandelic acid.



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### UNIT IV: DERIVATIVES OF ACIDS AND CARBOHYDRATES

- Preparation of acid chloride, anhydride, ester and amides from acids. Reactions: Acidic and alkaline hydrolysis of ester (mechanism) and trans esterification
- Carbohydrates: Classification, Glucose and Fructose (open chain and cyclic Structure), ascending and descending in monosaccharide, Muto Rotation, Structure of disaccharides- sucrose and maltose - Polysaccharides - starch and cellulose (structure only).

### UNIT V: NITROGEN CONTAINING ORGANIC COMPOUNDS

- Aliphatic and aromatic Nitro compounds: Preparation by nitration, Reactions: reduction by chemical and electrolytic methods.
- Synthesis o-, m-, and p- dinitro benzenes and trinitro benzenes
- Amines (aliphatic and aromatic): Preparation from alkyl halides, Preparation of primary, secondary and tertiary amines, Preparation of aniline and benzylamine, Reactions: effects of substituents on the basic character of amines, reactions in aniline and benzylamine
- Preparation and synthetic applications of benzene diazonium chloride
- Preparation and properties of naphthylamines.

### TEXT BOOKS

- A. Bahl and B.S. Bahl, Advanced Organic Chemistry, 1<sup>st</sup> Multicolour Edition, S. Chand & Company, New Delhi, 2010.
- S.C. Sharma and M.K. Jain, Modern Organic Chemistry, Vishal Publishing Company, New Delhi, 2014.
- K.S. Tewari, N.K. Vishnoi and S.N. Mehrotra, A Textbook of Organic Chemistry, 2<sup>nd</sup> Edition, Vikas Publishing House (Pvt.) Ltd., New Delhi, 2004.

### REFERENCE BOOKS

- Jerry March, Advanced Organic Chemistry, 5<sup>th</sup> Edition, John Wiley and Sons, New York, 2004
- I.L. Finar, Organic Chemistry Vol. I, 6<sup>th</sup> Edition, Pearson Education, New Delhi, 2014.
- R.T. Morrison, R.N. Boyd, Organic Chemistry, 7<sup>th</sup> Edition, Pearson Education, New Delhi, 2013



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## DEPARTMENT OF CHEMISTRY

### CORE PAPER –VI

### PHYSICAL CHEMISTRY II

Credits –4

Max. Marks 100

Hours/Week: 4

Ext: 75 + Int: 25

#### OBJECTIVES

1. To learn the first law of thermodynamics and its applications
2. To understand second law of thermodynamics, entropy and free energy
3. To know the concept of thermodynamic equilibria
4. To understand phase rule and its applications to various systems
5. To learn the fundamentals of group theory and its applications

#### UNIT I: FIRST LAW OF THERMODYNAMICS AND ITS APPLICATIONS

- a. System-surrounding-Intensive and extensive variables; state and path functions; isolated, closed and open systems-zeroth law of thermodynamics
- b. First law of thermodynamics-mathematical form- Heat capacity, relation between  $C_P$  and  $C_V$ . Isothermal process: Change in internal energy, work done,  $W(\text{rev})$  and  $W(\text{irrev})$ . Adiabatic process: work done, and entropy changes. - Application of the laws of thermodynamics to real (van der Waals) gases: Isothermal process- Work done, change in internal energy, heat absorbed. Adiabatic process: Work done
- c. Joule- Thomson effect-derivation of Joule- Thomson coefficient for ideal gases and real gases, inversion temperatures.
- d. Variation of enthalpy change of reaction with temperature (Kirchoff's equation). – Hess's law of constant heat of summation- Bond energy and heat of reaction

