



SACRED HEART COLLEGE (AUTONOMOUS)

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Ready for
Every Good Work

A Don Bosco Institution of Higher Education, Founded in 1951 * Affiliated to Thiruvalluvar University, Vellore * Autonomous since 1987

Accredited by NAAC (4th Cycle – under RAF) with CGPA of 3.31 / 4 at 'A+' Grade

B. Sc Chemistry

B. Sc Chemistry - Scheme of papers (CBCS) - 2021 – 22

Year / Semester	Part	Subject	Title of the Paper	Hrs / Week	Credits	Exam hours	Max Marks		
							CIA	Sem	Total
I Year / I Semester	I	Tamil	Tamil – I	5	3	3	50	50	100
	II	English	English – I	5	3	3	50	50	100
	II		Communicative English		1				
	III	Core	Organic Chemistry – I	3	3	3	50	50	100
	III	Core	Analytical Chemistry - I	4	4	3	50	50	100
	III	Core Practical	Volumetric Analysis	3	3				
	III	Allied	Allied Mathematics - I	6	4	3	50	50	100
	IV		FC	2	1				
	IV		Religion & Ethics – I	2	1	3	50	50	100
I Year / II Semester	I	Tamil	Tamil – II	5	3	3	50	50	100
	II	English	English – II	5	3	3	50	50	100
	II		Communicative English		1				
	III	Core	Inorganic Chemistry - I	3	3	3	50	50	100
	III	Core	Physical Chemistry - I	4	4	3	50	50	100
	III	Core Practical	Volumetric Analysis	3	3	3	50	50	100
	III	Allied	Allied mathematics - II	6	4	3	50	50	100
	IV		FC	2	1	3	50	50	100
	IV		Religion & Ethics – II	2	1	3	50	50	100
II Year / III Semester	I	Tamil	Tamil – III	5	3	3	50	50	100
	II	English	General English – III	5	3	3	50	50	100
	III	Core	Organic Chemistry - II	3	3	3	50	50	100
	III	Core	Inorganic Chemistry – II	4	4	3	50	50	100
	III	Core Practical	Qualitative Inorganic Analysis	3	3				
	III	Allied	Allied Physics – I	6	4	3	50	50	100
	IV		FC	2	1				
	IV		Human Rights	2	1	3	50	50	100
	V		DEEDS						
	V		SHELTERS						
			Certificate course – I			2*			
II Year / IV Semester	I	Tamil	Tamil – IV	5	3	3	50	50	100
	II	English	English – IV	5	3	3	50	50	100
	III	Core	Organic Chemistry - III	3	3	3	50	50	100

	III	Core	Physical Chemistry - II	4	4	3	50	50	100
	III	Core Practical	Qualitative Analysis	3	3	4.5	50	50	100

Year / Semester	Part	Subject	Title of the Paper	Hrs / Week	Credits	Exam hours	Max Marks		
							CIA	Sem	Total
II Year / IV Semester	III	Allied	Allied Physics – II	6	4	3	50	50	100
	IV		FC	2	1		50	50	100
	IV		Environmental Studies	2	1	3	50	50	100
	V		DEEDS		2				
	V		SHELTERS		2				
III Year / V Semester	III	Core	Organic Chemistry – IV	4	4	3	50	50	100
	III	Core	Inorganic Chemistry – III	4	4	3	50	50	100
	III	Core	Physical Chemistry – III	4	4	3	50	50	100
	III	Core	Analytical Chemistry – II	4	4	3	50	50	100
	III	Main Elective	Elective – I	3	2	3	50	50	100
	III	Main Elective	Elective – II	3	2	3	50	50	100
		SSP	Chemistry for Competitive Exam – I		1*				
	III	Core Practical	Gravimetric & Organic Analysis	3	3		50	50	100
	III	Core Practical	Physical Chemistry Practicals	3	3		50	50	100
		NME	Chemistry of Drugs and Disease	2	1		50	50	100
			Certificate Course - II		2*				
III Year / VI Semester	III	Core	Organic Chemistry – V	4	4	3	50	50	100
	III	Core	Inorganic Chemistry – IV	4	4	3	50	50	100
	III	Core	Physical Chemistry – IV	4	4	3	50	50	100
	III	Subject Skill (SS-I)	Paper – I	5	4	3	50	50	100
	III	Subject Skill (SS-II)	Paper – II	5	4	3	50	50	100
	IV	NME	Chemistry in Everyday Life	2	1	3	50	50	100
	III	SSP	Chemistry for Competitive Exam – II		1*				
	III	Core Practical	Gravimetric & Organic Analysis	3	3	6	50	50	100
	III	Core Practical	Physical Chemistry Practicals	3	3	3	50	50	100
			Internship/Industrial Visit/ Case study/Project*		2*				
				180	148 +2* +2* +2*				

