

Bachelor of Science



Chemistry

## **SRI VIDYA MANDIR ARTS & SCIENCE COLLEGE**

**(Autonomous)**

**[An Autonomous College Affiliated to Periyar University, Salem, Tamil Nadu]**

**[Accredited by NAAC with 'A' Grade with CGPA of 3.27]**

**[Recognized 2(f) & 12(B) Status under UGC Act of 1956]**

**Katteri – 636 902, Uthangarai (Tk), Krishnagiri (Dt)  
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## **DEGREE OF BACHELOR OF SCIENCE IN CHEMISTRY**

### **CHOICE BASED CREDIT SYSTEM (CBCS)**

### **REGULATIONS AND SYLLABUS FOR**

### **B.Sc. CHEMISTRY PROGRAMME**

### **(SEMESTER PATTERN)**

**(For Students Admitted in the College from the Academic Year 2021-2022 Onwards)**



### Programme Outcomes (POs)

<b>PO1</b>	Graduates are prepared to be creators of new knowledge leading to innovation and <b>entrepreneurship employable</b> in various sectors such as private, government, and research organizations
<b>PO2</b>	Graduates are trained to evolve new technologies in their own discipline.
<b>PO3</b>	Graduates are groomed to engage in lifelong learning process by exploring their knowledge independently
<b>PO4</b>	Graduates are framed to design and conduct experiments /demos/create models to analyze and interpret data.
<b>PO5</b>	Graduates ought to have the ability of effectively communicating the findings of Physical sciences; incorporating with existing knowledge

### Programme Specific Outcomes (PSOs)

<b>PSO1</b>	Human and Social Values and Responsibilities in the context of learning Chemistry
<b>PSO2</b>	Communicative Skills and the Creative scientific mind towards learning chemistry
<b>PSO3</b>	Positive approach towards Environment and Ecology from the Chemistry perspective
<b>PSO4</b>	Critical thinking and the Analytical mind, students develop for the in depth knowledge in advanced-level Chemistry
<b>PSO5</b>	The relevance of extension of Chemistry in the social context for solving social issues
<b>PSO6</b>	Employability Skills shall enable the students to find jobs in core-chemistry and other related fields
<b>PSO7</b>	Entrepreneurial Skills shall empower the students to start their own industries / business in core-chemistry fields
<b>PSO8</b>	Analytical or Experimental Skills make the students capable of doing higher-level research works in the emerging fields of chemistry



## SRI VIDYA MANDIR ARTS & SCIENCE COLLEGE

(Autonomous)

Bachelor of Science (B.Sc.) in Chemistry

Programme Pattern and Syllabus (CBCS)

(For Students Admitted in the College from the Academic Year 2021-2022 Onwards)

Sl. No	Nature of the Course	Course Code	Name of the Course	Hours / Week	Credits	Marks		
						CIA	ESE	Total
<b>SEMESTER I</b>								
1	Language	21UTA1F01	Tamil - I	4	3	25	75	100
2	Language	21UEN1CE01	Communicative English – I	4	3	25	75	100
3	Core-I	21UCH1C01	General Chemistry I	5	4	25	75	100
4	Core practical-I	21UCH1P01	Inorganic Qualitative Analysis-I and Complex Preparation	3	3	40	60	100
5	Allied I	21UMA1A01	Allied Mathematics-I	5	4	25	75	100
		21UZO1A01	Allied Zoology-I					
6	Allied-I Practical	21UMA2AP01	Allied Mathematics Practical -I	3				
		21UZO2AP01	Allied Zoology Practical -I					
7	Value Education*	21UVE101	Value Education	2	2	25	75	100
8	Add On Course	21UPS1AO01	Professional English - I	4	4	25	75	100
<b>Total</b>				<b>30</b>	<b>23</b>	<b>190</b>	<b>510</b>	<b>700</b>
<b>SEMESTER II</b>								
9	Language	21UTA2F02	Tamil - II	4	3	25	75	100
10	Language	21UEN2CE02	Communicative	4	3	25	75	100



