

# **CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**



**B.Sc. CHEMISTRY**

**MINOR COURSES**



## FOUR-YEAR UNDER GRADUATE PROGRAMME

(CU-FYUGP)

### BSc CHEMISTRY

Programme	B.Sc Chemistry				
Course Title	<b>BASIC INORGANIC AND NANO CHEMISTRY</b>				
Type of Course	<b>MINOR</b>				
Semester	<b>I</b>				
Academic Level	<b>100-199</b>				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Concept of atom and molecule Constituents of the atom, Rutherford's model of the atom. Periodic table and classification of elements to different blocks, Basic knowledge of qualitative and quantitative analysis Titration and use of indicators				
Course Summary	This course is intended to provide basic knowledge in inorganic chemistry and nanochemistry. The student gets an understanding of the Bohr model of the atom and the modern quantum mechanical model of the atom through the first module of this course. Different types of chemical bonding are also included in the first module. General properties of the atom and the variation of these properties in the periodic table are also discussed in this course. Basic principles of analytical chemistry are included in the third module of this course which includes acid-base titration, redox titration, complexometric titration, and mixture analysis. This course also tries to explore the basic principles and importance of nanochemistry. To master the laboratory skills acid-base titration, and redox titration experiments are incorporated into this course structure.				

#### Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	<b>To Understand the structure of atoms and rules regarding the arrangement of electrons in an atom.</b>	U	C	Instructor-created exams / Quiz /Assignment
CO2	<b>To discuss the chemical bonding theories of chemical bonding and predict molecular shapes using VSEPR theory</b>	U	F	Instructor-created exams / Quiz /Assignment

CO3	<b>To Comprehend periodic properties, understand laws and the concept of the modern periodic table, and its implications</b>	U	F	Instructor-created exams / Quiz /Assignment
CO4	<b>To Master the principle of volumetric analysis, understand the separation of cations in qualitative analysis</b>	U	C	Instructor-created exams / Quiz /Assignment
CO5	<b>To understand the basics of Nano chemistry &amp; to describe the synthesis of nanomaterials, carbon nanotubes, and their applications,</b>	U	F	Instructor-created exams / Quiz /Assignment
CO6	<b>To Perform different titrations and execute open-ended experiments safely and effectively</b>	Ap	P	Lab work
<p>* - Remember (R), Understand (U), Apply (Ap), Analyze (An), Evaluate (E), Create (C)  # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)  Metacognitive Knowledge (M)</p>				

#### Detailed Syllabus:

Module	Unit	Content	Hrs	Mark
I		<b>Atomic structure and Chemical Bonding</b>	<b>15</b>	<b>34</b>
	1	Bohr atom model, merits and its limitations, Heisenberg uncertainty principle, Louis de Broglie's matter waves – dual nature.	2	
	2	Schrödinger wave equation (Mention the equation and the terms in it), - Concept of orbitals, comparison of orbit and orbital.	2	
	3	Quantum numbers and their significance	1	
	4	Pauli's Exclusion principle - Hund's rule of maximum multiplicity - Aufbau principle - Electronic configuration of atoms.	2	
	5	Chemical Bonding: Introduction – Type of bonds. Ionic bond, Covalent bond, Coordinate bond, and hydrogen bond (Intermolecular and intramolecular hydrogen bond with examples).	2	
	6	VSEPR theory: Shapes of BeCl <sub>2</sub> , BF <sub>3</sub> , CH <sub>4</sub> , NH <sub>3</sub> , H <sub>2</sub> O, PCl <sub>5</sub> , SF <sub>4</sub> , ClF <sub>3</sub> , XeF <sub>2</sub> , SF <sub>6</sub> , IF <sub>5</sub> , XeF <sub>4</sub> , IF <sub>7</sub> and XeF <sub>6</sub> . NH <sub>4</sub> <sup>+</sup> , SO <sub>4</sub> <sup>2-</sup>	2	
	7	Valence Bond theory - Hybridisation involving s, p and d orbitals: SP (acetylene), SP <sup>2</sup> (ethylene), SP <sup>3</sup> (CH <sub>4</sub> ), SP <sup>3</sup> d (PCl <sub>5</sub> ), SP <sup>3</sup> d <sup>2</sup> (SF <sub>6</sub> )	2	

	8	Molecular Orbital theory: LCAO – Electronic configuration of H <sub>2</sub> , B <sub>2</sub> , C <sub>2</sub> , N <sub>2</sub> , O <sub>2</sub> and CO – Calculation of bond order and its applications. (Bond length and bond strength), Comparison of VB and MO theories	2	
II		<b>Periodic Properties</b>	<b>5</b>	<b>10</b>
	9	Name and symbol of elements, Law of triads, octaves, X-ray studies of Henry Mosley, Moseley's periodic law - Modern periodic law – Long form periodic table.	2	
	10	Periodicity in properties: Atomic and ionic radii, Ionization enthalpy - Electron affinity (electron gain enthalpy) – Electronegativity, valency, Oxidation number (Representative element), metallic and non-metallic character, inert pair effect,	3	
III		<b>Analytical Chemistry</b>	<b>15</b>	<b>34</b>
	11	Atomic mass - Molecular mass - Mole concept – Molar volume - Oxidation and reduction – Equivalent mass.	2	
	12	Methods of expressing concentration: Molality, molarity, normality, ppm, and mole fraction.	2	
	13	Dilution formula, Theory of volumetric analysis – Acid-base, redox, and complexometric titrations :	3	
	14	acid-base, redox, and complexometric indicators. Double burette method of titration: Principle and advantages.	2	
	15	Principles in the separation of cations in qualitative analysis	2	
	16	Common ion effect and solubility product and its applications in qualitative analysis	2	
	17	Microanalysis and its advantages. Accuracy & Precision (mention only).	2	
IV		<b>Nano Chemistry</b>	<b>10</b>	<b>20</b>
	18	Introduction, Definition of nanomaterials and nanotechnology – Classification of nanomaterials based on dimension with examples for each 0D, 1D, and 2D	2	
	19	Synthesis of nanomaterials: top-down processes and Bottom-up processes	2	
	20	Carbon nanotubes, Types of Carbon nanotubes – SWCNT and MWCNT, Synthesis of Carbon nanotubes - electric arc discharge, laser ablation, and chemical vapor deposition.	3	

	21	Important properties of carbon nanotubes and applications of carbon nanotubes.	1	
	22	Fullerenes, graphene - (basic concept only, no classification is required) Applications of nanomaterials.	2	
		<b>Basic Inorganic Chemistry Practical: Acid-Base titrations and Redox titrations</b>	<b>30</b>	
		<b>General Instructions</b> For weighing electronic balance must be used. For titrations, double burette titration method should be used. Standard solution must be prepared by the student. Use a safety coat, gloves, shoes and goggles in the laboratory. A minimum of 7 experiments must be done. Out of the seven experiments, one is to be open-ended which can be selected by the teacher		
		Importance of lab safety – Burns, Eye accidents, Cuts, gas poisoning, Electric shocks, Treatment of fires, Precautions and preventive measures. Weighing using electronic balance, Preparation of standard solutions.		
	I	<b>Neutralization Titrations</b> 1. Strong acid – strong base. 2. Strong acid – weak base. 3. Weak acid – strong base.		
	II	<b>Redox Titrations - Permanganometry:</b> 4. Estimation of oxalic acid. 5. Estimation of Fe <sup>2+</sup> /FeSO <sub>4</sub> .7H <sub>2</sub> O/Mohr's salt  <b>Redox Titrations - Dichrometry</b> 6. Estimation of Fe <sup>2+</sup> /FeSO <sub>4</sub> .7H <sub>2</sub> O/Mohr's salt using internal indicator. 7. Estimation of Fe <sup>2+</sup> /FeSO <sub>4</sub> .7H <sub>2</sub> O/Mohr's salt using external indicator. <b>Redox Titrations - Iodimetry and Iodometry:</b> 8. Estimation of iodine. 9. Estimation of copper		
V	III	<b>Open-ended experiments - Suggestions</b> Iodometry: Estimation of chromium. Determination of acetic acid content in vinegar by titration with NaOH. Determination of alkali content in antacid tablets by titration with HCl. Determination of available chlorine in bleaching powder.		

## References

1. C. N. R. Rao, *Understanding Chemistry*, Universities Press India Ltd., Hyderabad, 1999.
2. Manas Chanda, *Atomic Structure and Chemical Bonding*, 4th Edn., Tata McGraw Hill Publishing Company, Noida, 2007.
3. R. Puri, L. R. Sharma K. C. Kalia, *Principles of Inorganic Chemistry*, 31st Edn., Milestone Publishers and Distributors, New Delhi, 2013.
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6. J. D. Lee, *Concise Inorganic Chemistry*, 5th Edn., Oxford University Press, New Delhi, 2008.
7. M. A. Shah, Tokeer Ahmad, *Principles of Nanoscience and Nanotechnology*, Narosa Publishing House, New Delhi, 2010.
8. T. Pradeep, *A Textbook of Nanoscience and Nanotechnology*, McGrawhill, New Delhi, 2012.
9. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, *Vogel's Textbook of Quantitative Chemical Analysis*, 6th Edn., Pearson Education, Noida, 2013.
10. G. Svehla, *Vogel's Qualitative Inorganic Analysis*, 7th Edn., Prentice Hall, New Delhi, 1996.

### Mapping of COs with PSOs and POs

	PS O1	PS O2	PS O3	PS O4	PS O5	PS O6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2				2		1				1		
CO 2	2				2		1				1		
CO 3	1				2		1				1		
CO 4	1		1		2		1				1		
CO 5	1				2		1				1		
CO 6			2		1		1		1		2		

### Correlation Levels:

Level	Correlation
0	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

### Assessment Rubrics:

- Quiz / Discussion / Seminar
- Internal Theory / Practical exam
- Assignments / Viva
- End Semester Exam (70%)

### Mapping of COs to Assessment Rubrics

	Internal Theory / Practical Exam	Assignment / Viva	Practical Skill Evaluation	End Semester Examination
CO1	✓	✓		✓
CO2	✓	✓		✓
CO3	✓	✓		✓
CO4	✓	✓		✓
CO5	✓	✓		✓
CO6	✓	✓	✓	



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### BSc CHEMISTRY

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Type of Course	<b>MINOR</b>				
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Academic Level	<b>100-199</b>				
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Course Summary	This course is intended to provide basic knowledge in inorganic chemistry and nanochemistry. The student gets an understanding of the Bohr model of the atom and the modern quantum mechanical model of the atom through the first module of this course. Different types of chemical bonding are also included in the first module. General properties of the atom and the variation of these properties in the periodic table are also discussed in this course. Basic principles of analytical chemistry are included in the third module of this course which includes acid-base titration, redox titration, complexometric titration, and mixture analysis. This course also tries to explain the roles of metal ions in biological systems and understand the biochemistry of certain key elements. To master the laboratory skills acid-base titration, and redox titration experiments are incorporated into this course structure.				

#### Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	<b>To Understand the structure of atoms and rules regarding the arrangement of electrons in an atom.</b>	U	C	Instructor-created exams / Quiz
CO2	<b>To discuss the chemical bonding, theories of chemical bonding and predict molecular shapes using VSEPR theory</b>	U	F	Class test /Assignment / Quiz

CO3	<b>To Comprehend periodic properties, understand laws and the concept of the modern periodic table, and its implications</b>	U	F	Class test /Assignment / Quiz
CO4	<b>To Master the principle of volumetric analysis, understand the separation of cations in qualitative analysis</b>	U	C	Class test /Assignment / Quiz
CO5	<b>To Explain roles of metal ions in biological systems and understand the biochemistry of certain key elements</b>	U	F	Class test /Assignment / Quiz
CO6	<b>To Perform different titrations and execute open-ended experiments safely and effectively</b>	Ap	P	Lab work
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