* Extra credits

Note:

SSP/Project/Certificate course – optional

Abbreviations

FC	Foundation Course
Comm. Eng	Communicative English
ET	Ethics
RE	Religion

DEEDS

Dept. of extension and educational services.

HR
SSP
NME

Human Rights
Self study paper
Non-major Elective

List of Electives

Elective - I

3 Hours

1. Pharmaceutical Chemistry
2. Forensic Chemistry
3. Bio-Inorganic Chemistry

Elective - II

3 Hours

1. Applied Chemistry
2. Protein Chemistry
3. Cheminformatics

Subject Skill Papers

5 Hours

1. Polymer Chemistry
2. Industrial and Environmental Chemistry
3. Green Chemistry
4. Materials Chemistry
5. Water Chemistry and Inorganic Materials of Industrial Importance
6. Chemistry of Drug Design

Certificate Courses

2 Hours

1. Organic Farming
2. Industrial Safety

Sacred Heart College (Autonomous), Tirupattur District

1.2.1 List of New Courses

Department: B.Sc.Chemistry

S.No	Course Code	Course Name
1.	CH116	Organic Chemistry-I
2.	CH117	Analytical Chemistry-I
3.	CH216	Inorganic Chemistry-I
4.	CH217	Physical Chemistry-I
5.	PCH209	Volumetric Analysis

Syllabus:

SEMESTER – I

Organic Chemistry – I

Course Code	CH116	Credit	3
Instruction Hours per Week	3	Marks	CIA (50) / SE (50)
Course Objective	<ul style="list-style-type: none">• Understanding the structure of organic compounds.• Understanding the fundamentals of acidity and basicity.• Providing the rudimentaries of stereochemistry.		

Outcomes

- Ability to draw the structure of molecules.
- Assess the acidic, basic and delocalization nature of molecules.

Unit 1 Electronic structure and bonding

9 Hours

1.1 Ionic and covalent bonds, Polar covalent bonds and dipole moment. Introduction to molecular orbital theory, Single, double, and triple bond formation in organic compounds.

1.2 Bonds in methyl cation, radical and anion. Bonds in water, ammonia, ammonium ion and hydrogen halides. Hybridization, bond lengths, strengths, and angles. Fischer, Flying wedge, Newmann

projection and Sawhorse representations .Rotation about carbon-carbon single bonds, conformational analysis of ethane, butane.

1.3 Baeyer strain theory-conformational analysis of cyclohexane

Unit 2 Acidity and basicity of organic compounds

9 Hours

2.1 Acids and Bases, pKa and pH, organic acids and bases, Acid-base reaction and position of equilibrium, Effect of structure on the pKa of acids(electronegativity, hybridization, size).

2.2 Effect of substituent on the strength of an acid, delocalized electrons. Buffer solutions, Lewis acids and bases.

2.3 Effect of pH on the structure of organic compounds.

Unit 3 Stereochemistry 1

9 Hours

3.1 Isomerism, constitutional, conformational isomers, stereoisomers, cis-trans isomers from restricted rotation, asymmetric centers and stereocenters.

3.2 Isomers with one and two asymmetric centers, configurational isomers, Cahn Ingold Prelog rules and assigning E, Z, R & S to molecules.

3.3 Optical activity, measurement of specific rotation, enantiomeric excess, meso compounds with an asymmetric center, reactions of compounds that contain an asymmetric center-Stereoselective, regioselective and stereospecific reactions.