			English – II					
11	Add On Course	21UPS2AO02	Professional English- II	4	4	25	75	100
12	EVS	21UES201	Environmental Studies	2	2	25	75	100
13	Core-II	21UCH2C02	General Chemistry II	4	4	25	75	100
14	SBEC I	21UCH2S01	Food and Nutrition	2	2	25	75	100
15	Core practical-II	21UCH2P02	Practical II: Inorganic Qualitative Analysis-II	3	3	40	60	100
16	Allied II	21UMA2A02	Allied Mathematics-II	4	4	25	75	100
		21UZO2A02	Allied Zoology-II					
17	Allied-I Practical	21UMA2AP02	Allied Mathematics Practical -II	3	3	40	60	100
		21UZO2AP02	Allied Zoology practical - II					
<b>Total</b>				<b>30</b>	<b>28</b>	<b>255</b>	<b>645</b>	<b>900</b>

### SEMESTER-III

18	Language III	21UFTA03	Tamil - III	5	3	25	75	100
19	English III	21UFEN03	English - I	5	3	25	75	100
20	Core-III	21UCH3C03	General Chemistry III	5	4	25	75	100
21	SBEC II	21UCH4S02	Polymer Chemistry	2	--	--	--	--
22	Allied-III	21UPH3A01	Allied Physics-I	5	4	25	75	100
23	NMEC - I	21UCH3N01	Diary chemistry	2	2	25	75	100
24	Core Practical-III	21UCH3P03	Practical III: Volumetric Analysis- I	3	3	40	60	100
25	Allied	21UPH4AP02	Allied Physics	3	--	--	--	--



	Practical - IV		Practical -II					
<b>Total</b>				<b>30</b>	<b>19</b>	<b>165</b>	<b>435</b>	<b>600</b>
<b>SEMESTER IV</b>								
26	Language IV	21UFTA04	Tamil - IV	5	3	25	75	100
27	English IV	21UFEN04	English - II	5	3	25	75	100
28	Core - IV	21UCH4C04	General Chemistry IV	5	4	25	75	100
29	SBEC II	21UCH4S02	Polymer Chemistry	2	2	25	75	100
30	Allied - IV	21UPH4A02	Allied Physics-II	5	4	25	75	100
31	Core practical - IV	21UCH4P04	Practical IV: Volumetric Analysis- II	3	3	40	60	100
32	Allied Practical - IV	21UPH4AP02	Allied Physics Practical -II	3	3	40	60	100
33	NMEC - II	21UCH4N02	Biological chemistry	2	2	25	75	100
<b>Total</b>				<b>30</b>	<b>24</b>	<b>230</b>	<b>570</b>	<b>800</b>
<b>SEMESTER V</b>								
29	Core - V	21UCH5C05	Inorganic Chemistry I	5	4	25	75	100
30	Core - VI	21UCH5C06	Organic Chemistry I	5	4	25	75	100
31	Core -VII	21UCH5C07	Physical Chemistry I	5	4	25	75	100
32	Elective I	21UCHE01	Analytical Chemistry I	5	4	25	75	100
33	SBEC -III	21UCH5S03	Agricultural Chemistry	2	2	25	75	100
35	Core Practical - V	21UCH5P05	Practical V: Gravimetric Estimation I	3	3	40	60	100
36	Core Practical - VI	21UCH5P06	Practical VI: Organic Chemistry Practical I	2	2	40	60	100
37	Core Practical - VII	21UCH5P07	Practical VII: Physical Chemistry Practical I	3	3	40	60	100



<b>Total</b>				<b>30</b>	<b>26</b>	<b>245</b>	<b>555</b>	<b>800</b>
<b>SEMESTER VI</b>								
38	Core - VIII	21UCH6C08	Inorganic Chemistry II	5	4	25	75	100
39	Core -IX	21UCH6C09	Organic Chemistry II	5	4	25	75	100
40	Core - X	21UCH6C10	Physical Chemistry II	5	4	25	75	100
41	Elective -II	21UCH6E02	Analytical Chemistry II	5	4	25	75	100
42	SBEC -IV	21UCH6S04	Pharmaceutical Chemistry	2	2	25	75	100
44	Core Practical - VIII	21UCH6P08	Practical VIII: Gravimetric Estimation II	3	3	40	60	100
45	Core Practical - IX	21UCH6P09	Practical IX: Organic Chemistry Practical II	2	2	40	60	100
46	Core Practical - X	21UCH6P10	Practical X: Physical Chemistry Practical II	3	3	40	60	100
47	Extension Activities (SWAYAM)			-	2	-	-	-
<b>Total</b>				<b>30</b>	<b>28</b>	<b>245</b>	<b>555</b>	<b>800</b>
<b>Cumulative Total</b>				<b>180</b>	<b>148</b>	<b>1360</b>	<b>3240</b>	<b>4600</b>

