SACRED HEART COLLEGE (AUTONOMOUS)

Tirupattur – 635 601, Tamil Nadu, S.India

Resi : (04179) 220103
College : (04179) 220553
Fax : (04179) 226423

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

Sacred Heart College (Autonomous), Tirupattur District

1.2.1 List of New Courses

Department: B.Sc.Chemistry

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/Iindusdrial Visit/ Case study/Project*		2*				
			Total	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	Human Rights
SSP	Self study paper
NME	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.	CH316	Organic Chemistry-II
2.	CH317	Inorganic Chemistry-II
3.	CH416	Organic Chemistry-III
4.	CH417	Physical Chemistry-II
5.	PCH408	Qualitative Inorganic Analysis

Syllabus:

SEMESTER-III

Organic Chemistry - II

Course Code	**CH316**	**Credit**	**3**
Instruction Hours per Week	**3**	**Marks**	**CIA (50) / SE (50)**
Course Objective	• Understanding substitution and elimination reactions. • Understanding metal carbon bonds.		

Outcomes

- Ability to differentiate elimination and substitution reactions.
- Knowledge on application of intermediates and mechanism.
- Knowledge on the synthetic nature of organometallic compounds.

Unit 1 Delocalisation **9 hours**

1.1 Delocalised electrons and benzene's structure, bonding in benzene, reasonance contributors and reasonance hybrids, stability of reasonance contributors, delocalization energy, delocalized electrons and stability, stability of allylic and benzyliccations., molecular orbital description of stability(1,3 Butadiene and 1,4 Pentadiene)

1.2 Effect of delocalized electrons on pKa values and product of a reaction

1.3 Reactions of isolated dienes and conjugated dienes, thermodynamic versus kinetic control of reactions, Diels- alder reaction 1,4 addition, conformations of the diene.

Unit 2 Substitution reactions **9 hours**

2.1 Alkyl halides- substitution reactions- S_N2, factors affecting S_N2, reversibility of S_N2 reaction.

2.2 S_N1, factors affecting S_N1, stereochemistry of S_N1 and S_N2

2.3 Competition between S_N1 and S_N2, role of solvents S_N1 and S_N2-Intermolecular versus intramolecular reactions.

Unit 3 Elimination reactions **9 hours**

3.1 Elimination reactions, E2 reaction regioselectivity. E1 reaction, competition between E2 and E1 reactions.

3.2 E2 and E1 reactions stereo selectivity, elimination from substituted cyclohexanes.

3.3 Kinetic isotope effect in mechanism determination, competition between substitution and elimination.

Unit 4 Alcohols and Amines **9 hours**

4.1 Conversion of alcohols to alkyl halides, alcohols to sulfonate esters, elimination reactions of water from alcohols, oxidation of alcohols.

4.2 Nucleophilic substitution reaction of ethers, epoxides.

4.3 Substitution or elimination reactions in amines, Elimination reactions of quaternary ammonium hydroxides, phase transfer catalysis(concept only). Reactions of thiols, sulfides and sulfonium salts.

Unit 5 Organometallic compounds **9 hours**

5.1 Metal carbon bond, Synthesis of Grignard reagents and Organolithium compounds.

5.2 Organometallics by deprotonating alkynes, Ortholithiation. Primary, secondary and tertiary alcohols from aldehydes and ketones.

5.3 Reactions of organolithium and Grignard reagents with electrophiles, transmetallation, coupling reactions, palladium catalyzed coupling reactions, alkene metathesis.

Reference Books:

Text Book

1. Paula YurkanisBruice, *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,

SEMESTER-III

Inorganic Chemistry - II

Course Code	**CH317**	**Credit**	**4**
Instruction Hours per Week	**4**	**Marks**	**CIA (50) / SE (50)**
Course Objective	• To have a sound knowledge about structure and shape using VB and MO theory • To know about Chemistry of group-14 and 15 and its applications • To understand the importance of Nuclear chemistry and its applications		

Unit-1 VB and MO Theory

1.1 Valence bond theory – postulates and limitations – hybridization – explanation with examples.

1.2 Concept of resonance and resonating structures in various inorganic and organic compounds. MO Approach: Rules for the LCAO method, bonding and antibondingMOs.