Unit 4 Chemistry of Alkenes

9 Hours

4.1 Stereochemistry of electrophilic addition reactions of alkenes. Addition reactions resulting in one and two asymmetric centers: addition reactions forming a cyclic bromonium ion intermediate.

4.2 Alkenes, addition of hydrogen halides, stability of carbocations, electrophilic addition reactions and regioselectivity.

4.3 Addition of water, alcohols, halogens, peroxy acid and hydrogenation of alkenes. Oxymercuration-reduction and hydroboration-oxidation with mechanism.

Unit 5 Chemistry of Alkynes

9 Hours

5.1 Alkynes: Structure and reactivity of alkynes(with mechanism).

5.2 Addition of hydrogen halides, halogens, water, hydroboration-oxidation

5.3 Addition of hydrogen to an alkyne, acidity of hydrogen bonded to an 'sp' carbon, synthesis using

Reference Books:

Text Book

1. Paula Yurkanis Bruice, *Organic chemistry*, 6th Edition, Prentice Hall, Illinois, 2011.

Further reading

2. R.T. Morrison and R. N. Boyd, *Organic chemistry*, 6th Edition, Prentice-Hall of India, New Delhi, 2008.
3. Leroy. G. Wade, *Organic chemistry*, 6th Edition, Pearson, New York, 2005.
4. Clayden, J Greeves, N and Warren, S, *Organic Chemistry*, 2nd Edition,. Oxford University Press, New York, 2001.
5. Loudon, Marc G, *Organic Chemistry*, 6th Edition,. Oxford University Press, New York, 2016.

Syllabus:**SEMESTER -I****Analytical Chemistry-I**

Course Code	CH117	Credit	4
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Instruction Hours per Week	4	Marks	CIA (50) / SE (50)
Course Objective	<ul style="list-style-type: none"> To learn the basic principles and applications of important analytical techniques To develop a sound knowledge in chemistry involved in an analysis 		

Learning Outcomes

- Identify the suitable methods for separation; explain chemical analysis of compounds
- Outline the principle behind Volumetric, gravimetric analysis, mass spectrometry, Chromatography and list out their applications

Unit-1. Laboratory hygiene and Safety

12 Hours

- Storage and handling of corrosive, flammable, toxic, carcinogenic and poisonous chemicals. Disposal of solid, liquid and fume wastes.
- Simple First Aid Procedures: Acids, alkalis, phenols, toxic substances like bromine, benzene, pyridine, glass cuts and poisons. Universal antidotes, tartaremetic and tincture of iodine.
- Laboratory Glassware-Cleansing agents-interchangeable ground joints apparatus-description, advantages and precautions to be followed. Safety practices in the laboratory.

Unit - II Separation Techniques

12 Hours

- Solvent Extraction-Principle-Extracting from solid-liquid phases-Soxhlet extractor Extraction by chemically active Solvents-Chromatography-types of chromatography.
- Principle, techniques and applications of TLC, and Paper. Principle, techniques and applications of Column chromatography.
- Gas-Liquid Chromatography-Principle, Instrumentation, and applications.

Unit-III Volumetric analysis

12 Hours

- Primary and secondary standards. Requirements of primary standards with examples-classifications of volumetric analysis. Acid-base titrations: Principle-theory of acid-base indicators- Methyl red and phenolphthalein.
- Redox titrations: Theory of redox titrations-theory of redox Indicators-Diphenyl amine, Ferroin, and Starch.
- Precipitation Titrations: Principle-Estimations of Chloride by Mohr's method and Volhard's Method. Complexometric Titrations: Principle-Estimation of Magnesium using EDTA-Theory of metal-ion indicators.

Unit - IV Gravimetric Analysis and Thermal Analysis

12 Hours

- Gravimetric Analysis-Principle-Conditions of precipitation-choice of Precipitants. Inorganic and Organic Precipitants-specific and selective precipitants.