**Note**

- CBCS – Choice Based Credit system  
 CIA – Continuous Internal Assessment  
 ESE – End of Semester Examinations  
 SWAYAM –Study Webs of Active-Learning for Young Aspiring Minds  
 NPTEL –National Programme on Technology Enhanced Learning

**List of Extension Activities**

1. National Cade Corps (NCC)
2. National Service Scheme (NSS)
3. Youth Red Cross (YRC)
4. Physical Education (PYE)
5. Eco Club (ECC)
6. Red Ribbon Club (RRC)
7. Women Empowerment Cell (WEC)



# PROGRAMME SYLLABUS





Program: B.Sc. Chemistry				
Core – I		Course Code: 22UCH1C01		Course Title: General Chemistry – I
Semester	Hours/Week	Total Hours	Credits	Total Marks
I	5	75	4	100

### Course Objectives

1. Students shall explain the behavior and interactions between matter and energy at both the atomic and molecular levels.
2. Students shall use standardized names and symbols to represent atoms, molecules, ions and apply on chemical reactions.
3. Students shall predict the atomic structure, chemical bonding or molecular geometry based on accepted models.
4. Students shall apply quantitative reasoning skills to matter and energy and also study the physical or chemical changes that occur.
5. Students shall use accepted models to describe the reactions between gaseous systems and become aware of their physical properties.
6. Students shall demonstrate competence in collecting and interpreting data from their knowledge on analytical techniques.

#### **UNIT- 1 Atomic Structure -I (15 Hours)**

Dual nature of matter- Debroglie equation- derivation and limitation-Heisenberg's uncertainty principle-postulates of Bohr atom model-origin of Hydrogen spectrum

Quantum numbers-Pauli's Exclusion principle and its application- Hund's rule- its basis and applications - stability of half-filled and fully – filled orbitals- Aufbau principle and its limitations - Sommerfield model

#### **UNIT-II Atomic Structure – II (15 Hours)**

Periodic properties: Atomic and ionic radii, Ionization Energy, Electron affinity and Electro negativity – Definition, Variation of the periodic properties along periods and groups-theoretical explanation for the variations. Measurement of electronegativity using Pauling's scale and Mulliken scale.

**UNIT-III Analytical chemistry (15 Hours)**

Handling of chemicals – Safety and hygiene in chemical laboratory-storage and handling of chemicals, handling of acids, ethers, toxic and poisonous chemicals, antidotes. Disposal of waste, waste chemicals and fumes.

Principles of Volumetric analysis- Definition of molarity, molality, normality and mole fraction-Definition and examples for Primary and Secondary standards.

**UNIT – IV Structure and Bonding of Alkanes and Alkenes (15 Hours)**

IUPAC Nomenclature – aliphatic and aromatic compounds of simple functional groups –

Hybridization and structure of Methane – ethylene – acetylene.

Alkane – Methane preparation – properties -Alkenes-Ethylene preparation, electrophilic and free radical mechanism of addition– Markownikoff's Rule – Anti Markownikoff's Rule - mechanism of hydroboration.

Electron displacement effects: Inductive and steric effects-their effect on properties of compounds, resonance, hyperconjugation.

**UNIT V The first law of thermodynamics (15 Hours)**

Terminology of Thermodynamics-Nature of work and heat- Law of conservation of energy - first law of thermodynamics - Internal energy - Enthalpy of a system- Heat capacity of a system - Expansion of an ideal gas - work done in reversible isothermal expansion-work done in reversible isothermal compression - Joule-Thomson effect, Joule-Thomson coefficient-Inversion temperature - zeroth law of thermodynamics-Kirchoff's equation.

**Text Books**

1. Puri B R, Sharma L R and Kalia K K, Principles of Inorganic Chemistry, 23rd Ed., (1993) Shoban Lal Nagin Chand & Co., New Delhi.
2. Bhal B S and Arun Bhal, Advanced Organic Chemistry, 12th Ed., (1997), Sultan Chand & Co., New Delhi.
3. Puri B R, Sharma L R and Kalia K K, Principles of Physical Chemistry, 23rd Ed., (1993) Shoban LalNagin Chand & Co., New Delhi.