#### UNIT II: SECOND LAW OF THERMODYNAMICS AND ITS APPLICATIONS

- a. Second law of thermodynamics: Limitations of first law and the need for the second law. Formulation of the second law of thermodynamics on the basis of Carnot cycle-various statements of the second law of thermodynamics- Carnot theorem-Thermodynamic principle of the working of refrigerator
- b. Concept of entropy- entropy changes for physical transformations- entropy and probability.
- c. Free Energy Functions: Gibbs and Helmholtz energy; variation of  $S$ ,  $G$  and  $A$  with  $T$ ,  $V$  and  $P$  - Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state. Criteria of spontaneity. Changes in  $S$ ,  $G$  and  $A$  as criteria for spontaneous process
- d. Partial molar properties- Chemical potential-variation of chemical potential with temperature and pressure-Gibbs –Duhem equation

#### UNIT III: THERMODYNAMICS OF EQUILIBRIUM PROCESSES

- a. Law of mass action. Various forms of equilibrium constants. Relationships between  $K_P$  and  $K_C$ ; Vant Hoff isotherm. Vant Hoff isochore. Le-Chatelier-Braun principle:



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Formation of ammonia.

- b. *Third Law*: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.- Nernst heat theorem
- c. Colligative properties- relative lowering of vapour pressure-Raoult's law-thermodynamic derivation of relationship between relative lowering of vapour pressure and (i)osmotic pressure, (ii)elevation of boiling point,(iii) depression in freezing point – Abnormal behavior of solutions of electrolytes

### UNIT IV: PHASE EQUILIBRIA

- a. Phase Rule: Concepts of phase, component and degrees of freedom, with examples. Gibb's phase rule – derivation.
- b. One-component system: Phase diagrams: Water and sulphur systems.
- c. Two component system: (i) Simple eutectic: Lead-silver system- Formation of compound with congruent melting point: Ferric chloride – water system.
- d. Clapeyron and Clausius-Clapeyron equations and their applications to equilibria in phase transitions. (solid – liquid, liquid – vapour, solid – vapour)

### UNIT V: GROUP THEORY

- a. Symmetry and importance of symmetry aspects -Symmetry elements and various associated symmetry operations-Definitions and examples
- b. Mathematical group – properties of a group – construction of group multiplication table (GMT) for H<sub>2</sub>O and NH<sub>3</sub> – Abelian and non -Abelian groups-point groups-
- c. C<sub>nv</sub>, C<sub>nh</sub> and D<sub>nh</sub>- symmetry present with examples – matrix representation of symmetry operations E, C<sub>n</sub>,  $\sigma$ , S<sub>n</sub> and i.

### TEXT BOOKS

1. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 46<sup>th</sup> Edition, Vishal Publishing Company, New Delhi, 2013.
2. P.L. Soni, O.P. Dharmarha and U.N. Dash, Textbook of Physical Chemistry, 23<sup>rd</sup> Edition, Sultan Chand & Sons, New Delhi, 2011.
3. J. Rajaram and J.C. Kuriacose, Chemical Thermodynamics, Pearson Education, New Delhi, 2013.
4. Gurdeep Raj, Advanced Physical Chemistry, 35<sup>th</sup> Edition, Goel Publishing House, Meerut, 2009.
5. S. Swarnalakshmi, T. Saroja, R. M. Ezhilarasi, A simple Approach to Group theory in Chemistry, University Press, 2008
6. A. K. Mukherjee. B. C. Ghosh, Group Theory in Chemistry, University Press,2018

### REFERENCE BOOKS

1. S. Glasstone and D.H. Lewis, Elements of Physical Chemistry, 2<sup>nd</sup> Edition, Macmillan &Company, UK, 1962.
2. W.J. Moore, Physical Chemistry, 5<sup>th</sup> Edition, Orient Longman, London, 1999.
3. R.P. Rastogi and R.R. Misra, An Introduction to Chemical Thermodynamics, 6<sup>th</sup> Edition, Vikas Publishing House Pvt. Ltd., Noida, 2002.