- 4.2 Masking Agents-Precipitation from homogeneous Medium-Post Precipitation-Co-Precipitation-Differences between post and Co-precipitation.
- 4.3 Principles of thermogravimetric analysis and Instrumentation-Derivative thermogravimetry-Factors influencing thermogram. DTA-Principle and Instrumentation-Applications: TGA-Calcium oxalate monohydrate-DTA-Calcium acetate monohydrate.

Unit - V Units of measurement and Error Analysis

12 Hours

- 5.1 Units of measurement-normality, molality, and molarity, examples for this concept. Mole fraction-percentage solution
- 5.2 Significant Figures-Rules-Rounding off figures. Definition of terms in mean, median, and mode. Standard deviation, relative standard deviation.
- 5.3 Precision and Accuracy-absolute error, relative error. Types of error in experimental data, determinate (systematic), indeterminate (or random) and gross.

References

1. Gary D. Christian,; Purnendu K. Dasgupta,; Kevin A. Schug, *Analytical Chemistry*, 7thEdition;Wiley Global Education, 2013.
2. Douglas A. Skoog,; F. James Holler,; Stanley R. Crouch, *Principles of Instrumental Analysis*, 6thEdition;Cengage Learning, 2006.
3. John H Kennedy, *Analytical Chemistry: Principles*, 2ndEdition; Saunders College Pub, 1990.
4. Larry G. Hargis, *Analytical Chemistry: Principles and Techniques*, 1stEdition; Prentice Hall, 1988.
5. Reuben Alexander Day,; Arthur Louis Underwood, *Quantitative Analysis*, 6thEdition;Prentice Hall India Learning Private Limited, 1992.
6. S. M. Khopkar, *Basic Concepts of Analytical Chemistry*, 3rd Rev Edition; New Age Science Ltd, 2008.
7. Frank A. Settle, *Handbook of Instrumental Techniques for Analytical Chemistry*, 1stEdition; Prentice Hall, 1997.
8. R.Gopalan, P. S. Subramanian and K. Rengarajan, *Elements of analytical chemistry*, 3rdEdition, Sultan Chand, New Delhi, 2003
9. A. K. Srivatsava and P. C. Jain, *Chemical Analysis and Instrumental Approach*, 3rdEdition, S.Chand and Company Ltd., New Delhi, 2010.

Syllabus:

SEMESTER-II

Inorganic Chemistry – I

Course Code	CH216	Credit	3
Instruction Hours per Week	3	Marks	CIA (50) / SE (50)
Course Objective	<ul style="list-style-type: none">• To understand the basic atomic structure of elements their periodic properties and chemical bonding.• To learn the properties and applications of <i>s</i> and <i>p</i> block elements.• To understand the principles and theories of Acids and Bases		

Unit-1 Atomic Structure

9 Hours

- 1.1 Electronic configurations of the elements, Aufbau principle, quantum numbers, and Pauli's exclusion principle. Hund's multiplicity rule for filling electrons in various orbitals, Stability of half-filled and completely filled orbitals, effective nuclear charge.
- 1.2 Shapes of s, p, d orbitals - s, p, d and f block elements – classification and characteristic properties.
- 1.3 Periodicity of properties – Definition and periodicity of the following properties – Atomic radii – factors affecting atomic radii – ionic radii – factors affecting ionic radii. Ionisation potential – factors affecting ionisation potential – Electron affinity – factors affecting electron affinity – Electronegativity – factors affecting electronegativity – Pauling scale.

Unit-2 Chemical Bonding

9 Hours

- 2.1. Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications.
- 2.2 Polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.
- 2.3. Covalent bonding: Lewis theory, Octet theory, VSEPR theory and applications – geometries of BCl₃, H₂O, ClF₃, PCl₅, IF₇ and XeF₆ molecules.