1.3 MO treatment of homonuclear diatomic molecules: H_2, N_2, O_2, and F_2 .Heteronuclear diatomic molecules: HF, CO, and NO

1.4 Comparison of VB and MO approaches.

Unit-2 Chemistry of Group 14

2.1 Group 14: general properties, electronic configuration, metallic character, and oxidation states.
2.2 Uniqueness of Carbon and Silicon in comparison to remaining elements. Carbides-Preparation, classification and applications. Allotropes of Carbon- structure, properties and uses. Oxides of carbon (structure and properties):
2.3 CO, CO_2 and carbon suboxides. Carbon cycle.
2.4 Silicates-classification, properties, structure and uses. Silicones- Polysiloxanes.

Unit-3 Chemistry of Group 15

3.1 Group 15: general properties, electronic configuration, oxidation states.
3.2 Compounds of group 15: Hydrides of Nitrogen and Phosphorus, Haber's process, Oxides of Nitrogen: NO, NO_2, N_2O, and N_2O_3 (structure, properties and uses).
3.3 Oxo-acids of Nitrogen and Phosphorous- preparation and structure.
3.4 Polyphosphates-preparation and structure.

Unit-4 Nuclear Chemistry

4.1 Fundamental particles of the nucleus- nucleon, nuclides, isotopes, isobars, isotones.
4.2 Nuclear radius, nuclear mass, nuclear density, nuclear forces operating between the nucleons, and packing fraction.
4.3 Natural radioactivity- nuclear reactions, radioactive decay, group displacement law, N/P ratio, curves, stability belts and rate of radioactive disintegration.
4.4 Nuclear binding energy. Mass defect, simple calculations involving mass defect and B.E per nucleon, Q value determination, magic numbers.

Unit-5 Applications of Nuclear Chemistry

5.1 Detection and measurement of radioactivity- G. M counter, and scintillation counter. Application of radioisotopes as tracers: Rock and Carbon dating.
5.2 Artificial radioactivity: artificial transmutation of elements and Particle accelerators- cyclotron. Induced radioactivity and preparation of transuranic elements.
5.3 Nuclear fusion reactions and applications: nuclear fusion in the sun and hydrogen bomb. Safe disposal of radioactive waste.
5.4 Preparation of Inorganic Complexes (Any two)

Learning Outcome:

- The student will understand the chemistry of 14 and 15 group.
- The student can know the importance of nuclear chemistry and its applications
- The student can understand the structure and shape of the molecule using VB and MO theory.

References

(Text Book)

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.

3. H. J. Arnikar, *Essentials of nuclear chemistry*, Fourth Edition, New Age International Private Limited, New Delhi, 2011

(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. G. R. Choppin, and J-O.Liljenzin, and J. Rydberg, *Radiochemistry and Nuclear chemistry*, Butterwoth-Heinemann, Woburn, 2002.

4. P. A. C. McPherson, *Principles of Nuclear Chemistry*, World scientific, Singapore, 2017.

SEMESTER IV

Organic Chemistry – III

Course Code	**CH416**	**Credit**	**3**
Instruction Hours per Week	**3**	**Marks**	**CIA (50) / SE (50)**
Course Objective	• Understanding the fundamentals of organic spectroscopy. • Understanding Aromatic compounds. • Understanding the reactivities of carbonyl compounds. • Learning radical reactions		

Outcomes

- Correlate reactants and products using spectroscopy.
- Knowledge on Aromacity and reactivity.
- Knowledge of the nature of carbonyl compounds.