### Detailed Syllabus:

Module	Unit	Content	Hrs	Marks
I	<b>Atomic structure and Chemical Bonding</b>		<b>15</b>	<b>34</b>
	1	Bohr atom model, merits and its limitations, Heisenberg uncertainty principle, Louis de Broglie's matter waves – dual nature.	2	
	2	Schrödinger wave equation (Mention the equation and the terms in it), - Concept of orbitals, comparison of orbit and orbital.	2	
	3	Quantum numbers and their significance	1	
	4	Pauli's Exclusion principle - Hund's rule of maximum multiplicity - Aufbau principle - Electronic configuration of atoms.	2	
	5	Chemical Bonding: Introduction – Type of bonds. Ionic bond, Covalent bond, Coordinate bond, and hydrogen bond (Intermolecular and intramolecular hydrogen bond with examples).	2	
	6	VSEPR theory: Shapes of BeCl <sub>2</sub> , BF <sub>3</sub> , CH <sub>4</sub> , NH <sub>3</sub> , H <sub>2</sub> O, PCl <sub>5</sub> , SF <sub>4</sub> , ClF <sub>3</sub> , XeF <sub>2</sub> , SF <sub>6</sub> , IF <sub>5</sub> , XeF <sub>4</sub> , IF <sub>7</sub> and XeF <sub>6</sub> . NH <sub>4</sub> <sup>+</sup> , SO <sub>4</sub> <sup>2-</sup>	2	
	7	Valence Bond theory - Hybridisation involving s, p and d orbitals: SP (acetylene), SP <sup>2</sup> (ethylene), SP <sup>3</sup> (CH <sub>4</sub> ), SP <sup>3</sup> d (PCl <sub>5</sub> ), SP <sup>3</sup> d <sup>2</sup> (SF <sub>6</sub> )	2	
	8	Molecular Orbital theory: LCAO – Electronic configuration of H <sub>2</sub> , B <sub>2</sub> , C <sub>2</sub> , N <sub>2</sub> , O <sub>2</sub> and CO – Calculation	2	

		of bond order and its applications.(Bond length and bond strength), Comparison of VB and MO theories		
II		<b>Periodic Properties</b>	<b>5</b>	<b>10</b>
	9	Name and symbol of elements, Law of triads, octaves, X-ray studies of Henry Mosley, Moseley's periodic law - Modern periodic law – Long form periodic table.	<b>2</b>	
	10	Periodicity in properties: Atomic and ionic radii, Ionization enthalpy - Electron affinity (electron gain enthalpy) – Electronegativity, valency, Oxidation number (Representative element), metallic and non-metallic character, inert pair effect,	<b>3</b>	
III		<b>Analytical Chemistry</b>	<b>15</b>	<b>34</b>
	11	Atomic mass - Molecular mass - Mole concept – Molar volume - Oxidation and reduction – Equivalent mass.	<b>2</b>	
	12	Methods of expressing concentration: Molality, molarity, normality, ppm, and mole fraction.	<b>2</b>	
	13	Dilution formula, Theory of volumetric analysis – Acid-base, redox, and complexometric titrations :	<b>3</b>	
	14	acid-base, redox, and complexometric indicators. Double burette method of titration: Principle and advantages.	<b>2</b>	
	15	Principles in the separation of cations in qualitative analysis	<b>2</b>	
	16	Common ion effect and solubility product and its applications in qualitative analysis –	<b>2</b>	
	17	Microanalysis and its advantages. Accuracy & Precision (mention only).	<b>2</b>	
IV		<b>Bio-inorganic Chemistry</b>	<b>10</b>	<b>20</b>
	18	Metal ions in biological systems - Biochemistry of iron, Haemoglobin and myoglobin,	<b>2</b>	
	19	O <sub>2</sub> and CO <sub>2</sub> transportation (mechanism not required) - Chlorophyll and photosynthesis (mechanism not expected)	<b>2</b>	
	20	Elementary idea of structure and mechanism of action of sodium potassium pump	<b>2</b>	
	21	Biochemistry of zinc and cobalt. Toxicity of metal ions (Pb, Hg and As).	<b>2</b>	
	22	Anticancer drugs: <i>Cis</i> -platin, oxaliplatin,– Structure and significance.	<b>2</b>	
		<b>Basic Inorganic Chemistry Practical: Acid-Base titrations and Redox titrations</b>	<b>30</b>	

V		<b>General Instructions</b> For weighing electronic balance must be used. For titrations, double burette titration method should be used. Standard solution must be prepared by the student. Use a safety coat, gloves, shoes and goggles in the laboratory. A minimum of 7 experiments must be done. Out of the seven experiments, one is to be open-ended which can be selected by the teacher		
		Importance of lab safety – Burns, Eye accidents, Cuts, gas poisoning, Electric shocks, Treatment of fires, Precautions and preventive measures. Weighing using electronic balance, Preparation of standard solutions.		
	I	<b>Neutralization Titrations</b> 1. Strong acid – strong base. 2. Strong acid – weak base. 3. Weak acid – strong base.		
	II	<b>Redox Titrations - Permanganometry:</b> 4. Estimation of oxalic acid. 5. Estimation of Fe <sup>2+</sup> /FeSO <sub>4</sub> .7H <sub>2</sub> O/Mohr's salt  <b>Redox Titrations - Dichrometry</b> 6. Estimation of Fe <sup>2+</sup> /FeSO <sub>4</sub> .7H <sub>2</sub> O/Mohr's salt using internal indicator. 7. Estimation of Fe <sup>2+</sup> /FeSO <sub>4</sub> .7H <sub>2</sub> O/Mohr's salt using external indicator.  <b>Redox Titrations - Iodimetry and Iodometry:</b> 8. Estimation of iodine. 9. Estimation of copper		
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7. G. L. Meissler, D. A. Tarr, *Inorganic Chemistry*, 3<sup>rd</sup> Edn. Pearson Education, 2004.
8. J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, *Inorganic Chemistry*, 5<sup>th</sup> Edn., Pearson, 2009.
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CO 6			2		1		1		1		2		

**Correlation Levels :**

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**Assessment Rubrics:**

- Quiz / Discussion / Seminar
- Internal Theory / Practical exam
- Assignments / Viva
- End Semester Exam (70%)

**Mapping of COs to Assessment Rubrics**

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CO1	✓	✓		✓
CO2	✓	✓		✓
CO3	✓	✓		✓
CO4	✓	✓		✓
CO5	✓	✓		✓
CO6		✓	✓	



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(CU-FYUGP)

**BSc CHEMISTRY**

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Semester	<b>I</b>				
Academic Level	<b>100-199</b>				
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CO5	<b>To Comprehend the process in metallurgy including extraction of metals and alloy formation</b>	U	F	Class test /Assignment / Quiz
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		bond order and its applications.(Bond length and bond strength), Comparison of VB and MO theories		
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	9	Name and symbol of elements, Law of triads, octaves, X-ray studies of Henry Mosley, Mosleys periodic law - Modern periodic law – Long form periodic table.	<b>2</b>	
	10	Periodicity in properties: Atomic and ionic radii, Ionization enthalpy - Electron affinity (electron gain enthalpy) – Electronegativity, valency, Oxidation number (Representative element), metallic and non-metallic character, inert pair effect,	<b>3</b>	
<b>III</b>		<b>Analytical Chemistry</b>	<b>15</b>	<b>34</b>
	11	Atomic mass - Molecular mass - Mole concept – Molar volume - Oxidation and reduction – Equivalent mass.	<b>2</b>	
	12	Methods of expressing concentration: Molality, molarity, normality, ppm, and mole fraction.	<b>2</b>	
	13	Dilution formula, Theory of volumetric analysis – Acid-base, redox, and complexometric titrations :	<b>3</b>	
	14	acid-base, redox, and complexometric indicators. Double burette method of titration: Principle and advantages.	<b>2</b>	
	15	Principles in the separation of cations in qualitative analysis	<b>2</b>	
	16	Common ion effect and solubility product and its applications in qualitative analysis –	<b>2</b>	
	17	Microanalysis and its advantages. Accuracy & Precision (mention only).	<b>2</b>	
<b>IV</b>		<b>Metallurgy</b>	<b>10</b>	<b>20</b>
	18	Ores and minerals, Concentration of ores – Calcination and roasting – Reduction to free metal.	<b>2</b>	
	19	Electrometallurgy – Hydrometallurgy. Refining of metals: Electrolytic refining, zone refining	<b>2</b>	
	20	Extractive metallurgy of Al, Fe	<b>2</b>	
	21	Alloys: Definition – Composition and uses of German silver, brass, bronze, gunmetal and alnico. Steel: Open hearth process (brief description only)	<b>2</b>	
	22	Classification of steel – Composition and uses of stainless steels, and applications of industrially important stainless steel types- (AISI Grade mention only)	<b>2</b>	
		<b>Basic Inorganic Chemistry Practical: Acid-Base titrations and Redox titrations</b>	<b>30</b>	

V		<b>General Instructions</b> For weighing electronic balance must be used. For titrations, double burette titration method should be used. Standard solution must be prepared by the student. Use a safety coat, gloves, shoes and goggles in the laboratory. A minimum of 7 experiments must be done. Out of the seven experiments, one is to be open-ended which can be selected by the teacher		
		Importance of lab safety – Burns, Eye accidents, Cuts, gas poisoning, Electric shocks, Treatment of fires, Precautions and preventive measures. Weighing using electronic balance, Preparation of standard solutions.		
	I	<b>Neutralization Titrations</b> 1. Strong acid – strong base. 2. Strong acid – weak base. 3. Weak acid – strong base.		
	II	<b>Redox Titrations - Permanganometry:</b> 4. Estimation of oxalic acid. 5. Estimation of $\text{Fe}^{2+}/\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ /Mohr's salt  <b>Redox Titrations - Dichrometry</b> 6. Estimation of $\text{Fe}^{2+}/\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ /Mohr's salt using internal indicator. 7. Estimation of $\text{Fe}^{2+}/\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ /Mohr's salt using external indicator.  <b>Redox Titrations - Iodimetry and Iodometry:</b> 8. Estimation of iodine. 9. Estimation of copper		
	III	<b>Open-ended experiments - Suggestions</b> Iodometry: Estimation of chromium. Determination of acetic acid content in vinegar by titration with NaOH. Determination of alkali content in antacid tablets by titration with HCl. Determination of available chlorine in bleaching powder.		

### References

1. C. N. R. Rao, *Understanding Chemistry*, Universities Press India Ltd., Hyderabad, 1999.
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3. R. Puri, L. R. Sharma K. C. Kalia, *Principles of Inorganic Chemistry*, 31st Edn., Milestone Publishers and Distributors, New Delhi, 2013.
4. Satya Prakash, *Advanced Inorganic Chemistry*, Vol. 1, 5th Edn., S. Chand and Sons, New Delhi, 2012.

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- J. D. Lee, *Concise Inorganic Chemistry*, 5th Edn., Oxford University Press, New Delhi, 2008.
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- J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, *Vogel's Textbook of Quantitative Chemical Analysis*, 6th Edn., Pearson Education, Noida, 2013.
- G. Svehla, *Vogel's Qualitative Inorganic Analysis*, 7th Edn., Prentice Hall, New Delhi, 1996.

### Mapping of COs with PSOs and POs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	2				2		1				1		
CO 2	2				2		1				1		
CO 3	1				2		1				1		
CO 4	1		1		2		1				1		
CO 5	1				2		1				1		
CO 6			2		1		1		1		2		

### Correlation Levels :

Level	Correlation
0	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

### Assessment Rubrics:

- Quiz / Discussion / Seminar
- Internal Theory / Practical exam
- Assignments / Viva
- End Semester Exam (70%)

### Mapping of COs to Assessment Rubrics

	Internal Theory / Practical Exam	Assignment / Viva	Practical Skill Evaluation	End Semester Examination
CO1	✓	✓		✓
CO2	✓	✓		✓
CO3	✓	✓		✓
CO4	✓	✓		✓
CO5	✓	✓		✓
CO6		✓	✓	



**FOUR-YEAR UNDER GRADUATE PROGRAMME  
(CU-FYUGP)**

**BSc CHEMISTRY**

Programme	B. Sc. Chemistry				
Course Title	<b>ENVIRONMENTAL CHEMISTRY</b>				
Type of Course	<b>MDC</b>				
Semester	<b>I</b>				
Academic Level	<b>100-199</b>				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	3	-	-	45
Pre-requisites	What is Environment. Basic idea of environmental pollution.				
Course Summary	This course ensures that the students acquire a profound knowledge and understanding on environmental pollution and the necessity of controlling environmental pollution.				

**Course Outcomes (CO):**

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Acquire the knowledge on ecosystem.	U	C	Instructor-created exams / Quiz
CO2	Recall the technical/scientific terms involved in pollution.	U	C	Instructor-created exams / Quiz
CO3	Recognize different types of toxic substances that cause environmental pollution.	U	C	Instructor-created exams / Assignment
CO4	Understand the effects of environmental pollution.	U	C	Seminar Presentation / Viva
CO5	Understand various pollution control measures.	U	C	Instructor-created exams / Quiz
CO6	Discuss and report local and global environmental issues based on the knowledge gained throughout the course.	Ap	P	Group discussion and Seminar presentation/Viva

\* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)  
 # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)  
 Metacognitive Knowledge (M)

**Detailed Syllabus:**

Module	Unit	Content	Hrs	Mark
<b>I</b>	<b>Introduction to Environmental Chemistry</b>		<b>9</b>	<b>18</b>
	1	Environmental segments-Atmosphere, Hydrosphere, Lithosphere, Biosphere	2	
	2	Interaction between different environmental spheres Concept of ecosystem, abiotic and biotic components	2	
	3	Composition of Air, Water and Soil	2	
	4	Environmental pollution – Concepts and definition – Pollutant, contaminant, receptor and sink	1	
	5	Classification of pollutants – Global, regional, local, persistent and non-persistent pollutants.	1	
	6	Types of pollution	1	
<b>II</b>	<b>Air Pollution</b>		<b>9</b>	<b>18</b>
	7	Tropospheric pollution – Gaseous air pollutants – Hydrocarbons, oxides of sulphur, nitrogen and carbon (Elementary idea only)	2	
	8	Global warming, green house effect, acid rain	1	
	9	Particulates – Smog: London smog and photochemical smog –	2	
	10	stratospheric pollution - depletion of ozone layer, chlorofluorocarbons - Automobile pollution.	2	
	11	Control of air pollution	2	
<b>III</b>	<b>Water Pollution</b>		<b>10</b>	<b>20</b>
	12	Impurities in water – cause of pollution – natural and anthropogenic – Marine water pollution – Underground water pollution.	1	
	13	Source of water pollution – Industrial waste, Municipal waste, Agricultural waste, Radioactive waste, Petroleum, Pharmaceutical, heavy metal, pesticides, soaps and detergents.	2	
	14	Types of water pollutants: Biological agents, physical agents and chemical agents – Eutrophication- biomagnification and bioaccumulation.	2	
	15	Water quality parameters: DO, BOD, COD, alkalinity, hardness, chloride, fluoride and nitrate. Toxic metals in water and their effects: Cadmium, lead and oil pollution in water.	3	
	16	Water pollution control methods	2	

IV	<b>Soil, Thermal, and Radioactive Pollutions</b>		<b>8</b>	<b>14</b>
	18	Soil pollution: Sources by industrial and urban wastes. Non-degradable, degradable and biodegradable wastes. Hazardous waste.	2	
	19	Pollution due to plastics, pesticides, biomedical waste and <i>e-waste</i> (source, effects and control measures) – Control of soil pollution - Solid waste Management – Open dumping, Landfilling, Incineration, Re-use, reclamation, recycle, composting.	3	
	20	Thermal pollution – definition, sources, harmful effects and prevention.	1	
	21	Radioactive pollution (source, effects and control measures) – Hiroshima, Nagasaki and Chernobyl accidents (brief study).	2	
V	<b>Open Ended Module: Environmental issues</b>		<b>9</b>	
	1	Environment and society  Pollution case studies: Chernobyl disaster, Bhopal tragedy, Endosulfan disaster in Kerala (brief study) etc.		