Unit-3 Alkali and alkaline earth metals

9 Hours

- 3.1 Alkali metals – Comparative study of elements – oxides, halides, hydroxides and carbonates – Exceptional property of Lithium – Diagonal relationship of Li with Mg.
- 3.2. Alkaline earth metals – comparative study of the elements with respect to oxides, hydroxides, halides, sulphates and carbonates – Exceptional property of Beryllium – Diagonal relationship of Be with Al
- 3.3. Comparison of alkaline earth metals with alkali metals – Magnesium acting as bridge element between IIA and IIB groups – Magnesium resembles zinc. Properties and uses of Alkaline earth metals. Biological role of Mg^{2+} and Ca^{2+}

Unit-4 p-block elements, Chemistry of group 13

9 Hours

- 4.1. Main group elements- introduction, general and special characteristics. Group 13: general properties, electronic configuration, oxidation states, inert pair effect, size of atoms and ions, electropositive nature and ionization energy.
- 4.2 Compounds of group 13: Structure and bonding in diborane. Preparation, properties and structure: Borazine, trihalides- Boron and Aluminium.
- 4.3 Compounds of Boron and Oxygen (structure and properties): Sesquioxides-Borates and Borax.

Unit-5 Acids and Bases

9 Hours

- 5.1. Arrhenius concept. Lowry Bronsted concept-conjugate acid-base pairs, relative strengths of acid-base pairs.
- 5.2. Lux-flood concept. Lewis concept, limitations of lewis concept.
- 5.3. Pearson concept-HSAB principle. Estimation of TDS in water.

Learning Outcomes

- The student can explain the atomic structure and bonding nature present in a molecule along with the applications and importance of s and p block elements
- The students can understand the theories pertaining to the acids and bases.

References

1. R. D. Madan, *Modern Inorganic Chemistry*, Second edition, S. Chand publications, New Delhi, 2000.
2. B. R. Puri, L. R. Sharma and K. C. Kalia, *Principles of Inorganic Chemistry*, 33rd Edition, Vishal Publishing Co, Jalandar, 2004.

(Advanced Reading)

1. C. Chambers and A. K. Holliday, *Modern Inorganic Chemistry*, First edition, Butterworth and Co. , Sussex, 1975.
2. Gary L Miessler and Donald A Tarr, *Inorganic Chemistry*, Third edition, Pearson Prentice Hall.
3. B. Murphy, C. Murphy and B. J. Hathway, *Basic Principles of Inorganic Chemistry*, The Royal Society of Chemistry, Cambridge, 1998.

Syllabus:

SEMESTER-II

Physical Chemistry – I

Course Code	CH217	Credit	4
Instruction Hours per Week	4	Marks	CIA (50) / SE (50)
Course Objective	<ul style="list-style-type: none">• To understand the important behaviour of gases and liquids• To learn the fundamentals of thermochemistry and thermodynamics		

Learning Outcome:

- Recognize and relate the properties of ideal and real gases
- Describe the properties of liquids
- Describe the thermodynamic parameters in exo and endothermic process.

Unit – I Gaseous State -I

12 Hours

- 1.1. Kinetic theory of gases –derivation of kinetic gas equation–Gas laws from the kinetic gas equation.
- 1.2. Maxwell’s distribution of-molecular velocities (no derivation)–Experimental verification of velocity distribution – Effect of temperature on velocity distribution.
- 1.3. Kinds of velocities – mean, rms, most probable velocities-Degrees of freedom of a gaseous molecule, equipartition of energy, heat capacity on molecular basis.
- 1.4. Collision diameter-Collision Number-Collision frequency-and mean free path

Unit - II Gaseous State -II

12 Hours

- 2.1 Effect of Temperature and Pressure on mean free path and Collision frequency
- 2.2 ideal gas and real gas-Deviation of real gas from ideal behaviour-Compressibility factor-causes of deviation-Compressibility of various Gases (variation of Z with Pressure)
- 2.3 Derivation of van der Waals Equation for real gases-significance of van der Waals constants-Behaviour of real gas using van der Waals equation-Exceptional behaviour of H and He.
- 2.4 Liquification of gases-Linde’s Process and Claudes Process

Unit -III Liquid State**12 Hours**

- 3.1 Differences between solids/liquids/gases in terms of structure-Intermolecular forces in liquids – Vapour pressure and Factors affecting them – Determination of Vapour pressure of a liquid -
- 3.2 Surface tension of a liquid-surface energy-liquid raises in a capillary tube-surface active agents Effect of temperature on surface tension-Determination of surface tension-
- 3.3 Capillary Rise and Drop Weight Method-Drop weight methods
- 3.4 Viscosity-factors affecting viscosity-Ostwald Viscometer method