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DEPARTMENT OF CHEMISTRY

CORE PAPER –VII

## INORGANIC, ANALYTICAL & APPLICATIONS OF COMPUTERS IN CHEMISTRY

Credits –4  
Max. Marks 100

Hours/Week: 4  
Ext: 75 + Int: 25

### OBJECTIVES

1. To know the various theories of acids and bases
2. To learn the fundamentals of bioinorganic chemistry
3. To understand the importance of inorganic polymers
4. To study the analytical techniques
5. To learn the C language and its applications

### UNIT I: ACIDS- BASE CONCEPTS AND NON- AQUEOUS SOLVENTS

- a. Arrhenius concept- Bronsted Lowry concept – Conjugate acid base pairs-relative strength of acid – base pair- Lux Flood concept- auto ionization concept – Lewis concept – leveling and differentiating effects – Usanovich concept – Hard and Soft acids – Applications of HSAB principle
- b. Non-aqueous solvents – classification – reactions in liquid ammonia – precipitation reaction – acid – base reaction – protolysis - ammonolysis

### UNIT II: BIOINORGANIC CHEMISTRY

- a. Metallo porphyrins - Porphyrins – Chlorophyll – vitamin B<sub>12</sub> - Metal ions in biological system – Trace and bulk metal ions – Hemoglobin and myoglobin (elementary idea of structure and oxygen binding mechanism) – Chlorophyll and photosynthesis (mechanism not expected) - Sodium–potassium pump
- b. Biochemistry of Ca, Zn and Co - Toxicity of metal ions (Pb, Hg and As).
- c. Anticancer drugs: *Cis*-platin, oxaliplatin and carboplatin – Structure and significance.

### UNIT III: INORGANIC POLYMERS

- a. General properties of inorganic polymers – glass transition temperature
- b. Various types of silicones, preparation, properties and uses of silicones
- c. Sulphur based polymers – polymeric sulphur – polymeric sulphur nitride – preparation, properties and uses

### UNIT IV: ANALYTICAL CHEMISTRY

- a. Introduction – Definition – Classification - Principles and applications of column chromatography, thin layer chromatography, paper chromatography, ion exchange chromatography, - R<sub>f</sub> values



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## DEPARTMENT OF CHEMISTRY

- b. Analytical chemistry in consumer protection – detection of adulterants in milk, oils, ghee, coffee powder, chilly powder and pulses – sweeteners – preservatives – flavors – colorants – pesticide residue in food.
- c. Precision – Accuracy – absolute and relative error – classification of errors – confidence limit – students Q-test – rejection of experimental data – sources and elimination of errors – significant errors and computation

### UNIT V: APPLICATIONS OF 'C' LANGUAGE IN CHEMISTRY

- a. Important features of C – structure of C program – character set of C language – key words - constants in C program – identifiers – variables and data types – operators in a C program
- b. C programs for chemistry – calculation of energy of a photon – calculation of rate constant of a zero order reaction – calculation of half-life period of a first order reaction – calculation of rms speed of a molecule – calculation of entropy change for a phase transition - calculation of molarity, molality and normality of a solution

### TEXT BOOKS

1. B.R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, 31<sup>st</sup> Edition, Milestone Publishers and Distributors, New Delhi, 2013.
2. Satya Prakash, Advanced Inorganic Chemistry, R.D.Madan, Volume 1, 5<sup>th</sup> Edition, S. Chand and Sons, New Delhi, 2012.
3. R. Gopalan, Text book of Inorganic Chemistry, Universities Press India Ltd., Hyderabad, 2012.
4. Computers for Chemist by Pundir – Bansal, Pragathi Prakashan, 12<sup>th</sup> edition, 2016