**Reference Books**

1. Lee J D, Concise Inorganic Chemistry, 5th Ed., (2006), Black Well Science, UK.



- Morrison R T, Boyd R N and Batcharjee S K, Organic Chemistry, 7th Ed., (2009), Pearson New York
- Peter Atkins and Julio De Paula, Atkin's Physical Chemistry, 4th Ed., (2006), Oxford University Press, New Delhi.

### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Identify structure of atom	K1
CO2	Understand the concept of Dual nature of matter and atomic character in some molecules	K2
CO3	Illustrate the importance of storage and handling of chemicals	K3
CO4	Analyse the Safety and hygiene in chemical laboratory	K4
CO5	Evaluate the techniques of thermochemistry	K5&K6
CO6	Formulate the structure and bonding reactions shown by organic molecules	K5&K6

**K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create**

### Mapping of COs with POs

PO \ CO	PO1	PO2	PO3	PO4	PO5
CO1	S	H	H	M	S
CO2	S	H	M	H	H
CO3	H	M	S	S	M
CO4	H	H	H	M	S
CO5	S	S	M	H	S
CO6	H	S	S	S	S

S - Strong

H - High

M - Medium

L – Low



Program: B.Sc. Chemistry				
Core Practical – I		Course Code: 22UCH1CP01		Course Title: Inorganic Qualitative Analysis – I & Complex Preparation
Semester I	Hours/Week 3	Total Hours 45	Credits 3	Total Marks 100

### Course Objectives

(a). To Analysis of Inorganic salt containing one anion and one cation. Semi-micro method using the conventional scheme to be adopted.

#### **Anions to be Studied - I**

Carbonate, Sulphide, Sulphate, Nitrate, Chloride, Bromide.

#### **Cations to be Analyzed – II**

Lead, Copper, Cadmium, Bismuth, Aluminium, Iron, Nickel, Zinc and Ammonium.

#### **Preparation of Inorganic Compounds - II**

1. Tetrammine copper II sulphate
2. Tris (thiourea) copper I chloride
3. Potassium trioxalato ferrate (II)
4. Chloropentammine cobalt (III) chloride
5. Ferrous ammonium sulphate
6. Microcosmic salt

RECORD      10 Marks

VIVA VOCE   10 Marks

Acid Radicals   20 Marks

Basic Radicals 20 Marks

**Total            60 Marks**

#### **Reference Book**

1. Venkateswaran V, Veeraswamy R., Kulandaivelu A.R., Basic Principles of Practical Chemistry, (2nd edition), New Delhi, Sultan Chand & sons, (1997)

### Course Outcomes

Students shall learn the techniques of semi micro qualitative analysis of inorganic salt mixtures. Students become familiar with elimination of interfering acid radicals.



Program: B.Sc. Chemistry				
Core –II	Course Code: 22UCH2C02		Course Title: General Chemistry – II	
Semester	Hours/Week	Total Hours	Credits	Total Marks
II	5	75	4	100

### Course Objectives

1. Students shall understand the concepts of chemical bonding
2. Students shall become aware of the fundamental aspects of reaction intermediate and its influence on chemical properties
3. Students will learn the chemical aspects of cycloalkanes
4. Students shall become aware of the chemistry of aromatic hydrocarbons
5. Students shall learn the Second law of Thermodynamic principles
6. Students shall learn to apply the concept of thermodynamics in real life context.

### **UNIT – I Chemical Bonding-I (15 Hours)**

- 1.1. Ionic bond-condition for the formation of ionic bond -inert pair effect-Born Haber cycle-polarization of ions- Fajan's rules and applications. Covalent Bond-mode of formation-properties of covalent compounds-Octet theory- Explanation of the failure of Octet rule-
- 1.2 Co-ordinate bond – mode of formation –properties of co-ordinate bond – Nature of Metallic bond by Electron – gas theory –Hydrogen bond –mode of formation – properties of Hydrogen bonds-Types of Hydrogen bonds .