Unit 1Radical reactions

1.1 Radical reactions of alkanes, poor reactivity of alkanes, chlorination and bromination of alkanes.

1.2 Radical stability and alkyl substituents, distribution of products and reactivity selectivity principle, formation of explosive peroxides, addition of radicals to alkenes, stereochemistry of radical substitution and addition reactions

1.3 Radical substitution of Benzylic and allylichydrogens.

Unit 2Organic Spectroscopy 1

2.1 Mass spectrometry, mass spectrum and fragmentation, isotopes in mass spectrometry, high resolution mass spectrometry, fragmentation pattern of functional groups.

2.2 Infrared spectroscopy, infrared spectrum functional group and fingerprint region, characteristic absorption bands, intensity of absorption bands, position of absorption bands: effect of bond order, delocalization, electron donation, withdrawal and hydrogen bonding. OH and CH absorptions.

2.3 Shape of absorption bands and absence of absorption bands, interpreting and IR spectrum.

Unit 3Aromaticity

3.1 Aromaticity, unusual stability of aromatic compounds, two criteria for aromaticity, applying the criteria for aromaticity, aromatic heterocyclic compounds, chemical consequences of aromaticity,

3.2 Anti-aromaticity, molecular orbital description of aromaticity.

3.3 Reactivity of Benzene, electrophilic aromatic substitution reactions: halogenation, sulfonation, nitration, Friedel crafts acylation, alkylation. Reduction of acylated benzene to alkyl benzene.

Unit 4Substituted Benzenes

4.1 Reaction of Substituted Benzenes: Chemical conversion of substituents on the benzene ring, effect of substituents on reactivity.

4.2 Effect of substituents on orientation of incoming groups, on pKa. Ortho-Para ratio, substituent effects. Synthesis of mono and disubstituted, substituted benzenes using diazonium salts.

4.3 Arenediazonium as an electrophile, Reaction of Amines with Nitrous acid, Nucleophilic aromatic substitution an addition elimination reaction and Benzyne reaction. Dyes: Phenolpthlaein, Methyl orange and Fluorescein.

Unit 5Carbonyl compounds 1

5.1 Carbonyl compounds, Nomenclature of carbonyls, Structure of carboxylic acid and their derivatives, Physical properties of carbonyl compounds.

5.2 Reactivity of carbonyls, relative reactivities of carboxylic acids and their derivatives. General mechanism of nucleophilic addition and elimination reaction.

5.3 Reaction of acyl halides, anhydrides, esters. Acid and base catalyzed hydrolysis of an ester and transesterification. Hydroxide ion hydrolysis of esters, evidence for nucleophilic addition elimination reaction of carbonyls.

Reference Books:

Text Book

1. Paula YurkanisBruice, *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.

SEMESTER IV

Physical Chemistry – II

Course Code	**CH417**	**Credit**	**4**
Instruction Hours per Week	**4**	**Marks**	**CIA (50) / SE (50)**
Course Objective	• To understand the important laws of thermodynamics and their implications in chemical systems • To learn the importance of chemical potential and its significance • To understand the basic concepts and importance of phase equilibria • To learn the basics of colloids, surfactants and solutions		

Learning Outcome:

- Relate and interpret the various laws of thermodynamics
- Know the relevance of free energy in chemical reactions
- Discuss the fundamental aspects of chemical equilibrium
- Illustrate the behaviour of chemical mixtures using suitable phase diagrams
- Correlate the type of colloids with its properties
- Identify and distinguish the types of solutions

Unit – IThermodynamics - II

1.1 Need for second Law-Spontaneous Process- Cyclic Process- Carnot cycle- Concept of entropy-Entropy changes in reversible and irreversible process-

1.2 Statement of second law -entropy of mixture of ideal gases, entropy of mixing-physical significance of entropy

1.3 Helmholtz and Gibbs free energy- Maxwell relations-Criteria for spontaneity and equilibrium-Gibbs- Helmholtz equation-Chemical potential

1.4 Gibbs- Duhem equation- Variation of chemical potential with temperature and pressure -Chemical potential in a system of ideal gas-Third Law- Importance of third law, Testing and validity of third law. Residual entropy

Unit IIChemical Equilibrium:

2.1 State of chemical equilibrium - Characteristics and experimental verification of chemical equilibrium. Law of Mass action – Law of chemical equilibrium

2.2 Types of equilibrium constants, Relationship between Kp, Kc and Kx – Applications of equilibrium constant with solved problems.