### References

1. A. K. De, *Environmental Chemistry*, 6<sup>th</sup> Edn., New Age International.
2. A. K. Ahluwalia, *Environmental Chemistry*, The Energy and Resources Institute, 2017.
3. Balram Pani, *Textbook of Environmental Chemistry*, I. K. International Pvt Ltd, 2010.
4. S.K. Banerjee, *Environmental Chemistry*, 2<sup>nd</sup> Edn., Prentice-Hall of India Pvt. Ltd., New Delhi, 2005.
5. V.N. Bashkin, *Environmental Chemistry: Asian Lessons*, Springer Science & Business Media, 2003.
6. S.E. Manahan, *Environmental Chemistry*, 8<sup>th</sup> Edn., CRC Press, Florida, 2004.
7. Balram Pani, *Textbook of Environmental Chemistry*, I. K. International Pvt Ltd, 2010.
8. J. M. H. Selendy, *Water and Sanitation-Related Diseases and the Changing Environment*, John Wiley & Sons, Inc.
9. P. K. Goel, *Water Pollution: Causes, Effects and Control*, New Age International, 2006.
10. V. N. Bashkin, *Environmental Chemistry: Asian Lessons*, Springer Science & Business Media, 2003.
11. Pallavi Saxena, Vaishali Naik, *Air Pollution: Sources, Impacts and Controls*, CAB International, 2018.
12. Gabi Mocatta (2015) *Environmental Journalism*, Deakin University Open School of Journalism.
13. D. S. Poomananda (2022), *Environmental Journalism: Reporting on Environmental Concerns and Climate Change in India*, SAGE Publishing India
14. Frome, Michael. (1998) *Green Ink: An Introduction to Environmental Journalism*. Salt Lake City: University of Utah Press.
15. Sachsman, D. B. & Valenti, J. M. (2020). *Routledge handbook of environmental journalism*. New York, NY: Routledge.
16. Blum, D., Henig, R., Knudson, M., (2005). "[A Field Guide for Science Writers](#)." Oxford University Press; 2nd edition.
17. Hansen, Anders. (2010) *Environment, Media and Communication*. London: Routledge

**Mapping of COs with PSOs and POs :**

	PSO 1	PSO 2	PSO 3	PSO4	PSO5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	-	-	1	1	1			2	1		
CO 2	1		-	-	1	1	1			1	1	1	1
CO 3	-	-		1	2	2	1			2	2	1	
CO 4	-	-			1	2	1			1	1	1	1
CO 5	-		-	1	2	2	1			1		1	1
CO 6	-	-	-	1	2	2	1			1	1	1	1

**Correlation Levels:**

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics :**

	Internal Exam	Assignment/viva	Quiz/seminar/ Group discussion	End Semester Examinations
CO 1	✓		✓	✓
CO 2	✓		✓	✓
CO 3	✓	✓		✓
CO 4		✓	✓	✓
CO 5	✓		✓	✓
CO 6		✓	✓	



**FOUR-YEAR UNDER GRADUATE PROGRAMME  
(CU-FYUGP)**

**BSc CHEMISTRY**

Programme	B.Sc Chemistry				
Course Title	<b>QUANTUM MECHANICS, SOLID STATE AND GASEOUS STATE</b>				
Type of Course	<b>MINOR</b>				
Semester	<b>II</b>				
Academic Level	<b>100 - 199</b>				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Basic idea the structure of atom 2. Fundamentals of states of matter 3. Basic knowledge in analytical principles				
Course Summary	1. This course aims to introduce the failures of classical theories in explaining many experiments and the emergence of quantum theory. 2. This course also aims to realise the theories of different states of matter and their implications. 3. This course also aims to develop proficiency in qualitative analysis and to familiarize physical chemistry experiments				

**Course Outcomes (CO):**

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand the importance and the impact of quantum revolution in science.	U	F	Instructor-created exams / Quiz /Assignment
CO2	To evaluate the properties of solids	E	C	Instructor-created exams / Quiz /Assignment
CO3	To analyse the behaviour of gases	An	C	Instructor-created exams / Quiz /Assignment
CO4	To understand the properties of gaseous state and how it links to thermodynamic systems.	U	C	Instructor-created exams / Quiz /Assignment
CO5	To perform the cation analysis on a provided mixture containing two cations.	An	P	Lab work

CO6	To enable the students to determine the physical properties (physical constants).	Ap	P	Lab work
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

### Detailed Syllabus:

Module	Unit	Content	Hrs	Marks
<b>I</b>	<b>Introduction to Quantum mechanics</b>		<b>15</b>	<b>32</b>
	1	Postulates of quantum mechanics – derivation of time-independent Schrodinger equation	2	
	2	Particle in one dimensional box problem- Schrodinger equation, derivation for expression of energy, quantisation of energy levels, HOMO-LUMO transition in 1,3-butadiene Particle in three dimensional box (no derivation)- Concept of degeneracy of energy levels	3	
	3	Harmonic oscillator model, Schrodinger equation and Energy levels (basic idea only, no derivation)	1	
	4	Spherical polar coordinates and Rigid rotor model (no derivation, basic idea only), Expression for energy, Spherical harmonics, Angular momentum	2	
	5	Quantum mechanics of Hydrogen-like atoms - Hamiltonian operator of H-like systems, The Schrodinger equation in spherical polar coordinates, separation of variables	3	
	6	Wave functions or atomic orbitals, radial and angular parts of atomic orbitals. Quantum numbers (n, l, m).	2	
	7	The Stern - Gerlach experiment and the concept of electron spin, spin quantum number.	2	
<b>II</b>	<b>Solid state</b>		<b>10</b>	<b>22</b>
	8	Classification of solids: Amorphous, Crystalline, Lattice points, lattice energy (general idea), unit cell, seven crystal systems.	2	
	9	Weiss and Miller indices - Bravais lattices, Close packing in crystals, examples of simple cubic, bcc and fcc lattices,	1	
	10	Explanation of electrical properties using concepts of bands, Explanation of conductors, semiconductors and insulators, Super conductors	2	
	11	Magnetic Properties: classification - diamagnetic, paramagnetic, antiferromagnetic, ferro and ferrimagnetic, permanent and temporary magnets.	3	
	12	Defects in crystals – stoichiometric and non-stoichiometric defects (Basic ideas only).	2	
<b>III</b>	<b>Gaseous state - I</b>		<b>10</b>	<b>22</b>

	13	Characteristics of gases	1	
	14	Postulates of kinetic theory of gases	2	
	15	Maxwell's distribution of molecular velocities – Root mean square, average and most probable velocities.	3	
	16	Collision number – Mean free path – Collision diameter	1	
	17	Viscosity of gases, including their temperature and pressure dependence,	1	
	18	Relation between mean free path and coefficient of viscosity, calculation of $\sigma$ from $\eta$ ; variation of viscosity with temperature and pressure.	2	
<b>IV</b>	<b>Gaseous state -II</b>		<b>10</b>	<b>22</b>
	19	Behaviour of real gases - Deviation from ideal behaviour – Compressibility factor	3	
	20	Causes of deviation from ideal behaviour - van der Waals equation of state (derivation not required) – Expression of van der Waals equation in virial form and calculation of Boyle temperature	4	
	21	PV isotherms of real gases – Continuity of states – Isotherm of van der Waals equation	1	
	22	Critical phenomena (basic idea only) – Critical constants and their determination (derivation not required) – Relationship between critical constants and van der Waals constants.	2	
<b>V</b>	<b>Practical</b>		<b>30</b>	
	A minimum of seven experiments must be done. Out of the seven experiments, one is to be open-ended which can be selected by the teacher			
	1	Inorganic Qualitative Analysis (semi – micro analysis) <ul style="list-style-type: none"> <li>● Reactions of Cations: Study of the reactions of the following cations with a view of their identification and confirmation. <math>\text{NH}_4^+</math>, <math>\text{Pb}^{2+}</math>, <math>\text{Cu}^{2+}</math>, <math>\text{Cd}^{2+}</math>, <math>\text{Al}^{3+}</math>, <math>\text{Ni}^{2+}</math>, <math>\text{Co}^{2+}</math>, <math>\text{Mn}^{2+}</math>, <math>\text{Zn}^{2+}</math>, <math>\text{Ba}^{2+}</math>, <math>\text{Sr}^{2+}</math>, <math>\text{Ca}^{2+}</math>, and <math>\text{Mg}^{2+}</math></li> <li>● Systematic qualitative analysis of a solution containing any two cations from the above list. (Minimum 6 mixtures)</li> </ul>	25	
	2	Open ended experiments– Physical chemistry experiments. (Any one experiment) <p>Suggestions</p> <p>Determination of Physical Constants [Determination of colligative properties, Determination of viscosity of a binary liquid solution (Glycerol-water system) Refractometry experiments etc]</p>	5	

### Reference Books

1. P. W. Atkins, J. de Paula, Atkin's Physical Chemistry, 8th Edn., Oxford University Press, 2006.

- B. R. Puri, L. R. Sharma, M. S. Pathania, Principles of Physical Chemistry, 46th Edn., Vishal Publishing Company, New Delhi, 2013.
- Kapoor K. L., Text Book of Physical Chemistry, McGraw Hill, 3rd Edn. 2017.
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- Anthony R. West, Solid State Chemistry and its Applications, 2nd Edn., Wiley-Blackwell, 2014.
- L. V. Azaroff, Introduction to Solids, Tata McGraw Hill Publishing Company, New Delhi, 1960.
- J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, Vogel's Textbook of Qualitative Chemical Analysis, 6<sup>th</sup> Edn., Pearson Education, Noida, 2013.
- V. V. Ramanujam, Inorganic Semi Micro Qualitative Analysis, 3<sup>rd</sup> Edn., The National Publishing Company, Chennai, 1974.
- A. Findlay, Findlay's Practical Physical Chemistry, 9<sup>th</sup> Edn., John Wiley and Sons, New York, 1972.
- J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publications, Meerut, 2008.

#### Mapping of COs with PSOs and POs

	PS O1	PS O2	PS O3	PS O4	PS O5	PS O6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2				2		1						
CO 2	2				2		1						
CO 3	2				2		1						
CO 4	2				2		1						
CO 5			2		2		1				1		
CO 6			2		2		1				1		

#### Correlation Levels :

Level	Correlation
0	Nil
1	Slightly / Low

2	Moderate / Medium
3	Substantial / High

**Assessment Rubrics:**

- Quiz / Discussion / Seminar
- Internal Theory / Practical exam
- Assignments / Viva
- End Semester Exam (70%)

**Mapping of COs to Assessment Rubrics**

	Internal Theory / Practical Exam	Assignment / Viva	Practical Skill Evaluation	End Semester Examination
CO1	✓	✓		✓
CO2	✓	✓		✓
CO3	✓	✓		✓
CO4	✓	✓		✓
CO5	✓	✓	✓	
CO6	✓	✓	✓	



**FOUR-YEAR UNDER GRADUATE PROGRAMME  
(CU-FYUGP)**

**BSc CHEMISTRY**

Programme	B.Sc Chemistry				
Course Title	<b>LIQUID STATE, GASEOUS STATE AND ELECTROCHEMISTRY</b>				
Type of Course	<b>MINOR</b>				
Semester	<b>II</b>				
Academic Level	<b>100 - 199</b>				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Fundamentals of Gaseous and Liquid states of matter 2. Basic principles of Electrochemistry 3. Basic knowledge in analytical principles				
Course Summary	1. This course provides the students a thorough knowledge about gaseous and liquid states of matter and the continuity between them. 2. This course aims to impart an idea about electrochemistry 3. This course also aims to develop proficiency in qualitative analysis and to familiarize physical chemistry experiments				

**Course Outcomes (CO):**

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To apply the postulates of kinetic theory of gases.	Ap	F	Instructor-created exams / Quiz /Assignment
CO2	To describe the properties of liquids.	E	C	Instructor-created exams / Quiz /Assignment
CO3	To analyse the behaviour of gases and liquids	An	C	Instructor-created exams / Quiz /Assignment
CO4	To illustrate the basic concepts of electrochemistry and its applications	U	C	Instructor-created exams / Quiz /Assignment
CO5	To perform the cation analysis on a provided mixture containing two cations.	An	P	Lab work

CO6	To enable the students to determine the physical properties (physical constants).	Ap	P	Lab work
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

### Detailed Syllabus:

Module	Unit	Content	Hrs (75)	Marks
<b>I</b>	<b>Liquid State</b>		<b>15</b>	<b>34</b>
	1	Introduction – Definition and characteristics of liquids - Vapour pressure, surface tension and viscosity - Explanation of these properties on the basis of intermolecular attraction.	4	
	2	Kinds of solutions –Solubility of gases in liquids – Henry’s law and its applications	2	
	3	Raoult’s law – Ideal and non-ideal solutions – Dilute solutions.	2	
	4	Colligative properties – Qualitative treatment of colligative properties – Relative lowering of vapour pressure – Elevation of boiling point,– Depression in freezing point – Osmotic pressure – Reverse osmosis and its applications	3	
	5	– Application of colligative properties in finding molecular weights (thermodynamic derivation not needed) – Abnormal molecular mass – Van’t Hoff factor	2	
	6	Introduction to liquid crystal phases. Types of liquid crystals: nematic, smectic, cholesteric.	1	
	7	Applications of liquid crystals.	1	
<b>II</b>	<b>Gaseous State - I</b>		<b>10</b>	<b>20</b>
	8	Characteristics of gases	1	
	9	Postulates of kinetic theory of gases	2	
	10	Maxwell’s distribution of molecular velocities – Root mean square, average and most probable velocities.	3	
	11	Collision number – Mean free path – Collision diameter	1	
	12	Viscosity of gases, including their temperature and pressure dependence,	1	

