B.Sc Chemistry Curriculum Design

First Year

Semester-II

Part		**Credit**	**Hours per week (L/T/P)**
Part-I	Language – Tamil	3	6
Part-II	English	3	6
Part-III	General Chemistry–II CC3	5	5
	Qualitative Organic Analysis and preparation of Organic Compounds CC4	5	5
	Elective II Generic/ Discipline Specific Mathematics (or) Botany /Zoology EC 2	3	4
Part-IV	Skill Enhancement Course SEC-2: Dairy Chemistry	2	2
	Skill Enhancement Course SEC-3 (Discipline Specific) Cosmetics and Personal care Products	2	2
		23	**30**

<table>
<tr><td>Title of the Course</td><td colspan="8">GENERAL CHEMISTRY-II</td></tr>
<tr><td>Paper No.</td><td colspan="8">Core III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>5</td><td>Course Code</td><td colspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="3">5</td></tr>
<tr><td>Prerequisites</td><td colspan="8">General Chemistry I</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">This course aims at providing an overall view of the
• chemistry of acids, bases and ionic equilibrium
• properties of s and p-block elements
• chemistry of hydrocarbons
• applications of acids and bases
• compounds of main block elements and hydrocarbons</td></tr>
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<tr><td>Course Outline</td><td>UNIT-I

Acids, bases and Ionic equilibria
Concepts of Acids and Bases - Arrhenius concept, Bronsted-Lowry concept, Lewis concept; Relative strengths of acids, bases and dissociation constant; dissociation of poly basic acids, ionic product of water, pH scale, pH of solutions; Degree of dissociation, common ion effect, factors affecting degree of dissociation; acid base indicators, theory of acid base indicators – action of phenolphthalein and methyl orange, titration curves - use of acid base indicators;
Buffer solutions – types, mechanism of buffer action in acid and basic buffer, Henderson-Hasselbalch equation;
Salt hydrolysis - salts of weak acids and strong bases, weak bases and strong acids, weak acids and weak bases - hydrolysis constant, degree of hydrolysis and relation between hydrolysis constant and degree of hydrolysis;
Solubility product - determination and applications; numerical problems involving the core concepts.</td></tr>
<tr><td></td><td>Unit-II

Chemistry of s - Block Elements
Hydrogen: Position of hydrogen in the periodic table. Alkali metals: Comparative study of the elements with respect to oxides, hydroxides, halides, carbonates and bicarbonates. Diagonal relationship of Li with Mg. Anomalous behaviour of Be.

Chemistry of p- Block Elements (Group 13 & 14) preparation and structure of diborane and borazine. Chemistry of borax. Extraction of Al and its uses. Alloys of Al. comparison of carbon with silicon. Carbon-di-sulphide – Preparation, properties, structure and uses. Percarbonates, per monocarbonates and per dicarbonates.</td></tr>
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UNIT-III

Chemistry of p- Block Elements (Group 15-18)

General characteristics of elementsof Group 15; chemistry of H_2N-NH_2, NH_2OH, HN_3 and HNO_3. Chemistry of PH_3, PCl_3, PCl_5, $POCl_3$, P_2O_5 and oxy acids of phosphorous (H_3PO_3 and H_3PO_4).

General properties of elements of group16 - Structure and allotropy of elements - chemistry of ozone - Classification and properties of oxides - oxides of sulphur SO_2 SO_3 H_2SO_4 and selenium SeO2 – Oxy acids of sulphur (Caro's and Marshall's acids).

Chemistry of Halogens: General characteristics of halogen with reference to electro-negativity, electron affinity, oxidation states and oxidizing power. Peculiarities of fluorine. Halogen acids (HF, HCl, HBr and HI), oxides and oxy acids ($HClO_4$). Inter-halogen compounds (ICl, ClF_3, BrF_5 and IF_7), pseudo halogens [$(CN)_2$ and $(SCN)_2$] and basic nature of Iodine.