### REFERENCE BOOKS

1. Jeffrey A. Lee, The Scientific Endeavor: A Primer on Scientific Principles and Practice, Pearson Education, 1999.
2. M.C. Day and J. Selbin, Theoretical Inorganic Chemistry, East West Press, New Delhi, 2002
3. D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, Fundamentals of Analytical Chemistry, 8<sup>th</sup> Edition, Brooks/Cole, Thomson Learning, Inc., USA, 2004.
4. J.E. Huheey, E.A. Keitler and R.L. Keitler, Inorganic Chemistry – Principles of Structure and Reactivity, 4<sup>th</sup> Edition, Pearson Education, New Delhi, 2013



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## DEPARTMENT OF CHEMISTRY

### Part IV: Skill based course - V

#### NANOTECHNOLOGY AND GREEN CHEMISTRY

Credits –2

Hours/Week: 2

Max. Marks 100

Ext: 75 + Int: 25

#### **Unit I: INTRODUCTION TO NANO MATERIALS**

Definition of nano sized material – origin of nano technology - difference in properties between bulk and nano materials - Dimension based classification of nano materials - 0D, 1D, 2D, 3D

#### **Unit II: PROPERTIES AND SYNTHESIS OF NANO MATERIALS**

Magnetic and electrical properties of nano materials - synthesis of nano materials - basics of bottom-up and top down approach - PVD, CVD, Sol-gel, wet chemical synthesis only.

#### **Unit III: APPLICATIONS OF NANO TECHNOLOGY**

Quantum dots - fabrication - applications - CNT - synthesis and applications - application of nano materials in nano medicines and pollution control - Principle of Scanning electron microscope.

#### **Unit IV: INTRODUCTION TO GREEN CHEMISTRY**

Green chemistry and its significance- Difference between conventional chemistry and green chemistry techniques - twelve principles of green chemistry - atom economy - prevention and recycling of byproducts - limitations of green chemical techniques.

#### **Unit V: GREEN SYNTHESIS TECHNIQUES**

Green solvents, - synthesis involving basic principles of green chemistry - synthesis of adipic acid, methyl methacrylate, paracetamol – microwave assisted reactions in water- Hofmann Elimination, Hydrolysis of benzamide, Ultrasound assisted esterification - Cannizaro reaction.

#### **REFERENCE BOOKS**

1. Textbook of Nanoscience and Nanotechnology - BS Murthy P Shankar, BaldevRaj, BB Rath, and James Murday - Orient Blackswan Private Limited - New Delhi
2. An Introduction to Nanomaterials and Nanoscience A. Das - CBS Publications
3. Nanoscience and Nanotechnology: Fundamentals of Frontiers - Shubra Singh M.S. RamachandraRao
4. A Textbook of Nanoscience and Nanotechnology - T. Pradeep
5. New Trends in Green Chemistry - V.K. Ahluwalia & M.R. Kidwai, Anamalaya Publishers.
6. An Introduction to Green Chemistry - V.Kumar Vishal Publishing Co.,
7. Green Chemistry: Greener Alternatives to Synthetic Organic Transformations - V.K. Ahluwalia
8. Environmental Chemistry - B.K.Sharma, GOEL Publishing House.





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DEPARTMENT OF CHEMISTRY

## PRACTICAL - IV

### ORGANIC ANALYSIS AND ESTIMATION

Credits – 5

Max. Marks 100

Hours/Week: 3

Ext: 75 + Int: 25

#### Objectives

1. To enable the students to develop analytical skills in organic qualitative analysis
2. At the end of the course, the students should be able to plan the experimental projects and execute them.

#### 1. Organic Analysis

- a. Identification of acidic, basic, phenolic, and neutral organic substances.
- b. Detection of N, S and halogens.
- c. Test for aliphatic and aromatic nature of substances.
- d. Test for saturation and unsaturation.
- e. Identification of functional groups: i) Carboxylic acids ii) Phenols iii) Aldehydes iv) Ketones v) Esters vi) Carbohydrates vii) Amines viii) Amides ix) Halogen compounds
- f. Preparation of derivatives for the functional groups.