	13	Relation between mean free path and coefficient of viscosity, calculation of $\sigma$ from $\eta$ ; variation of viscosity with temperature and pressure.	2	
<b>III</b>	<b>Gaseous State - II</b>		<b>10</b>	<b>22</b>
	14	Behaviour of real gases - Deviation from ideal behaviour – Compressibility factor	3	
	15	Causes of deviation from ideal behaviour - van der Waals equation of state (derivation not required) – Expression of van der Waals equation in virial form and calculation of Boyle temperature	4	
	16	PV isotherms of real gases – Continuity of states – Isotherm of van der Waals equation	1	
	17	Critical phenomena (basic idea only) – Critical constants and their determination (derivation not required) – Relationship between critical constants and van der Waals constants.	2	
<b>IV</b>	<b>Electrochemistry</b>		<b>10</b>	<b>22</b>
	18	Specific conductance, equivalent conductance and molar conductance	2	
	19	Variation of conductance with dilution - Kohlrausch's law - Degree of ionization of weak electrolytes	2	
	20	Application of conductance measurements – Conductometric titrations.	1	
	21	Galvanic cells – emf of cell and electrode potentials - IUPAC sign convention – Reference electrodes – Standard Hydrogen electrode – Calomel electrode - Standard electrode potential - Nernst equation	2	
	22	H <sub>2</sub> -O <sub>2</sub> fuel cell. Ostwald's dilution law – Buffer solutions – Buffer action [acetic acid/sodium acetate & NH <sub>4</sub> OH/NH <sub>4</sub> Cl], applications of buffers.	3	
<b>V</b>	<b>Practical</b>		<b>30</b>	
	A minimum of seven experiments must be done. Out of the seven experiments, one is to be open-ended which can be selected by the teacher			
	1	a) Inorganic Qualitative Analysis (semi – micro analysis) <ul style="list-style-type: none"> <li>Reactions of Cations: Study of the reactions of the following cations with a view of their identification and</li> </ul>	25	

		confirmation. $\text{NH}_4^+$ , $\text{Pb}^{2+}$ , $\text{Cu}^{2+}$ , $\text{Cd}^{2+}$ , $\text{Al}^{3+}$ , $\text{Ni}^{2+}$ , $\text{Co}^{2+}$ , $\text{Mn}^{2+}$ , $\text{Zn}^{2+}$ , $\text{Ba}^{2+}$ , $\text{Sr}^{2+}$ , $\text{Ca}^{2+}$ , and $\text{Mg}^{2+}$ <ul style="list-style-type: none"> <li>• Systematic qualitative analysis of a solution containing any two cations from the above list. (Minimum 6 mixtures)</li> </ul>		
2	b) Open ended experiments– Physical chemistry experiments. (Any one experiment) Suggestions Determination of Physical Constants [Determination of colligative properties, Determination of viscosity of a binary liquid solution (Glycerol-water system) Refractometry experiments etc.]		5	

### Reference Books

1. P. W. Atkins, J. de Paula, Atkin's Physical Chemistry, 8th Edn., Oxford University Press, 2006.
2. B. R. Puri, L. R. Sharma, M. S. Pathania, Principles of Physical Chemistry, 46th Edn., Vishal Publishing Company, New Delhi, 2013.
3. Kapoor K. L., Text Book of Physical Chemistry, McGraw Hill, 3rd Edn. 2017.
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7. V. V. Ramanujam, Inorganic Semi Micro Qualitative Analysis, 3rd Edn., The National Publishing Company, Chennai, 1974.
8. A. Findlay, Findlay's Practical Physical Chemistry, 9th Edn., John Wiley and Sons, New York, 1972.
9. J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publications, Meerut, 2008.

### Mapping of COs with PSOs and POs

	PS O1	PS O2	PS O3	PS O4	PS O5	PS O6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2				2		1						
CO 2	2				2		1						
CO 3	2				2		1						
CO 4	2				2		1						
CO 5			2		2		1				1		
CO 6			2		2		1				1		

### Correlation Levels :

Level	Correlation
0	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

### Assessment Rubrics:

- Quiz / Discussion / Seminar
- Internal Theory / Practical exam
- Assignments / Viva
- End Semester Exam (70%)

### Mapping of COs to Assessment Rubrics

	Internal Theory / Practical Exam	Assignment / Viva	Practical Skill Evaluation	End Semester Examination
CO1	✓	✓		✓
CO2	✓	✓		✓
CO3	✓	✓		✓
CO4	✓	✓		✓
CO5	✓	✓	✓	
CO6	✓	✓	✓	



**FOUR-YEAR UNDER GRADUATE PROGRAMME  
(CU-FYUGP)**

**BSc CHEMISTRY**

Programme	B.Sc Chemistry				
Course Title	<b>STATES OF MATTER AND NUCLEAR CHEMISTRY</b>				
Type of Course	<b>MINOR</b>				
Semester	<b>II</b>				
Academic Level	<b>100 - 199</b>				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Fundamentals of Gaseous and Liquid states of matter 2. Basic idea about nucleons 3. Basic knowledge in analytical principles				
Course Summary	1. This course provides the students a thorough knowledge about gaseous and liquid states of matter and the continuity between them. 2. This course aims to introduce the applications of nuclear chemistry 3. This course also aims to develop proficiency in qualitative analysis and to familiarize physical chemistry experiments				

**Course Outcomes (CO):**

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand the fundamental concepts and the properties of gaseous state and how it relates to thermodynamic systems.	U	F	Instructor-created exams / Quiz /Assignment
CO2	To understand the behaviour of ideal and non-ideal solutions	E	C	Instructor-created exams / Quiz /Assignment
CO3	To analyse the properties of gases and liquids.	An	C	Instructor-created exams / Quiz /Assignment
CO4	To apply the theories of different states of matter and understand their implications.	Ap	F	Instructor-created exams / Quiz /Assignment

CO5	To describe various processes in nuclear chemistry	U	C	Instructor-created exams / Quiz /Assignment
CO6	To analyse cations from a given mixture and enable the students to determine the physical constants.	An	P	Lab work
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

### Detailed Syllabus:

Module	Unit	Content	Hrs (75)	Marks
<b>I</b>	<b>Gaseous State - I</b>		<b>10</b>	<b>22</b>
	1	Characteristics of gases	1	
	2	Postulates of kinetic theory of gases	2	
	3	Maxwell's distribution of molecular velocities – Root mean square, average and most probable velocities.	3	
	4	Collision number – Mean free path – Collision diameter	1	
	5	Viscosity of gases, including their temperature and pressure dependence,	1	
	6	Relation between mean free path and coefficient of viscosity, calculation of $\sigma$ from $\eta$ ; variation of viscosity with temperature and pressure.	2	
<b>II</b>	<b>Gaseous State - II</b>		<b>10</b>	<b>22</b>
	7	Behaviour of real gases - Deviation from ideal behaviour – Compressibility factor	3	
	8	Causes of deviation from ideal behaviour - van der Waals equation of state (derivation not required) – Expression of van der Waals equation in virial form and calculation of Boyle temperature	4	
	9	PV isotherms of real gases – Continuity of states – Isotherm of van der Waals equation	1	
	10	Critical phenomena (basic idea only) – Critical constants and their determination (derivation not required) –	2	

		Relationship between critical constants and van der Waals constants.		
<b>III</b>	<b>Solutions and Liquid crystals</b>		<b>15</b>	<b>32</b>
	11	Introduction – Definition and characteristics of liquids - Vapour pressure, surface tension and viscosity - Explanation of these properties on the basis of intermolecular attraction.	4	
	12	Kinds of solutions –Solubility of gases in liquids – Henry’s law and its applications	2	
	13	Raoult’s law – Ideal and non-ideal solutions – Dilute solutions.	2	
	14	Colligative properties – Qualitative treatment of colligative properties – Relative lowering of vapor pressure – Elevation of boiling point,– Depression in freezing point – Osmotic pressure – Reverse osmosis and its applications	3	
	15	– Application of colligative properties in finding molecular weights (thermodynamic derivation not needed) – Abnormal molecular mass – Van’t Hoff factor	2	
	16	Introduction to liquid crystal phases. Types of liquid crystals: nematic, smectic, cholesteric.	1	
	17	Applications of liquid crystals.	1	
<b>IV</b>	<b>Nuclear Chemistry</b>		<b>10</b>	<b>22</b>
	18	Natural radioactivity – Modes of decay – Group displacement law.	2	
	19	Nuclear forces - n/p ratio - Nuclear stability - Mass Defect - Binding energy	2	
	10	Isotopes, isobars and isotones with examples. Nuclear fission - Atom bomb - Nuclear fusion – Hydrogen bomb	1	
	21	Nuclear reactors	1	
	22	Application of radioactive isotopes – <sup>14</sup> C dating, Rock dating, Isotopes as tracers, Radio diagnosis, Radiotherapy. Problems	4	
<b>V</b>	<b>Practical</b>		<b>30</b>	

	A minimum of seven experiments must be done. Out of the seven experiments, one is to be open-ended which can be selected by the teacher		
1	a) Inorganic Qualitative Analysis (semi – micro analysis) <ul style="list-style-type: none"> <li>● Reactions of Cations: Study of the reactions of the following cations with a view of their identification and confirmation. <math>\text{NH}_4^+</math>, <math>\text{Pb}^{2+}</math>, <math>\text{Cu}^{2+}</math>, <math>\text{Cd}^{2+}</math>, <math>\text{Al}^{3+}</math>, <math>\text{Ni}^{2+}</math>, <math>\text{Co}^{2+}</math>, <math>\text{Mn}^{2+}</math>, <math>\text{Zn}^{2+}</math>, <math>\text{Ba}^{2+}</math>, <math>\text{Sr}^{2+}</math>, <math>\text{Ca}^{2+}</math>, and <math>\text{Mg}^{2+}</math></li> <li>● Systematic qualitative analysis of a solution containing any two cations from the above list. (Minimum 6 mixtures)</li> </ul>	25	
2	b) Open ended experiments– Physical chemistry experiments. (Any one experiment) Suggestions  Determination of Physical Constants [Determination of colligative properties, Determination of viscosity of a binary liquid solution (Glycerol-water system)  Refractometry experiments etc.]	5	

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1. Atkins P. W. & Paula, J. de, Elements of Physical Chemistry, Oxford University Press, 6th Ed., (2006).
2. Puri, Sharma & Pathania, Principles of Physical Chemistry, Vishal Publishing Co, 47th Edn., 2017.
3. Kapoor K. L., Text Book of Physical Chemistry, McGraw Hill, 3rd Edn. 2017 G. M. Barrow, Physical Chemistry, 5th Edn., Tata McGraw Hill Education, New Delhi, 2006.
4. 1. H. J. Arnikar, Essentials of Nuclear Chemistry, 4th Edn., New Age International (P) Ltd., New Delhi, 1995
5. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, Vogel's Textbook of Qualitative Chemical Analysis, 6th Edn., Pearson Education, Noida, 2013.
6. V. V. Ramanujam, Inorganic Semi Micro Qualitative Analysis, 3rd Edn., The National Publishing Company, Chennai, 1974.
7. A. Findlay, Findlay's Practical Physical Chemistry, 9th Edn., John Wiley and Sons, New York, 1972.
8. J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publications, Meerut, 2008.

### Mapping of COs with PSOs and POs

	PS O1	PS O2	PS O3	PS O4	PS O5	PS O6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2				2		1						
CO 2	2				2		1						
CO 3	2				2		1						
CO 4	2				2		1						
CO 5	2				2		1						
CO 6			2		2		1				1		

### Correlation Levels :

Level	Correlation
0	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

### Assessment Rubrics:

- Quiz / Discussion / Seminar
- Internal Theory / Practical exam
- Assignments / Viva
- End Semester Exam (70%)

### Mapping of COs to Assessment Rubrics

	Internal Theory / Practical Exam	Assignment / Viva	Practical Skill Evaluation	End Semester Examination
CO1	✓	✓		✓
CO2	✓	✓		✓
CO3	✓	✓		✓
CO4	✓	✓		✓
CO5	✓	✓		✓
CO6	✓	✓	✓	



**FOUR-YEAR UNDER GRADUATE PROGRAMME  
(CU-FYUGP)**

**BSc CHEMISTRY**

Programme	B. Sc. Chemistry				
Course Title	<b>CHEMISTRY IN DAILY LIFE</b>				
Type of Course	<b>MDC</b>				
Semester	<b>II</b>				
Academic Level	<b>100-199</b>				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	3	-	-	45
Pre-requisites	Role of chemicals in or life. Basic idea of environmental pollution.				
Course Summary	This course ensures that the students acquire a profound knowledge and understanding on chemicals that are used in daily life.				