Noble gases: Position in the periodic table. Preparation, properties and structure of XeF_2, XeF_4, XeF_6 and $XeOF_4$; uses of noble gases - clathrate compounds.

	UNIT-IV **Hydrocarbon Chemistry-I** **Petroproducts:** Fractional distillation of petroleum; cracking, isomerisation, alkylation, reforming and uses **Alkenes**-Nomenclature, general methods of preparation – Mechanism of □-elimination reactions – E_1 and E_2 mechanism - factors influencing – stereochemistry – orientation – Hofmann and Saytzeff rules. Reactions of alkenes – addition reactions – mechanisms – Markownikoff's rule, Kharasch effect, oxidation reactions – hydroxylation, oxidative degradation, epoxidation, ozonolysis; **Alkadienes** Nomenclature - classification – isolated, conjugated and cumulated dienes; stability of conjugated dienes; mechanism of electrophilic addition to conjugated dienes - 1, 2 and 1, 4 additions; free radical addition to conjugated dienes– Diels– Alder reactions — polybutadiene, polyisoprene (natural rubber), vulcanisation, polychloroprene. **Alkynes** Nomenclature; general methods of preparation, properties and reactions; acidic nature of terminal alkynes and acetylene. **Cycloalkanes:** Nomenclature, Relative stability of cycloalkanes, Bayer's strain theory and its limitations.
	UNIT-V **Hydrocarbon Chemistry - II** **Benzene:** Source, structure of benzene, stability of benzene ring, molecular orbital picture of benzene, aromaticity, Huckel's (4n+2) rule and its applications. Electrophilic substitution reactions - General mechanism of aromatic electrophilic substitution - nitration, sulphonation, halogenation, Friedel-Craft's alkylation and acylation. Mono substituted and disubstituted benzene - Effect of substituent – orientation and reactivity. **Polynuclear Aromatic hydrocarbons**: Naphthalene – nomenclature, Haworth synthesis; physical properties, reactions – electrophilic substitution reaction, nitration, sulphonation, halogenation, Friedel – Crafts acylation & alkylation, preferential substitution at □position – reduction, oxidation – uses. Anthracene – synthesis by Elbs reaction, Diels – Alder reaction and Haworth synthesis; physical properties; reactions - Diels-Alder reaction, preferential substitution at C-9 and C-10; uses.
Extended Professional Component (is a part of internal	Questions related to the above topics, from various competitive examinations UPSC/JAM /TNPSC others to be solved (To be discussed during the Tutorial hours)

component only, Not to be included in the external examination question paper)	
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Madan R D, Sathya Prakash, (2003), Modern Inorganic Chemistry, 2nd ed, S.Chand and Company, New Delhi. 2. Sathya Prakash, Tuli G D,Basu S K and Madan R D, (2003), Advanced Inorganic Chemistry, 17th ed., S.Chand and Company, New Delhi. 3. Bahl B S, Arul Bhal, (2003), Advanced Organic Chemistry, 3rd ed., S.Chand and Company, New Delhi. 4. Tewari K S, Mehrothra S N and Vishnoi N K, (1998), Text book of Organic Chemistry, 2nd ed., Vikas Publishing House, New Delhi. 5. Puri B R, Sharma L R, (2002), Principles of Physical Chemistry, 38th ed., Vishal Publishing Company, Jalandhar.
Reference Books	1. Maron S H and Prutton C P, (1972), Principles of Physical Chemistry, 4th ed., The Macmillan Company, Newyork. 2. Barrow G M, (1992), Physical Chemistry, 5th ed., Tata McGraw Hill, New Delhi. 3. Lee J D, (1991), Concise Inorganic Chemistry, 4thed., ELBS William Heinemann, London. 4. Huheey J E, (1993), Inorganic Chemistry: Principles of Structure and Reactivity, 4th ed., Addison Wesley Publishing Company, India. 5. Gurudeep Raj, (2001), Advanced Inorganic Chemistry Vol – I, 26th ed., Goel Publishing House, Meerut. 6. Agarwal O P, (1995), Reactions and Reagents in Organic Chemistry, 8thed., Goel Publishing House,Meerut.
Website and e-learning source	https://onlinecourses.nptel.ac.inhttp://cactus.dixie.edu/smblack/chem1010/lecture_notes/4B.html http://www.auburn.edu/~deruija/pdareson.pdfhttps://swayam.gov.in/course/64 - atomic-structure-and-chemical-bonding **MOOC components** http://nptel.ac.in/courses/104101090/ Lecture 1: Classification of elements and periodic properties http://nptel.ac.in/courses/104101090/