#### 2. Organic Estimation

- a) Estimation of aniline
- b) Estimation of phenol
- c) Estimation of glucose

**Scheme of evaluation (Max. marks 100) Internal Assessment: 40 Marks**

Regularity	20 Marks
Class Test	15 Marks
Observation Note	5 Marks
Total	40 Marks

**External Examination: 60 Marks (6 hours)**

<b>Record Note Book</b>	<b>10 marks</b>		
<b>Organic Estimation</b>	<b>25 Marks</b>	<b>Organic Analysis</b>	<b>25 Marks</b>
<b>Procedure</b>	<b>10 Marks</b>	<b>Elements present</b>	<b>8 Marks</b>
<b>Estimation</b>	<b>15 Marks</b>	<b>Aliphatic/aromatic</b>	<b>4 Marks</b>
<b>&lt; 2 %</b>	<b>15 Marks</b>	<b>Saturated/unsatd.</b>	<b>4 Marks</b>
<b>2 -3%</b>	<b>12 Marks</b>	<b>Functional group</b>	<b>6 Marks</b>
<b>3- 4%</b>	<b>10 Marks</b>	<b>Derivative /color reaction</b>	<b>3 Marks</b>
<b>&gt; 4%</b>	<b>5 Marks</b>		



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## DEPARTMENT OF CHEMISTRY

### PHYSICAL CHEMISTRY EXPERIMENTS

Credits –5

Max. Marks 100

Hours/Week: 2

Ext: 75 + Int: 25

#### Objectives

1. To apply the principles of physical chemistry and do some experiments
2. At the end of the course, the students should be able to plan the experimental projects and execute them.
  1. **Rast Method**- Determination of cryoscopic constant ( $K_f$ ) of solid solvent using a solute of known molecular mass. Determination of molecular mass of the solute using a solvent of known cryoscopic constant ( $K_f$ ). Solid solvents: Naphthalene, biphenyl, camphor. Solutes: Naphthalene, biphenyl, 1,4 dichlorobenzene, diphenylamine, acetanilide, benzophenone
  2. **Transition Temperature** - Determination of molal transition point depression constant ( $K_t$ ) of salt hydrate using solute of known molecular mass. Determination of molecular mass of the solute using a solvent of known molal transition point depression constant ( $K_t$ ). Salt hydrates:  $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ ,  $\text{CH}_3\text{COONa} \cdot 3\text{H}_2\text{O}$ . Solutes: Urea, Glucose
  3. **Phase Equilibria** - Construction of phase diagram & determination of eutectic composition and eutectic temperature. Naphthalene-biphenyl system, Naphthalene-diphenylamine system, Biphenyl-diphenylamine system. Naphthalene – m-dinitrobenzene system
  4. **Critical solution temperature** –Determination of CST of phenol-water system- Influence of NaCl impurity on miscibility temperature of phenol–water system and determination of concentration of given NaCl solution
  5. **Thermochemistry** – Heat of solution – potassium dichromate – ammonium oxalate – oxalic acid
  6. **Kinetics** – Determination of relative strength of acids by acid catalysed hydrolysis of ester – inversion of cane sugar
  7. **Potentiometric titration** – (i)  $\text{KMnO}_4$  Vs  $\text{Fe SO}_4$  (ii)  $\text{K}_2\text{Cr}_2\text{O}_7$  Vs  $\text{Fe SO}_4$
  8. **Conductometric titration**
  9. **Partition Coefficient Experiment**
  10. **Viscosity** – Determination of composition of unknown mixture



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## **Scheme of evaluation (Max. marks 100)**

Internal Assessment 40 Marks      External Examination: 60 Marks (6 hours)

Regularity	20 Marks
Class Test	15 Marks
Observation Note	5 Marks
Total	40 Marks

Record note	10 Marks
Ability to complete the experiment	30 Marks
Graph/calculation	10 Marks
Tabulation	5 Marks
Result	5 Marks