**Course Outcomes (CO):**

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	<i>Know the different chemicals that sustain our life</i>	U	C	Instructor-created exams / Quiz
CO2	<i>Understand the role of chemistry in forensic analysis.</i>	U	C	Instructor-created exams / Seminar
CO3	<i>Understand the application of chemistry in agriculture and need of green methods</i>	U	C	Instructor-created exams /Assignment
CO4	<i>Understand the chemistry of soaps, synthetic detergents and their environmental effects.</i>	U	C	Instructor-created exams / Seminar
CO5	<i>Understand the chemistry of cosmetics and the effect on health.</i>	U	C	Instructor-created exams / Quiz

CO6	<i>Understand the chemistry of drugs, food additives their action and possible side effects</i>	U	C	Seminar/Viva
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

### Detailed Syllabus:

Module	Unit	Content	Hrs	Marks
<b>I</b>	<b>Chemistry in Biological Systems &amp; Forensic Chemistry</b>		<b>12</b>	<b>22</b>
	1	Vitamins and Minerals: Name, source, function and deficiency diseases.	2	
	2	Enzymes - Classifications, characteristics, examples.	1	
	3	Hormones - Sex hormones - example, function. Pheromones.	2	
	4	Brain chemicals and human mood variations	1	
	5	General discussion of poisons with special reference to mode of action of cyanide, organophosphates and snake venom.	2	
	6	Detection of finger print, blood stain, semen, Breath analyzer	2	
	7	Sport doping-Steroids-Anabolic agents, Stimulants, Diuretics	2	
<b>II</b>	<b>Chemistry and Agriculture</b>		<b>6</b>	<b>12</b>
	8	Essential nutrients for plants – NPK value Chemical composition of soil, Soil enrichment	1	
	9	Fertilizers- natural, synthetic, mixed, NPK fertilizers. Excessive use of fertilizers and its impact on the environment. Bio fertilizers.	2	
	10	Pesticides: Classification – Insecticides, herbicides, rodenticides and fungicides (definition and examples only) – Non-degradable pesticides	2	
	11	Pesticide pollution and its impact on environment – Endosulfan disaster in Kerala (brief study).	1	
<b>III</b>	<b>Cleansing agents and cosmetics</b>		<b>9</b>	<b>18</b>
	12	Soaps – Hard and soft soaps – Alkali content – TFM – Detergents (classification) – Cleaning action – Advantages and disadvantages of soaps and detergents –	3	
	13	Shampoos: Ingredients and functions – Different kinds of shampoos (Antidandruff, anti-lice, herbal and baby shampoos).	1	
	14	Tooth paste: Composition and health effects.  Hair dye: Chemicals used and its harmful effects.	1	
	15	Face and skin powders: Types, ingredients and functions. Cleansing creams: Cold creams, vanishing creams and bleach creams.	2	

	16	Perfumes, antiperspirants, sun screen preparations, nail polishes, lipsticks, rouges, eyebrow pencils and eye liners (ingredients and functions) – Harmful effects of cosmetics.	2	
<b>IV</b>	<b>Pharmaceuticals and Dyes</b>		<b>9</b>	<b>18</b>
	17	Drug: Chemical name, generic name and trade names with examples.	1	
	18	Terminology: Prodrug, pharmacy, pharmacology, pharmacophore, pharmacognosy, pharmacodynamics and pharmacokinetics (elementary idea only).	2	
	19	Antipyretics, analgesics, antacids, antihistamines, antibiotics, antiseptics, disinfectants, anaesthetics, tranquilizers, narcotics, antidepressants and psychedelic drugs (definition and examples).	2	
	20	Dyes: classification based on constitution, application, examples, uses.	2	
	21	Dyes: Requirements of a dye – Classification based on mode of application to the fabric –	1	
	22	Applications of dyes (general study). Ancient and modern colours – Mention of indigo and alizarin.	1	
<b>V</b>	<b>Food Chemistry (OPEN ENDED)</b>		<b>9</b>	
	23	Common adulterants Food Additives: Artificial sweeteners – Taste enhancers Artificial ripening of fruits and its side effects. Modern Food Habits:		

### References

1. M. V. Kulkarni, *Biochemistry*, Pragati Books Pvt. Ltd., 2008.
2. S. C. Rastogi, *Biochemistry*, 2nd Edn., Tata McGraw Hill Publishing Co., New Delhi, 2007.
3. U. Satyanarayana, U. Chakrapani, *Biochemistry*, Elsevier Health Sciences, 2014.
4. N. V. Bhagavan, *Medical Biochemistry*, Academic Press, 2002.
5. *Pharmaceutical Analysis*, T. Higuchi and E.B. Hanseen, John Wiley and Sons, New York.
6. *Quantitative Analysis of drugs*, P.D. Sethi, 3rd edition, CBS Publishers, New Delhi, 1997.
7. *Practical Clinical biochemistry methods and interpretations*, R. Chawala, J.P. Brothers Medical Publishers (P) Ltd., 1995.
8. *Laboratory manual in biochemistry*, J. Jayaraman. New Age International Publishers, New Delhi, 1981.
9. H. S. Rathore, L. M. L. Nollet, *Pesticides: Evaluation of Environmental Pollution*, CRC Press, USA, 2012.
10. Murray Park, *The Fertilizer Industry*, Elsevier, 2001.
11. B. K. Sharma, *Industrial Chemistry*, Krishna Prakashan Media, 1991.
12. M. S. R. Winter, *A Consumer's Dictionary of Cosmetic Ingredients*, 7th Edn., Three Rivers Press, New York, 2009.
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14. Jayashree Ghosh, *A Textbook of Pharmaceutical Chemistry*, 3rd Edn., S. Chand and Company Ltd., New Delhi, 1999.
15. Lillian Hoagland Meyer, *Food Chemistry*, 1st Edn., CBS Publishers & Distributors, New Delhi, 2004.
16. B. A. Fox, A. G. Cameron, E. Arnold, *Food Science, Nutrition and Health*, 6th Edn., Edward Arnold, London, 1995.

17. A. Siddiqui, N. Anusha, *Deleterious Effects of Food Habits in Present Era*, J. Aller. Ther. 3:114, 2012.
18. H. S. Ramaswamy, M. Marcotte, *Food Processing: Principles and Applications*, CRC Press, 2005.
19. A. F. Smith, *Encyclopedia of Junk Food and Fast Food*, Greenwood Publishing Group, 2006.
20. T. A. M. Sagati, *The Chemistry of Food Additives and Preservatives*, John Wiley & Sons, 2012.
21. S. N. Mahindru, *Food Additives*, APH Publishing, 2009.
22. Biju Mathew, *Anchor India*, Info Kerala Communications Pvt. Ltd., 2015.

**Mapping of COs with PSOs and POs :**

	PSO 1	PSO 2	PSO 3	PSO4	PS O5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	1	-	-	-	1	1	1			2	1		
CO 2	1		-	-	1	1	1			1	1		1
CO 3	-	-		1	2	2	1			2	2		1
CO 4	-	-			1	2	1			1	1	1	1
CO 5	-		-	1	2	2	1			2	2	1	1
CO 6	-	-	-	1	2	2	1			2	2	1	1

**Correlation Levels:**

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics :**

	Internal Exam	Assignment/viva	Quiz/seminar/Group discussion	End Semester Examinations
CO 1	✓		✓	✓
CO 2	✓		✓	✓
CO 3	✓	✓		✓
CO 4	✓		✓	✓
CO 5	✓		✓	✓
CO 6		✓	✓	



**FOUR-YEAR UNDER GRADUATE PROGRAMME  
(CU-FYUGP)**

**BSc CHEMISTRY**

Programme	B.Sc Chemistry				
Course Title	<b>BASIC ORGANIC CHEMISTRY</b>				
Type of Course	<b>MINOR</b>				
Semester	<b>III</b>				
Academic Level	<b>200-299</b>				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Fundamental Concepts of organic chemistry- Nomenclature, Isomerism, Fuctional groups, Homologous series				
Course Summary	This course explores basics of organic chemistry reaction mechanism, Reactions and mechanism of important functional groups and stereochemistry				

**Course Outcomes (CO):**

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand the basic concepts of reaction mechanisms	U	C	Instructor-created exams / Assignment
CO2	To realise types of organic reactions and intermediates	Ap	P	Instructor-created exams Assignment / quizzes
CO3	To analyse important application of functional groups	An	P	Assignment / seminar/Internale xam
CO4	To understand how different functional groups confer distinct properties and reactivity, influencing the chemical behaviour of molecules	U	C	Assignment/Seminar/
CO5	To realise the imporantace of stereoisomerism,optical activity and chirality/	U	C	Assignment/Group Discussion
CO6	To enable the students to develop analytical skills in organic qualitative analysis.	Ap	P	Observation of practical skill/Viva voce

\* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)  
 # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)  
 Metacognitive Knowledge (M)

### Detailed Syllabus:

Module	Unit	Content	Hrs	Marks
<b>I</b>	<b>Basic concepts of Organic Chemistry.</b>		<b>15</b>	<b>30</b>
	1	Introduction- Homolysis and Heterolysis with suitable examples. Curley arrow rules. Reagents – Electrophiles, nucleophiles and free radicals	2	
	2	Electron Displacement Effects: Inductive effect, Definition - Characteristics - +I and -I groups. Applications: Acidity of carboxylic acids-effect of substituents.	2	
	3	Electromeric effect: Definition – Characteristics - +E effect and -E effect - Addition of H <sup>+</sup> to ethene and addition of CN <sup>-</sup> to acetaldehyde.	1	
	4	. Mesomeric effect: Definition, Characteristics - +M and -M groups. Applications: Comparison of electron density in benzene, nitrobenzene, Phenol and Aniline	3	
	5	Hyperconjugation effect: Definition – Characteristics. Applications: comparison of stability of But-1-ene and But-2-ene.	1	
	6	Steric effect	1	
	7	Reaction intermediate: Type, shape and stability of Carbocations, carbanions and free radicals.	3	
	8	Types of organic reactions: Addition, Elimination, Substitution, Rearrangement and Redox reactions- Definition and one example	2	
<b>II</b>	<b>Chemistry of alkyl halides, Alcohols and phenols</b>		<b>10</b>	<b>23</b>
	9	<b>Alkyl halides</b> Preparation of alkyl halides from alkanes and alkenes – Wurtz reaction and Fittig's reaction. SN1 and SN2 reactions of alkyl halides-Mechanism and stereochemistry.	3	
	10	<b>Alcohols:</b> Preparation from Grignard reagent – Preparation of ethanol from molasses – Wash, rectified spirit, absolute alcohol, denatured spirit, proof spirit and power alcohol (mention only).	2	
	11	<b>Reactions of Alcohols</b> -Substitution, dehydration, oxidation and esterification. Haloform reaction - iodoform test – Luca's test – Chemistry of methanol poisoning, harmful effect of ethanol in human body	3	

	12	<b>Phenols:</b> Preparation from chlorobenzene. Comparison of acidity of phenol, p-nitrophenol and p-methoxyphenol –.	1	
	13	Preparation and uses of phenolphthalein	1	
<b>III</b>	<b>Chemistry of carbonyl compounds and amines</b>		<b>10</b>	<b>22</b>
	14	<b>Aldehydes &amp; Ketones:</b> Preparation from alcohols – Comparison of reactivity of aldehydes and ketones. Nucleophilic addition reactions-addition of HCN and bisulphite. Clemmenson reduction and wolff kishner reduction	3	
	15	<b>Carboxylic Acids:</b> Preparation from Grignard reagent – Decarboxylation – Kolbe electrolysis.	2	
	16	<b>Amines:</b> Preparation from nitro compounds – Hofmann’s bromamide reaction – Hofmann’s carbylamines reaction. Basicity: Comparison of basicity of ammonia, methylamine and aniline	3	
	17	<b>Diazonium salts:</b> Preparation and synthetic application of benzene diazonium chloride.	1	
	18	Preparation and uses of methyl orange	1	
<b>IV</b>	<b>Stereochemistry</b>		<b>10</b>	<b>23</b>
	19	<b>Stereoisomerism:</b> definition, classification. Geometrical Isomerism: Definition, Condition, Geometrical isomerism in but-2-ene and but-2-ene-1,4-dioic acid. cis and trans isomerism, E and Z configurations. Methods of distinguishing geometrical isomers using melting point and dipolemoment.	3	
	20	<b>Conformations:</b> Newman projection, Saw-horse projection. Conformations of ethane, n-butane, and cyclohexane. Relative stability and energy diagrams. Conformation of methyl cyclohexane.	3	
	21	<b>Optical Isomerism</b> - Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with one and two chiral-centres-Lactic acid and tartaric acid. Distereoisomers, meso-structures .	3	
	22	Racemic, mixture. Racemisation and resolution	1	
<b>V</b>	<b>PRACTICALS RELATED TO THE MODULE II and III</b>		<b>30</b>	
	1	Reactions of Organic Compounds	4	
	2	II. Functional groups test for 1. Phenols -Phenol 2. Amines-Aniline 3. Aldehydes and ketones -benzaldehyde, benzophenone). 4. Carboxylic acid (benzoic acid, cinnamic acid). 5. Carbohydrates (glucose). 6. Amides (benzamide, urea	20	
	3	III.Preparation of organic compounds-	6	

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1. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Bhal and Bhal, Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher, 2012.
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5. M. K. Jain, S. C. Sharma, *Modern Organic Chemistry*, 3<sup>rd</sup> Edn., Vishal Publishing Company Co., 2010.
6. K. S. Tewari, N. K. Vishnoi, S. N. Mehrotra, *A Textbook of Organic Chemistry*, 2<sup>nd</sup> Edn., Vikas Publishing House, New Delhi, 2004.
7. B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchell, *Vogel's Textbook of Practical Organic Chemistry*, 5<sup>th</sup> Edn., Pearson Education, Noida, 2014.
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9. Arthur I. Vogel, *Elementary Practical Organic Chemistry- Small Scale Preparations*, 2<sup>nd</sup> Edn., Pearson Education, Noida, 2013

## Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO4	PS O5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2	-	2	-	1	-	2			1	2	1	
CO 2	2		2	-	-	1	2			2	1	1	
CO 3	2	-	2	-	-	2	2			2	1		
CO 4	2	-	2		2	2	2			2	1		
CO 5	2		-	-	2	-	2			2	1		
CO 6	2	-	2		-	2	2		1		2		1

**Correlation Levels:**

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

**Assessment Rubrics:**

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Practical exam (20%)

**Mapping of COs to Assessment Rubrics :**

	Internal Exam	Assignment	Seminar/Group Discussion	Quizzes/viva	Observation Of practical Skill	End Semester Examinations
CO 1	✓	✓				✓
CO 2	✓	✓		✓		✓
CO 3	✓		✓			✓
CO 4		✓	✓			✓
CO 5		✓	✓			✓
CO 6				✓	✓	✓