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

CO1: explain the concept of acids, bases and ionic equilibria; periodic properties of s and p block elements, preparation and properties of aliphatic and aromatic hydrocarbons
CO2: discuss the periodic properties of sand p- block elements, reactions of aliphatic and aromatic hydrocarbons and strength of acids
CO3: classify hydrocarbons, types of reactions, acids and bases, examine the properties s and p-block elements, reaction mechanisms of aliphatic and aromatic hydrocarbons
CO4: explain theories of acids, bases and indicators, buffer action and important compounds of s-block elements
CO5: assess the application of hard and soft acids indicators, buffers, compounds of s and p-block elements and hydrocarbons

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M
CO5	S	M	S	S	S	S	S	M	M	S

CO-PO Mapping (Course Articulation Matrix)

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

Model Question Paper

SECTION A – (10 × 2 = 20 marks)

Answer ALL questions

1. Write a short note on the concept of Bronsted-Lowry theory.
2. Define a solubility product.
3. Mention the uses of KClO3.
4. Write any two alloys of Al.
5. Write down any four oxy-acids of sulphur.
6. What is meant by pseudo-halogens?
7. What is cracking?
8. What is geometric isomerism, given a suitable example?
9. Define Huckel's rule.
10. Mention any two uses of naphthalene.

SECTION B – (5 × 5 = 25 marks)

Answer ALL questions

11. a) Discuss the theory of acid base indicators.

Or

b) Derive the Hederson- Hasselbalch equation.

12. a) Discuss the anomalous behavior of Berilium.

Or

b) Write notes on the comparison between carbon and silicon.

13. a) Discuss the chemical properties of P_2O_5 and PH_3.

Or

b) Discuss the inert halogen compounds of ICl, ClF_3 and IF_7.

14. a) Discuss the Hafmann and Saytzeff rule with a suitable example.

Or

b) Explain the conformational analysis of cyclohexane.

15. a) Discuss the MO of benzene.

Or

b) Discuss the Haworth synthetic preparation method of Anthracene.

SECTION C – (3 × 10 = 30 marks)

Answer any THREE questions

16. Discuss the mechanism of buffer action in acids and bases.
17. Discuss the preparation and structure of diborane and borazine.
18. Explain the preparation, properties, and structure of XeF_2, XeF_4, and $XeOF_4$.
19. Write notes on Brayer's strain theory and mention its limitations.
20. Explain the following electrophilic reactions of anthracene:
    a) Nitration
    b) Sulphonation
    c) Friedel-Crafts acylation
    d) Halogenation
    e) Friedel-Crafts alkylation

Title of the Course	QUALITATIVE ORGANIC ANALYSIS AND PREPARATION OF ORGANIC COMPOUNDS						
Paper No.	Core IV						
Category	Core	Year	I	Credits	2	Course Code	
		Semester	II				