2.3 Free energy change - criterion of spontaneity (Problems). Thermodynamic treatment of chemical equilibrium, De Donder's Concept- Chemical affinity.Thermodynamic relations for chemical affinity.

2.4 Van't Hoff reaction isotherm (problems)-Van't Hoff equation (Temperature dependence) (problems) – Le Chatelier's principle – Effect of temperature, pressure and concentration and applications

Unit - III Phase Rule

3.1 Explanations of terms – Phase, components and Degrees of freedom. Equilibrium – Criteria for equilibrium – Thermal, mechanical and chemical equilibrium.Thermodynamic derivation of Phase rule.

3.2 Clausius-Clapeyron Equation and its application in phase transition-Phase diagram - One component system – Water and sulphur with polymorphism.

3.3 Two component system– Reduced phase rule, types of two component system involving solid – liquid equilibria - General features of two component system – Colling curve method.

3.4 Simple eutectic system: Pb– Ag system. KI – water system – freezing mixture

Unit – IVPhase Equilibria II and Colloids:

4.1 Two components with compound formation - Congruent Melting point – Ferric chloride – water system – (Activity – Construction of Mg – Zn system phase diagram) - Incongruent Melting point – Na - K system

4.2 Colloids – Types of colloids - Origin of charge on colloids- electrical double layer-Electrokinetic properties (Electrophoresis, electro osmosis)

4.3 Surfactants: Classification- Micelle and reverse micelle formation- shape and structure of micelles-critical micelle concentration, aggregation number

4.4 Factors affecting CMC in aqueous media- Thermodynamics of Micellization (no derivation)

Unit – V Solutions

5.1 Thermodynamics of ideal solutions: Ideal solutions, Henry',s law and Raoult's law, deviations from Raoult's law – non-ideal solutions.

5.2 Temperature composition diagrams – ideal liquid mixture (Toluene – Benzene)-Non-ideal mixture (water – ethanol and water – hydrogen chloride) – Distillation of immiscible liquids.

5.3 Partially miscible liquids: Phenol – Water, Triethylamine – Water and Nicotine – Water systems.

5.4 Nernst distribution law – Thermodynamic derivation-limitations, Applications of Nernst distribution law- Solvent extraction and Determination of Hydrolysis constant.

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.

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

SEMESTER IV

Qualitative Inorganic Analysis

Course Code	**PCH408**	**Credit**	**3**
Instruction Hours per Week	**3**	**Marks**	**CIA (50) / SE (50)**
Course Objective	• To enable the student to systematically identify the cations a anions present in a inorganic mixture • To know the appropriate chemical procedures and apply them prepare some familiar complexes		

1. Qualitative Inorganic Mixture Analysis:

1.1 Analysis of mixture containing two cations and two anions of which one will be interfering.

1.2 Anions: Chloride, Carbonate, Sulphate, Nitrate, Borate, Fluoride, Oxalate, and Phosphate.

1.3 Cations: Lead, Copper, Bismuth, Cadmium, Iron, Aluminium, Zinc, Manganese, Cobalt, Nickel, Calcium, Strontium, Barium, Ammonium and Magnesium.

2. Inorganic Preparations

2.1 TetrammineCopper(II) Sulphate

2.2 Hexammine Nickel (II) Chloride

2.3 Tris (thiourea) Copper(II) Chloride

2.4 Potassium trioxalato ferrate (III)

References

1. V. Venkateswaran, R. Veerasamy, A.R. Kulandaisamy, *Basic principles of Practical Chemistry*, S.Chand publications, New Delhi, 2002.
2. V. V. Ramanujam,*Inorganic Semimicro Qualitative Analysis*, 3rd Edition, The National Publishing Company, 2003.
3. A.O, Thomas. *Practical Chemistry*, 6th Revised Edition, Sharada Press, 1995.