**FOUR-YEAR UNDER GRADUATE PROGRAMME  
(CU-FYUGP)**

**BSc CHEMISTRY**

Programme	B.Sc Chemistry				
Course Title	<b>BIOORGANIC CHEMISTRY</b>				
Type of Course	<b>MINOR</b>				
Semester	<b>III</b>				
Academic Level	<b>200-299</b>				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Fundamental Concepts of organic chemistry- Nomenclature, isomerism, Functional groups, Homologous series 2. Preliminary ideas of carbohydrates and Biomolecules				
Course Summary	This course explores basics of organic chemistry reaction mechanism, Reactions and mechanism of important functional groups, Chemistry of Carbohydrates, Biomolecules and natural products				

**Course Outcomes (CO):**

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO 1	To understand the basic concepts of reaction mechanisms	U	C	Instructor-created exams / Assignment
CO 2	To realise types of organic reactions and intermediates	Ap	P	Instructor-created exams Assignment /quizes
CO 3	To understand how different functional groups confer distinct properties and reactivity, influencing the chemical behaviour of molecules	U	C	Assignment/Seminar
CO 4	To appreciate the importance of biomolecules in recognizing their central role in life processes	An	P	Instructor-created exams / Assignment
CO 5	To emphasize how organic chemistry provides a framework for unravelling	U	C	Group work /Assignment/class test

	the complexities of bio molecular structures.			
CO 6	To enable the students to develop analytical skills in organic qualitative analysis	Ap	P	Observation of practical skill/Viva voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

### Detailed Syllabus:

Module	Unit	Content	Hrs	Marks
<b>I</b>	<b>Basic concepts of Organic Chemistry.</b>		<b>15</b>	<b>30</b>
	1	Introduction- Homolysis and Heterolysis with suitable examples. Curley arrow rules. Reagents – Electrophiles, nucleophiles and free radicals	2	
	2	Electron Displacement Effects: Inductive effect, Definition - Characteristics - +I and -I groups. Applications: Acidity of carboxylic acids-effect of substituents.	2	
	3	Electromeric effect: Definition – Characteristics - +E effect and - E effect - Addition of H <sup>+</sup> to ethene and addition of CN <sup>-</sup> to acetaldehyde.	1	
	4	. Mesomeric effect: Definition, Characteristics - +M and -M groups. Applications: Comparison of electron density in benzene, nitrobenzene, Phenol and Aniline	3	
	5	Hyperconjugation effect: Definition – Characteristics. Applications: comparison of stability of But-1-ene and But-2-ene.	1	
	6	Steric effect	1	
	7	Reaction intermediate: Type ,shape and stability of Carbocations, carbanions and free radicals.	3	
	8	Types of organic reactions: Addition, Elimination, Substitution, Rearrangement and Redox reactions-Defintion and one example	2	
<b>II</b>	<b>Chemistry of carbonyl compounds and amines</b>		<b>10</b>	<b>22</b>
	9	<b>Aldehydes &amp; Ketones:</b> Preparation from alcohols –Comparison of reactivity of aldehydes and ketones. Nucleophilic addition reactions-addition of HCN and bisulphite.	3	
	10	<b>Carboxylic Acids:</b> Preparation from Grignard reagent – Decarboxylation – Kolbe electrolysis	2	
	11	<b>Amines:</b> Preparation from nitro compounds – Hofmann’s bromamide reaction – Hofmann’s carbylamines reaction. Basicity: Comparison of basicity of ammonia, methylamine and aniline	3	
	12	<b>Diazonium salts:</b> Preparation and synthetic application of benzene diazonium chloride	1	

	13	Preparation and uses of methyl orange	1	
<b>III</b>	<b>Carbohydrates</b>		<b>10</b>	<b>23</b>
	14	Classification- Monosaccharides, oligosaccharides, and polysaccharides, Aldose and Ketose, reducing and nonreducing sugars	2	
	15	Cyclic structure of Ribose, Deoxy ribose. glucose and fructose.	2	
	16	D and L forms of glyceraldehyde, Glucose - manufacture of glucose from starch, physical properties, uses, Structure of D and L glucose	2	
	17	Analytical test for glucose - effect of heating, effect of conc sulphuric acid, Fehling's test, Tollens test, Molisches test.	1	
	18	Fructose- preparation from cane sugar, properties. Sucrose - manufacture of sucrose from sugar cane juice. Starch and cellulose - physical properties, structure (Basic ideas only)	3	
<b>IV</b>	<b>Proteins and Nucleic acids</b>		<b>10</b>	<b>23</b>
	19	Amino acids – Classification – Structure of amino acids – Zwitter ion formation – Isoelectric point. Peptide linkage, polypeptides and proteins. Primary, secondary and tertiary structure of proteins. Denaturation of proteins. Tests for proteins: Xanthoprotein test, Biuret test and Ninhydrin test.	3	
	20	Enzymes, characteristics and examples	1	
	21	Nucleic acids: Introduction, constituents of nucleic acids – nitrogenous bases, nucleosides and nucleotides. Double helical structure of DNA. Difference between DNA & RNA – DNA finger printing and its applications	3	
	22	Lipids: Classification-Fats and oils. Biological functions of lipids. Steroids :classification. Structure and biological functions of cholesterol, testosterone and progesteron. Elementary idea of HDL and LDL	3	
<b>V</b>	<b>PRACTICALS RELATED TO THE MODULE II and III</b>		<b>30</b>	
	1	Reactions of Organic Compounds	4	
	2	II. Functional groups test for 1. Phenols -Phenol 2. Amines-Aniline 3. Aldehydes and ketones -benzaldehyde, benzophenone). 4. Carboxylic acid (benzoic acid, cinnamic acid). 5. Carbohydrates (glucose). 6. Amides (benzamide, urea	20	
	3	III. Preparation of organic compounds-	6	

## References

1. Morrison, R. N. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Bhal and Bhal, Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher, 2012.
3. I. L. Finar, *Organic Chemistry*, Vol. I, 5<sup>th</sup> Edn., Pearson Education, New Delhi, 2013.
4. M. K. Jain, S. C. Sharma, *Modern Organic Chemistry*, 3<sup>rd</sup> Edn., Vishal Publishing Company Co., 2010.
5. K. S. Tewari, N. K. Vishnoi, S. N. Mehrotra, *A Textbook of Organic Chemistry*, 2<sup>nd</sup> Edn., Vikas Publishing House, New Delhi, 2004.
6. B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchell, *Vogel's Textbook of Practical Organic Chemistry*, 5<sup>th</sup> Edn., Pearson Education, Noida, 2014.
7. F. G. Mann, B. C. Saunders, *Practical Organic Chemistry*, 4<sup>th</sup> Edn., Pearson Education, Noida, 2011.
8. Arthur I. Vogel, *Elementary Practical Organic Chemistry- Small Scale Preparations*, 2<sup>nd</sup> Edn., Pearson Education, Noida, 2013

## Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO4	PS O5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2	-	2	-	1	-	2			1	2	1	
CO 2	2		2	-	-	1	2			2	1	1	
CO 3	2	-	2	-	2	2	2			2	1		
CO 4	2	-			2		2			2	1		
CO 5	2		-	-	2	-	2			2	1		
CO 6	2	-	2		-	2	2		1		2		1

## Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

**Assessment Rubrics:**

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Practical exam (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics :**

	Internal Exam	Assignment	Seminar/Group Discussion	Quizzes/viva	Observation Of practical Skill	End Semester Examinations
CO 1	✓	✓				✓
CO 2	✓	✓		✓		✓
CO 3	✓		✓			✓
CO 4		✓				✓
CO 5		✓	✓			✓
CO 6				✓	✓	✓



**FOUR-YEAR UNDER GRADUATE PROGRAMME  
(CU-FYUGP)**

**BSc CHEMISTRY**

Programme	B.Sc Chemistry				
Course Title	<b>ORGANIC CHEMISTRY IN DAILY LIFE</b>				
Type of Course	<b>MINOR</b>				
Semester	<b>3</b>				
Academic Level	<b>200-299</b>				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Basic concepts of Organic Chemistry 2. Chemistry and its importance in daily life				
Course Summary	This course ensure students to acquire a profound understanding of Organic Chemistry, emphasizing fundamental reactions, concepts and its implication in daily life.				

**Course Outcomes (CO):**

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand the fundamental concepts of reaction mechanisms through the step by step processes involved in chemical reactions	U	C	Instructor-created exams / Assignment
CO2	To recognize the various types of organic reactions and reaction intermediates	Ap	P	Assignment / seminar/quizzes
CO3	To understand how different functional groups confer distinct properties and reactivity, influencing the chemical behaviour of molecules.	U	C	Assignment/Seminar/Internal exam
CO4	To understand the importance of Chemistry in Daily Life.	Ap	P	Group work /Assignment
CO5	To understand the role of Chemistry in human	Ap	P	Group work /Assignment

	happiness index and life expectancy.			
CO6	To empower students to cultivate analytical skills in organic qualitative/quantitative analysis by emphasizing systematic approaches.	Ap	P	Observation of practical skill/Viva voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

### Detailed Syllabus:

Module	Unit	Content	Hrs	Marks
<b>I</b>	<b>Basic concepts of Organic Chemistry</b>		<b>15</b>	<b>30</b>
	1	Homolytic and heterolytic fission with suitable examples. Curly arrow rules. Types of reagents -Electrophiles, Nucleophiles and Free radicals.	1	
	2	Electron Displacement Effects: Inductive effect, definition, Characteristics - +I and -I groups. Applications: Acidity of carboxylic acids-effect of substituents.	2	
	3	Electromeric effect: Definition, Characteristics - +E effect and -E effect. Addition of H <sup>+</sup> to ethene and addition of CN <sup>-</sup> to acetaldehyde.	2	
	4	Mesomeric effect: Definition, Characteristics - +M and -M groups. Applications: Comparison of electron density in benzene, nitrobenzene, phenol and aniline.	2	
	5	Hyperconjugation effect: Definition, Characteristics. Applications: comparison of stability of But-1-ene and But-2-ene.	2	
	6	Steric effect and its importance in reactivity.	1	
	7	Reaction intermediate: Type, shape and stability of carbocations, carbanions and free radicals.	3	
	8	Types of organic reactions: Addition, Elimination, Substitution, Rearrangement and Redox reactions-Definition and example.	2	
<b>II</b>	<b>Chemistry of Alkyl halides, Alcohols and Phenols</b>		<b>10</b>	<b>22</b>
	9	Alkyl halides- Preparation of alkyl halides from alkanes and alkenes-Wurtz reaction and Fittig's reaction. SN <sup>1</sup> and SN <sup>2</sup> reactions of alkyl halides-Mechanism and stereochemistry.	3	
	10	Alcohols: Preparation from Grignard reagent – Preparation of ethanol from molasses – Wash, rectified spirit, absolute alcohol, denatured spirit, proof spirit and power alcohol (mention only).	2	
	11	Reactions of alcohols-Substitution, dehydration, oxidation and esterification. Haloform reaction - iodoform test -Luca's test-Chemistry of methanol poisoning, harmful effect of ethanol in human body.	3	

	12	Phenols: Preparation from chlorobenzene. Comparison of acidity of phenol, p-nitrophenol and p-methoxyphenol.	1	
	13	Preparation and uses of phenolphthalein.	1	
<b>III</b>	<b>Chemistry of Carbonyl compounds and Amines</b>		<b>10</b>	<b>23</b>
	14	Aldehydes & Ketones: Preparation from alcohols. Comparison of reactivity of aldehydes and ketones.	1	
	15	Nucleophilic addition reactions in aldehydes and ketone. Addition of HCN and bisulphite. Clemmensen reduction and Wolff Kishner reduction.	2	
	16	Carboxylic Acids: Preparation from Grignard reagent- Decarboxylation-Kolbeelectrolysis.	2	
	17	Amines: Preparation from nitro compounds-Hofmann's bromamide reaction, Hofmann's carbylamines reaction. Basicity: Comparison of basicity of ammonia, methylamine and aniline.	3	
	18	Diazonium salts: Preparation and synthetic application of benzene diazonium chloride. Preparation and uses of methyl orange.	2	
<b>IV</b>	<b>Chemistry in Daily Life</b>		<b>10</b>	<b>23</b>
	19	Petrochemicals: Name, carbon range and uses of fractions of petroleum distillation. Octane number, Cetane number, Flash point. LPG and CNG: Composition and uses.	2	
	20	Pharmaceuticals: Drug - Chemical name, generic name and trade names with examples. Antipyretics, analgesics, antibiotics, antacids, antiseptics (definition and examples, structure not expected).	2	
	21	Dyes: Definition- Requirements of a dye. Theories of colour and chemical constitution. Structure and applications of martius yellow, indigo and alizarin.	3	
	22	Food: Food additives: Food preservatives, artificial sweeteners and antioxidants (definition and examples, structures not required) Commonly used permitted and non-permitted food colours (structures not required).	3	
<b>V</b>	<b>Organic Chemistry Practicals</b>		<b>30</b>	
	23	General Reactions of Organic Compounds	4	
	24	Study of the reactions of functional groups from the following list. 1. Phenols –(phenol) 2. Amines-(aniline) 3. Aldehydes and Ketones-(benzaldehyde, benzophenone). 4. Carboxylic acids (benzoic acid, cinnamic acid). 5. Carbohydrates (glucose). 6. Amides (benzamide, urea)	20	
	25	Organic Preparations.	6	

## References

1. Morrison, R. T. & Boyd, R. N., Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Bhal and Bhal, Advanced Organic Chemistry, 2nd Edition, S. Chand Publisher, 2012.
3. I. L. Finar, *Organic Chemistry*, Vol. I, 5<sup>th</sup> Edn., Pearson Education, New Delhi, 2013.
4. M. K. Jain, S. C. Sharma, *Modern Organic Chemistry*, 3<sup>rd</sup> Edn., Vishal Publishing Company Co., 2010.
5. K. S. Tewari, N. K. Vishnoi, S. N. Mehrotra, *A Textbook of Organic Chemistry*, 2<sup>nd</sup> Edn., Vikas Publishing House, New Delhi, 2004.
6. Jayashree Ghosh. A textbook of Pharmaceutical Chemistry, 3<sup>rd</sup> Edn. S Chand and Company Ltd. New Delhi, 1999
7. B. Srilakshmi. Food Science 5<sup>th</sup> Edn. New Age publishers, New Delhi, 2010.
8. K. Singh. Chemistry in Daily Life. Prentice Hall of India, New Delhi
9. B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchell, *Vogel's Textbook of Practical Organic Chemistry*, 5<sup>th</sup> Edn., Pearson Education, Noida, 2014.
10. F. G. Mann, B. C. Saunders, *Practical Organic Chemistry*, 4<sup>th</sup> Edn., Pearson Education, Noida, 2011.