Unit-IV: Thermodynamics -I**12 Hours**

- 4.1. Thermodynamics – Definition and explanation of terms – System, boundary, surroundings – Homogeneous and heterogeneous system – Isolated system – Closed system – Open system. Thermodynamic functions - Intensive and extensive properties – state functions and path functions. Exact differentials
- 4.2. Thermodynamic processes - First law of thermodynamics Concept of internal energy – Energy changes with work –State functions.
- 4.3. Enthalpy (Heat) of the reaction- Factors influencing enthalpy-Measuring the enthalpy of combustion (Bomb Calorimeter)
- 4.4 Heat capacity – at constant pressure and volume – relationship between C_p and C_v

Unit-V: Thermochemistry**12 Hours**

- 5.1 Joule's law – Joule – Thomson effect – Joule – Thomson coefficient and its derivation – inversion temperature, its significance and its derivation.
- 5.2 Endothermic/Exothermic reaction. Enthalpy of formation and standard enthalpy of formation-importance of standard enthalpy of formation- Hess's Law of constant heat summation
- 5.3 Determination of enthalpy of formation – Problems related to Hess's Law Bond enthalpy and application -calculation from thermochemical data
- 5.4 Application of bond dissociation energies - calculation from thermochemical data –Kirchoff's equation and its significance.

Text Books:

1. B. R. Puri, L. R. Sharma and M. S. Pathania, *Principles of Physical Chemistry*, 47th Edition, Vishal Publishing Co, Jalandar, 2016.
2. R.L. Madan, *Physical Chemistry*, McGraw Hill Education Pvt. Ltd. 2015.
3. Peter Atkins and Julio de Paula, *Physical Chemistry*, 10th Edition, W. H. Freeman and Company. (Unit IV)
4. Raymond Chang and John W. Thoman, *Physical Chemistry for the chemical science*, Jr. University Science Books (Unit IV)

Reference:

1. ArunBahl, B.S. Bahl. G.D.Tuli, *Essentials of Physical Chemistry*, S. Chand Publications
2. A.S. Negi and S.C. Anand, *A text book of Physical Chemistry*, Wiley Eastern Ltd, New Delhi, 1984.

Syllabus:

SEMESTER-II

Volumetric Analysis

Course Code	PCH209	Credit	3
Instruction Hours per Week	3	Marks	CIA (50) / SE (50)
Course Objective	<ul style="list-style-type: none">• To learn the methods to estimate chemical substances through various volumetric procedures• To appreciate the merits and limitations of each type of analysis and acquiring knowledge about the implementation of these procedures for specific ions/species.		

Acidimetry

1. Estimation of Borax – Standard Sodium Carbonate
2. Estimation of Sodium Hydroxide – Standard Sodium Carbonate
3. Estimation of HCl – Standard oxalic acid.

Permanganometry

4. Estimation of oxalic acid – Standard FAS
5. Estimation of FeSO₄–Standard Oxalic acid

Dichrometry

6. Estimation of Ferrous Iron using Diphenyl amine as indicator.
7. Estimation of ferric ion using Diphenyl amine as indicator

Iodimetry

8. Estimation of Arsenious oxide

Iodometry

9. Estimation of Copper - Standard Potassium dichromate

Complexometry

10. Estimation of Magnesium using EDTA
11. Estimation of Zinc using EDTA
12. Estimation of Calcium using EDTA
13. Estimation of total hardness of water.

Cerimetry

14. Estimation of sodium nitrite.

References

1. V. Venkateswaran, R. Veerasamy, A.R. Kulandaisamy, *Basic principles of Practical Chemistry*, S.Chand publications, New Delhi, 2002.
2. A.O, Thomas. *Practical Chemistry*, 6th Revised Edition, Sharada Press, 1995.
3. J. N. Gurtu and R. Kapoor, *Advanced Experimental Chemistry*, Vol. I–III, S. Chand and Co., 1987.