Instructional hours per week	Lecture	Tutorial	Lab Practice	Total
	-	-	3	3
Prerequisites	General Chemistry II			
Objectives of the course	This course aims at providing knowledge on • laboratory safety • handling glass wares • analysis of organic compounds • preparation of organic compounds			
Course Outline	**UNIT I** Safety rules, symbols and first-aid in chemistry laboratory Basic ideas about Bunsen burner, its operation and parts of the flame. Chemistry laboratory glassware –basis information and uses			
	Unit II **Qualitative Organic Analysis** Preliminary examination, detection of special elements - nitrogen, sulphur and halogens Aromatic and aliphatic nature, Test for saturation and unsaturation, identification of functional groups using solubility tests Confirmation of functional groups • monocarboxylic acid, dicarboxylic acid • monohydric phenol, polyhydric phenol • aldehyde, ketone, ester • carbohydrate (reducing and non-reducing sugars) • primary, secondary, tertiary amine • monoamide, diamide, thioamide • anilide, nitro compound • Preparation of derivatives for functional groups			

	UNIT III **Preparation of Organic Compounds (Any 5)** i. Nitration - picric acid from Phenol ii. Halogenation - p-bromo acetanilide from acetanilide iii. Oxidation - benzoic acid from Benzaldehyde iv. Microwave assisted reactions in water: v. Methyl benzoate to Benzoic acid vi. Salicylic acid from Methyl Salicylate vii. Rearrangement - Benzil to Benzilic Acid viii. Hydrolysis of benzamide to Benzoic Acid

	Separation and Purification Techniques (Not for Examination) 1. Purificationof organic compounds by crystallization (from water / alcohol) and distillation 2. Determination of melting and boiling points of organic compounds. 3. **Steam distillation** - Extraction of essential oil from citrus fruits/eucalyptus leaves. 4. **Chromatography (any one) (Group experiment)** (i) Separation of amino acids by Paper Chromatography (ii)Thin Layer Chromatography - mixture of sugars / plant pigments /permanganate dichromate. (iii) Column Chromatography - extraction of carotene, chlorophyll and xanthophyll from leaves / separation of anthracene - anthracene picrate. 5. **Electrophoresis –** Separation of amino acids and proteins. **(Demonstration)** 6. Isolation of casein from milk/Determination of saponification value of oil or fat/Estimation of acetic acid from commercial vinegar. (Any one Group experiment) (4,5& 6–not for ESE)

Reference Books	1. Venkateswaran, V.; Veeraswamy, R.; Kulandaivelu, A.R. *Basic Principles of Practical Chemistry*, 2nd ed.; Sultan Chand: New Delhi, 2012. 2. Manna, A.K. *Practical Organic Chemistry*, Books and Allied: India, 2018. 3. Gurtu, J. N; Kapoor, R. *Advanced Experimental Chemistry (Organic)*, Sultan Chand: New Delhi, 1987. 4. Furniss,B. S.; Hannaford, A. J.; Smith, P. W. G.; Tatchell, A.R. *Vogel's Textbook of Practical Organic Chemistry*, 5th ed.; Pearson: India,1989.
Website and e-learning source	https://www.vlab.co.in/broad-area-chemical-sciences

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

CO1: observe the physical state, odour, colour and solubility of the given organic compound.

CO2: identify the presence of special elements and functional group in an unknown organic compound performing a systematic analysis.

CO3: compare mono and dicarboxylic acids, primary, secondary and tertiary amines, mono and diamides, mono and polyhydric phenols, aldehyde and ketone, reducing and non- reducing sugars and explain the reactions behind it.

CO4: exhibit a solid derivative with respect to the identified functional group.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M

CO-PO Mapping (Course Articulation Matrix)

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
Weightage	12	12	12	12	12

Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

SCHEME OF VALUATION

QUALITATIVE ORGANIC ANALYSIS AND PREPARATION OF ORGANIC COMPOUNDS

Internal assessment: 25 Marks

External assessment: 75 marks

Total: 100 marks

Max. Marks: 75

Record: 15 Marks

Preparation: 20 (quantity: 10 & quality: 10)

Organic Analysis: 40 Marks

Organic Analysis : 40 Marks

Aliphatic or Aromatic: 6 Marks

Saturated or unsaturated: 6 Marks

Tests for elements: 9 Marks

Preliminary Test: 7 Marks

Confirmation Tests: 12 Marks.