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	PSO 1	PSO 2	PSO 3	PSO4	PS O5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2	-	2	-	1	-	2			1	2	1	
CO 2	2		2	-	-	1	2			2	1	1	
CO 3	2	-	2	-	-	2	2			2	1		
CO 4	2	-	2		2	2	2			2	1		
CO 5	2		-	-	2	-	2			2	1		
CO 6	2	-	2		-	2	2		1		2		1

## Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

**Assessment Rubrics:**

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Practical exam (20%)

**Mapping of COs to Assessment Rubrics :**

	Internal Exam	Assignment	Seminar/Group Discussion	Quizzes/viva	Observation Of practical Skill	End Semester Examinations
CO 1	✓	✓				✓
CO 2	✓	✓		✓		✓
CO 3		✓	✓			✓
CO 4		✓	✓			✓
CO 5		✓	✓			✓
CO 6				✓	✓	✓

# **SYLLABUS FOR B.VOC. FOOD PROCESSING**



**FOUR-YEAR UNDER GRADUATE PROGRAMME  
(CU-FYUGP)**

**BSc CHEMISTRY**

Programme	B.Sc. Chemistry				
Course Title	<b>INORGANIC AND PHYSICAL CHEMISTRY</b>				
Type of Course	<b>MINOR</b>				
Semester	<b>I</b>				
Academic Level	<b>100-199</b>				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic types of chemical bonding—ionic, covalent, and coordinate—as well as concepts like electronegativity, molecular polarity, hydrogen bonding, solubility, and colloids				
Course Summary	This course provides foundational knowledge in key areas of inorganic and physical chemistry, essential for understanding chemical behavior, analysis techniques, and molecular interactions.				

**Course Outcomes (CO):**

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the nature of chemical bonding and molecular interactions	U	C	Instructor-created exams / Assignment
CO2	Apply principles of qualitative analysis and solubility equilibria	Ap	P	Instructor-created exams Assignment /Quizzes
CO3	Classify and explain colloidal systems and their behaviors	U	C	Assignment/Seminar
CO4	Understand core thermodynamic and kinetic concepts applied in chemical systems	U	C	Instructor-created exams / Assignment
CO5	Analyze acid-base equilibria, buffer mechanisms, and solution behavior	An	P	Group work /Assignment/class test
CO6	Perform the cation analysis on a provided mixture containing two	Ap	P	Observation of practical skill/Viva voce

	cations and determine physical constants			
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

### Detailed Syllabus:

Module	Unit	Content	Hrs	Marks
<b>I</b>	<b>Basic concepts of Inorganic Chemistry.</b>		<b>15</b>	<b>30</b>
	1	Chemical bond: Ionic, covalent, and coordinate bonds. Distinction between ionic and covalent compounds. Weak intermolecular forces- van der Waals forces.	3	6
	2	Physical properties -hydrogen bonding-inter and intra molecular hydrogen bonding, abnormal property of water-structure of ice	2	5
	3	Solute solvent - ion-dipole, dipole-dipole, and dipole- induced dipole interactions	2	5
	4	Principles in the separation of cations in qualitative analysis	3	5
	5	Common ion effect and solubility product and its applications in qualitative analysis	3	5
	6	Microanalysis and its advantages. Accuracy & Precision	2	4
<b>II</b>	<b>Colloids</b>		<b>10</b>	<b>22</b>
	1	Colloids: classification of colloids: Lyophilic, lyophobic, macromolecular, multimolecular and associated colloids with example	3	6
	2	Properties of colloids: Tyndall effect, Electrophoresis Origin of charge and stability of colloids: coagulation, Hardy-Schulze rule, protective colloids, gold number	4	6
	3	Purification of colloids	1	5
	4	Emulsions: Types of emulsions and emulsifying agents	2	5

<b>III</b>	<b>Thermodynamics and Kinetics</b>		<b>10</b>	<b>23</b>
	1	Thermodynamics-Basic concepts: definitions, approaches, thermodynamic systems thermodynamic properties and equilibrium state, state of a system.	3	5
	2	Zeroth law, first law, second law and third law of thermodynamics	2	4
	3	Kinetics - Rate of chemical reaction, Effect of temperature on rate constant,	2	5
	4	Order, molecularity of a reaction - first order and second order	2	5
	5	Half-life period, Arrhenius equation,	1	4
<b>IV</b>	<b>Solutions and Ionic Equilibria</b>		<b>10</b>	<b>23</b>
	1	Theories of acids and bases – Arrhenius, Lowry – Bronsted and Lewis theories-pKa, pKb and pH	3	5
	2	Concept of strong and weak electrolyte – dissociation constant, Handerson equation	2	5
	3.	Buffer solution – mechanism and application	1	3
	4	<b>Solutions:</b> Kinds of solutions, solubility of gases in liquids, Henry’s law, and its applications Raoult’s law: ideal and non-ideal solution	2	5
	5	Dilute solutions - colligative properties	2	5
<b>V</b>	<b>PRACTICALS</b>		<b>30</b>	
	1	Inorganic Qualitative Analysis (semi – micro analysis) ● Reactions of Cations: Study of the reactions of the following cations with a view of their identification and confirmation. NH <sub>4</sub> <sup>+</sup> , Pb <sup>2+</sup> , Cu <sup>2+</sup> , Cd <sup>2+</sup> , Al <sup>3+</sup> , Ni <sup>2+</sup> , Co <sup>2+</sup> , Mn <sup>2+</sup> , Zn <sup>2+</sup> , Ba <sup>2+</sup> , Sr <sup>2+</sup> , Ca <sup>2+</sup> , and Mg <sup>2+</sup> ● Systematic qualitative analysis of a solution containing any two cations from the above list. (Minimum 6 mixtures)	25	
	2	Open ended experiments– Physical chemistry experiments. (Any one experiment) Suggestions Determination of Physical Constants [Determination of colligative properties, Determination of viscosity of a binary liquid solution (Glycerol-water system) Refractometry experiments etc]	5	

## References

1. P. W. Atkins, J. de Paula, Atkin's Physical Chemistry, 8th Edn., Oxford University Press, 2006.
2. B. R. Puri, L. R. Sharma, M. S. Pathania, Principles of Physical Chemistry, 46th Edn., Vishal Publishing Company, New Delhi, 2013.
3. Kapoor K. L., Text Book of Physical Chemistry, McGraw Hill, 3rd Edn. 2017.
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5. C. N. R. Rao, Understanding Chemistry, Universities Press India Ltd, Hyderabad, 1999
6. George Gamow, One, Two, Three...Infinity: Facts and Speculations of Science, Dover
7. Resonance – Journal of Science Education, Indian Academy of Sciences.
8. Nature Chemistry, Nature Publishing Group.
9. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, Vogel's Text Book of Quantitative Chemical Analysis, 6th Edn., Pearson Education, Noida, 2013.
10. D. A. Skoog, D. M. West, F. J. Holler, S. R. Crouch, Fundamentals of Analytical Chemistry, 8th Edn., Brooks/Cole, Thomson Learning, Inc., USA, 2004.

## Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO4	PS O5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	-	2	-	1	-	2			1	2	1	
CO2	2		2	-	-	1	2			2	1	1	
CO3	2	-	2	-	2	2	2			2	1		
CO4	2	-			2		2			2	1		
CO5	2		-	-	2	-	2			2	1		
CO6	2	-	2		-	2	2		1		2		1

## Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial/ High

**Assessment Rubrics:**

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Practical exam (20%)
- Final Exam (70%)

**Mapping of COs to Assessment Rubrics:**

	Internal Exam	Assignment	Seminar/Group Discussion	Quizzes/viva	Observation Of practical Skill	End Semester Examinations
CO1	✓	✓				✓
CO2	✓	✓		✓		✓
CO3	✓		✓			✓
CO4		✓				✓
CO5		✓	✓			✓
CO6				✓	✓	✓



**FOUR-YEAR UNDER GRADUATE PROGRAMME  
(CU-FYUGP)**

**BSc CHEMISTRY**

Programme	B.Sc. Chemistry				
Course Title	<b>FUNDAMENTAL CONCEPTS AND ANALYTICAL TECHNIQUES IN CHEMISTRY</b>				
Type of Course	<b>MINOR</b>				
Semester	<b>II</b>				
Academic Level	<b>100-199</b>				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Foundational concepts include atomic and molecular masses, the mole concept, concentration terms titrations using indicators to detect endpoints. the interaction of radiation with matter				
Course Summary	This course covers foundational understanding of essential chemical principles and instrumental techniques.				

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Apply fundamental chemical principles	Ap	C	Instructor-created exams / Assignment
CO2	Prepare and analyze chemical solutions	An	P	Assignment / seminar/quizzes
CO3	Explain the interaction of electromagnetic radiation with matter.	U	C	Assignment/Seminar/Internal exam
CO4	Interpret spectroscopic data (IR, UV-Vis, and NMR)	Ap	P	Group work /Assignment
CO5	Perform volumetric experiments to determine solution concentration and chromatography	Ap	P	Group work /Assignment

\* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)  
 # - Factual Knowledge (F) Conceptual Knowledge (C) Procedural Knowledge (P)  
 Metacognitive Knowledge (M)

**Detailed Syllabus:**

<b>Module</b>	<b>Unit</b>	<b>Content</b>	<b>Hrs</b>	<b>Marks</b>
<b>I</b>	<b>Quantitative Chemistry Essentials</b>		<b>10</b>	<b>23</b>
	1	Atomic mass - Molecular mass - Mole concept – Molar volume - Oxidation and reduction – Oxidation number and valency - Equivalent mass	3	5
	2	Methods of expressing concentration: Molality, molarity, normality, and mole fraction.	2	4
	3	Preparation of solutions: Preparation of solutions, percentage by weight, volume, and strength, ppm, ppb	2	5
	4	Theory of volumetric analysis – Acid base titration, redox titrations and complexometric titrations	2	5
	5	Theory of indicators	1	4
<b>II</b>	<b>Molecular Spectroscopy - 1</b>		<b>15</b>	<b>30</b>
	1	Electromagnetic spectrum - wavelength, frequency, wavenumber, Interaction of electromagnetic radiation with matter – absorption spectra, emission spectra	3	5
	2	Energy levels in molecules – Born-Oppenheimer approximation.	2	4
	3	<b>IR Spectroscopy:</b> Principle, molecular vibrations, and selection rules	3	4

	4	Calculation of force constants for vibrations. Hydrogen bonding: intra- and intermolecular hydrogen bonding.	2	4
	5	Characteristic group absorptions of organic compounds- fingerprinting region.	2	5
	6	Anharmonicity – Fundamental frequencies – Overtones.	2	4
	7	Degree of freedom for polyatomic molecules – Modes of vibrations of CO <sub>2</sub> and H <sub>2</sub> O.	1	4
<b>III</b>	<b>Molecular Spectroscopy - 2</b>		<b>10</b>	<b>22</b>
	1	<b>UV-Visible Spectroscopy:</b> Introduction - Beer-Lambert's law - Electronic transitions in molecules ( $\sigma \rightarrow \sigma^*$ , $n \rightarrow \sigma^*$ , $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ ) -	1	6
	2	Chromophore and auxochrome - Red shift and blue shift - applications	2	5
	3	<b>NMR Spectroscopy:</b> Introduction - Chemical shift and spin-spin coupling.	2	5
	4	Application in elucidating the structure of ethanol, dimethyl ether, propanal and acetone (detailed study not required)	3	6
<b>IV</b>	<b>Fundamentals of Chromatography</b>		<b>10</b>	<b>23</b>
	1	<b>Chromatography</b> - Introduction Adsorption and partition chromatography	2	6
	2	Development of chromatograms: frontal, elution, and displacement methods	2	6
	3	Principle and applications of column, thin layer, paper, and gas chromatography	3	5
	4	R <sub>f</sub> value – Relative merits of different techniques.	3	6
<b>V</b>	<b>Practical</b>		<b>30</b>	
	1	1. Neutralization Titrations 1. Acidimetry and Alkalimetry: Strong acid Vs Strong base 2. Acidimetry and Alkalimetry: Strong acid Vs Weak base SECTION C Redox Titrations 1. Permanganometry: Estimation of Fe <sup>2+</sup> /FeSO <sub>4</sub> . 7H <sub>2</sub> O/Mohr's salt 2. Permanganometry: Estimation of Oxalic acid 3. Permanganometry: Estimation of Calcium using std KMnO <sub>4</sub> . Dichrometry: Estimation of Fe <sup>2+</sup> / FeSO <sub>4</sub> . 7H <sub>2</sub> O /Mohr's salt 5. Dichrometry: Estimation of Ferric iron 6. Iodometry and Iodimetry: Estimation of Copper 7. Iodometry and Iodimetry: Estimation of Iodine	25	
	2	Open Ended (Any two experiments are to be conducted. may be selected from the below list or the teacher can select related experiments) 1. Paper chromatography 2. Thin layer chromatography	5	

## References

1. P. W. Atkins, J. de Paula, Atkin's Physical Chemistry, 8th Edn., Oxford University Press, 2006
2. B. R. Puri, L. R. Sharma, M. S. Pathania, Principles of Physical Chemistry, 46th Edn., Vishal Publishing Company, New Delhi, 2013.
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5. Anthony R. West, Solid State Chemistry and its Applications, 2nd Edn., Wiley-Blackwell, 2014.
6. L. V. Azaroff, Introduction to Solids, Tata McGraw Hill Publishing Company, New Delhi, 1960.
7. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, Vogel's Textbook of Qualitative Chemical Analysis, 6th Edn., Pearson Education, Noida, 2013.
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10. J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publications, Meerut, 2008.

#### Mapping of COs with PSOs and POs :

	PS O 1	PSO 2	PSO 3	PSO4	PS O5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	-	2	-	1	-	2			1	2	1	
CO2	2		2	-	-	1	2			2	1	1	
CO3	2	-	2	-	-	2	2			2	1		
CO4	2	-	2		2	2	2			2	1		
CO5	2		-	-	2	-	2			2	1		
CO6	2	-	2		-	2	2		1		2		1

#### Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial/ High

#### Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam

- Practical exam (20%)

**Mapping of COs to Assessment Rubrics:**

	Internal Exam	Assignment	Seminar/Group Discussion	Quizzes/viva	Observation Of practical Skill	End Semester Examinations
CO1	✓	✓				✓
CO2	✓	✓		✓		✓
CO3		✓	✓			✓
CO4		✓	✓			✓
CO5		✓	✓			✓
CO6				✓	✓	✓



**FOUR-YEAR UNDER GRADUATE PROGRAMME  
(CU-FYUGP)  
BSc CHEMISTRY**

Programme	B.Sc. Chemistry				
Course Title	<b>ORGANIC CHEMISTRY IN FOOD SCIENCE</b>				
Type of Course	<b>MINOR</b>				
Semester	<b>III</b>				
Academic Level	<b>200-299</b>				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic Organic Chemistry -Functional groups: –OH, –NH <sub>2</sub> , –NO <sub>2</sub> , aromatic rings, Resonance and conjugation, Electrophilic and nucleophilic substitution, Roles of preservatives and antioxidants				
Course Summary	The course covers four key modules focusing on the chemistry of dyes, food additives, natural products, and biochemistry and give practical knowledge in organic chemistry.				

**Course Outcomes (CO):**

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the chemistry and classification of dyes and their industrial and biological relevance.	U	C	Instructor-created exams / Assignment
CO2	Identify the role and mechanism of preservatives and antioxidants in food safety.	An	P	Instructor-created exams Assignment / quizzes
CO3	Describe key natural products like alkaloids and terpenes and their extraction and uses.	U	P	Assignment / seminar/Internale xam
CO4	Explain the structure and function of major biomolecules and enzymes in biological systems.	U	C	Assignment/Semi nar/
CO5	To enable the students to develop analytical skills in organic qualitative analysis.	Ap	P	Observation of practical skill/Viva voce

\* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)  
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)  
Metacognitive Knowledge (M)

**Detailed Syllabus:**

Module	Unit	Content	Marks	Hrs.
<b>I</b>	<b>Dyes &amp; Colorants</b>		<b>23</b>	<b>10</b>
	1	Color and constitution - chromophores – hypochromic – auxochromes - nomenclature of dyes - dyes as indicators - phenolphthalein, methyl orange, indophenol	4	2
	2	Classification – based on chemical structure Azodyes – chrysoidine, methyl orange, Congored Diaryl methane dyes – auramine, Triphenyl methane dyes-malachite green, crystal violet. Phthalein dyes - florescein, eosin, phenolphthaleine, rhodamine-B Acridine dyes – acriflavine, acridin yellow Anthraquinone dyes: alizarine-indigo	5	3
	3	Food colorants: structure and properties-sunset yellow, orange-B, citrus red No2, yellow No5, green No3.	4	1
	4	Pigments in animals and plants tissues- occurrence and chemical nature and functions- myoglobin, oxymyoglobin, metmyoglobin	5	2
	5	Carotenoids-occurrence-distribution. Betalains–structure–stability-effects of pH, heat and light.	5	2
<b>II</b>	<b>Preservatives and antioxidants</b>		<b>22</b>	<b>10</b>
	1	Additives–contaminants–role of additives-intentional additives - Preservatives–benzoic acid–parabens–citric acid–sorbic acid–sulphites–nitrites– nitrates–hydrogen peroxide.	6	3
	2	Antioxidants: Generation–causes–effects–Naturally occurring antioxidants-role of Vitamin C– Vitamin E – tocoferols–lipoic acid–evaluation of antioxidant property.	5	3
	3	Food adulteration – Types of adulteration-incident and intentional	6	2

	4	Sweeteners: Natural intense sweeteners - Sweetener index.	5	2
<b>III</b>	<b>Alkaloids and terpenes</b>		<b>23</b>	<b>10</b>
	1	Chemical nature- general methods of extraction	6	1

	2	Classification – based on chemical structure - Phenylethylamine group: ephedrine, Benzedrine, mescaline, adrenaline. Hemlock alkaloids: conine; Pomogranate alkaloid - piperine; Tobacco alkaloid-nicotine- solanaceous alkaloid-cocaine; cinchona alkaloid-cinchonine, quinine; phenanthrene alkaloid - morphine, codeine,	6	4
	3	Terpenoids: Isolation-isoprene rules- application to simple systems - Source, structure, properties -Geraniol, nerol, geraniol, $\alpha$ -terpeneol, limonene, Menthol, camphor, borneol	6	3
	4	Applications of alkaloids and terpenoids - role as food ingredients wherever applicable.	5	2
<b>IV</b>	<b>Biomolecules</b>		<b>30</b>	<b>15</b>
	1	Carbohydrates: Definition and classification, General chemistry of carbohydrates	6	2
	2	Proteins and protein structures, Essential amino acids, physico-chemical function – denaturation - Important food proteins	6	3
	3	Lipids: occurrence, classification, and structure, physico-chemical function	6	3
	4	Vitamins and minerals: source and structure of minerals and vitamins	6	3
	5	Enzymes: Definition, function, classification, nomenclature and structure, coenzymes, and its function Mechanism of enzyme action, enzyme kinetics and environmental effects	6	4
<b>V</b>	<b>PRACTICALS</b>		<b>30</b>	
	1	Reactions of Organic Compounds	4	
	2	II. Functional groups test for 1. Phenols -Phenol 2. Amines-Aniline 3. Aldehydes and ketones -benzaldehyde, benzophenone). 4. Carboxylic acid (benzoic acid, cinnamic acid). 5. Carbohydrates (glucose). 6. Amides (benzamide, urea	20	
	3	III. Food adulteration tests	6	

## References

1. Morrison, R. N. & Boyd, R. N., *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Bhal and Bhal, *Advanced Organic Chemistry*, 2nd Edition, S. Chand Publisher, 2012.
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4. M. K. Jain, S. C. Sharma, *Modern Organic Chemistry*, 3<sup>rd</sup> Edn., Vishal Publishing Company Co., 2010.
5. K. S. Tewari, N. K. Vishnoi, S. N. Mehrotra, *A Textbook of Organic Chemistry*, 2<sup>nd</sup> Edn., Vikas Publishing House, New Delhi, 2004.
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8. Arthur I. Vogel, *Elementary Practical Organic Chemistry- Small Scale Preparations*, 2<sup>nd</sup> Edn., Pearson Education, Noida, 2013

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## Correlation Levels:

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CO 3	✓		✓			✓
CO 4		✓	✓			✓
CO 5		✓	✓			✓
CO 6				✓	✓	✓

# **MODEL QUESTION PAPERS**

**CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**  
**FYUGP CHEMISTRY**  
**FIRST SEMESTER EXAMINATION**  
**CHE1MN107 - INORGANIC AND PHYSICAL CHEMISTRY**

**Maximum Marks: 70**

**Duration: 2 hours**

**SECTION A (Short Answer)**

Overall Ceiling 24

Answer all.

Each question carries 3 marks

1. Define ionic and covalent bonds with examples.
2. What is van der Waals force? Mention two examples.
3. Differentiate between inter- and intra-molecular hydrogen bonding.
4. Explain ion-dipole and dipole-induced dipole interactions.
5. What is the common ion effect? Give one application.
6. Mention any two advantages of microanalysis.
7. Classify colloids with one example for each type.
8. What is Tyndall effect? How does it help in identifying colloids?
9. State the first law of thermodynamics.
10. Define pH and pKa. How are they related?

$10 \times 3 = 30$  marks

**SECTION B (Paragraph)**

Overall Ceiling 36

Answer all.

Each question carries 6 marks

11. Distinguish between ionic and covalent compounds based on physical properties.
12. Discuss the abnormal properties of water and the structure of ice.
13. Explain the principals involved in the separation of cations in qualitative analysis.
14. Describe the origin of charge and stability of colloids. What is Hardy-Schulze rule?
15. Write notes on electrophoresis and protective colloids.
16. Explain the Zeroth and First Laws of Thermodynamics with examples.

17. Derive the rate equation for a first-order reaction and state its characteristics.
18. Explain the mechanism of buffer action and its application in biological systems.

(6 × 6 = 36 marks)

**SECTION C (Essay)**

Answer any one

19. Explain the theories of acids and bases: Arrhenius, Brønsted-Lowry, and Lewis. Compare their definitions with suitable examples.
20. Discuss in detail the colligative properties of solutions, the solubility of gases in liquids, Henry's law, and Raoult's law for ideal and non-ideal solutions.

(1 × 10 = 10 marks)

**CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**  
**FYUGP CHEMISTRY**  
**SECOND SEMESTER EXAMINATION**  
**CHE2MN107 - FUNDAMENTAL CONCEPTS AND ANALYTICAL TECHNIQUES**  
**IN CHEMISTRY**

**Maximum Marks: 70**

**Duration: 2 hours**

**SECTION A (Short Answer)**

Overall Ceiling 24

Answer all.

Each question carries 3 marks

1. Define atomic mass and molecular mass with examples.
2. What is the mole concept? State Avogadro's number.
3. Differentiate between molality and molarity.
4. Define oxidation number. How is it different from valency?
5. What is equivalent mass? How is it determined for acids?
6. State Beer-Lambert's law and explain its significance.
7. What are chromophores and auxochromes? Give examples.
8. Write a note on hydrogen bonding with one intramolecular and one intermolecular example.
9. Explain the term 'chemical shift' in NMR spectroscopy.
10. What is the principle of acid-base titration?

(10 × 3 = 30 marks)

**SECTION B (Paragraph)**

Overall Ceiling 36

Answer all.

Each question carries 6 marks

11. Explain normality and mole fraction. How are they useful in solution preparation?
12. Describe methods of expressing concentration such as ppm, ppb, % by weight and volume.
13. Discuss the theory and application of redox titrations.

14. Explain the interaction of electromagnetic radiation with matter using absorption and emission spectra.
15. Describe the selection rules in IR spectroscopy and calculate the force constant for a diatomic molecule.
16. What is anharmonicity? Discuss fundamental frequency and overtones in IR.
17. Explain the types of electronic transitions in UV-Visible spectroscopy with examples.
18. Describe spin-spin coupling in NMR spectroscopy and mention its role in structure determination.

(6 × 6 = 36 marks)

**SECTION C (Essay)**  
Answer any one

19. Describe the molecular vibrations of CO<sub>2</sub> and H<sub>2</sub>O. Calculate the degree of freedom for polyatomic molecules and relate to modes of vibration.
20. Discuss the basic principles of NMR, UV-Visible, and IR spectroscopy. How do these techniques aid in the structural elucidation of organic molecules?

(1 × 10 = 10 marks)

**CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**  
**FYUGP CHEMISTRY**  
**THIRD SEMESTER EXAMINATION**  
**CHE3MN207 - ORGANIC CHEMISTRY IN FOOD SCIENCE**

**Maximum Marks: 70**

**Duration: 2 hours**

**SECTION A (Short Answer)**

Overall Ceiling 24

Answer all.

Each question carries 3 marks

1. Define chromophore and auxochrome with examples.
2. What is the role of phenolphthalein as an indicator?
3. Write the structure and color of methyl orange and malachite green.
4. Mention two natural food colorants and their sources.
5. Write a short note on parabens and their use as preservatives.
6. Differentiate between intentional and incidental food adulteration.
7. Name any two antioxidants and describe their function briefly.
8. What is the isoprene rule? Give an example.
9. List any two alkaloids from the solanaceous family and their applications.
10. What are essential amino acids? Give two examples.

(10 × 3 = 30 marks)

**SECTION B (Paragraph)**

Overall Ceiling 36

Answer all.

Each question carries 6 marks

11. Classify dyes based on chemical structure and explain azo and phthalein dyes with examples.
12. Discuss the structure and stability of betalains. How does pH affect them?
13. Explain the function and mechanism of benzoic acid and citric acid as food preservatives.

14. Describe the mechanism of antioxidant action of Vitamin C and tocopherols.
15. Explain the extraction and classification of alkaloids.
16. Write the structure and food-related applications of any four terpenoids.
17. Explain the classification of carbohydrates and their general chemical characteristics.
18. Describe enzyme classification and outline the mechanism of enzyme action.

(6 × 6 = 36 marks)

**SECTION C (Essay)**

Answer any one

19. Compare and contrast the chemical structures and properties of the following dye classes:

(a) Triphenylmethane dyes    (b) Acridine dyes    (c) Anthraquinone dyes  
Also, comment on their industrial or analytical uses.

20. Discuss in detail the structure, functions, and nutritional importance of proteins, lipids, vitamins, and minerals in human biochemistry. Include the role of any one enzyme system.