### **UNIT – II Chemical Bonding - II (15 Hours)**

- 2.1 Valency bond theory– different types of overlapping - Comparative study of VB and MO theory. Hydrides – types of hydrides – preparation, properties, uses and structure of  $\text{NaBH}_4$  and  $\text{LiAlH}_4$ .
- 2.2. Molecular orbital theory –Bonding , anti –bonding molecular orbitals – Energy level diagram for molecular orbitals-bond order – magnetic property –  $\text{N}_2, \text{O}_2^{2+}$  ion
- Energy level diagram for molecular orbitals-bond order – magnetic property of Hetero nuclear diatomic molecules – NO, HF

**UNIT – III Reaction intermediates (15 Hours)**

Reaction intermediates: carbocation, carbanion, free radicals-formation and stability. Aliphatic nucleophilic substitution- SN1, SN2 and SNi reactions – mechanism a stereochemistry. Relative reactivity of ethyl, Isopropyl and benzyl halides. Elimination reactions-mechanisms of E1 and E2 reactions- Hofmann and Saytzeff rule.

**UNIT – IV Cycloalkanes and Aromatic Hydrocarbons (15 Hours)**

Cycloalkanes- methods of formation-Wurtz reaction, Dieckmann ring closure and Baeyer's strain theory and its limitations.

Aromatic Hydrocarbons and aromaticity – resonance in benzene - delocalized cloud in benzene - aromaticity – Huckel's  $(4n+2)$  rule

Electrophilic substitution reactions in aromatic compounds- general mechanism – Nitration, Halogenation, Sulphonation, Friedel- Crafts acylation and alkylation.

**UNIT – V Second law of thermodynamics-I (15 Hours)**

Limitations of the first law - need for second law - spontaneous processes - cyclic process - Carnot cycle - efficiency - Carnot theorem - Thermodynamic scale of temperature.

Concept of entropy - Entropy-a state function - Entropy change in isothermal expansion of an ideal gas-entropy change in reversible and irreversible processes - Clausius inequality - Entropy change accompanying change of phase

**Text Books**

1. Puri B R, Sharma L R and Kalia K K, Principles of Inorganic Chemistry, 23rd Ed., (1993) Shoban Lal Nagin Chand & Co., New Delhi.
2. Bhal B S and Arun Bhal, Advanced Organic Chemistry, 12th Ed., (1997) Sultan Chand & Co., New Delhi.

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3. Peter Atkins and Julio De Paula, Atkin's Physical Chemistry, 4th Ed., (2006), Oxford University Press, New Delhi.



### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Define chemical bonding	K1
CO2	Understand the concept of different types of overlapping	K2
CO3	Illustrate the importance of Second law of thermodynamics and concept of entropy	K3
CO4	Analyse the Electrophilic substitution reactions in aromatic compounds	K4
CO5	Evaluate the Reaction intermediates	K5&K6
CO6	Formulate the Molecular orbital theory	K5&K6

**K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create**

### Mapping of COs with POs

PO CO	PO1	PO2	PO3	PO4	PO5
CO1	S	H	H	H	M
CO2	S	M	M	H	H
CO3	M	H	H	H	H
CO4	H	M	M	M	S
CO5	S	S	M	M	S
CO6	H	H	S	S	M

S - Strong

H - High

M - Medium

L – Low



Program: B.Sc. Chemistry				
Core Practical – II		Course Code: 22UCH2CP02		Course Title : Qualitative Analysis of Inorganic Salt Mixture-II
Semester II	Hours/Week 3	Total Hours 45	Credits 3	Total Marks 100

### Course Objective

Analysis of mixture containing two cations and two anions of which one will be an Interfering ion. Semi-micro methods using the conventional scheme to be adopted.

#### **Cations to be studied**

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

#### **Anions to be studied**

Carbonate, Sulphide, Sulphate, Nitrate, Chloride, Bromide, Fluoride, Borate, Oxalate and Phosphate.

RECORD 10 Marks

VIVA VOCE 10 Marks

ACID RADICALS 20 Marks

BASIC RADICALS 20 Marks

Total 60 Marks

#### **Reference Books**

1. Venkateswaran V, Veeraswamy R., Kulandaivelu A.R., Basic Principles of Practical Chemistry, (2nd edition), New Delhi, Sultan Chand & sons, (1997)

### Course Outcomes

- \* Students shall learn the techniques of titrimetric analyses.
- \* Students will become familiar with safe-handling of chemical balance





Program: B.Sc. Chemistry				
SBEC – I		Course Code: 22UCH2S01		Course Title : Food and Nutrition
Semester	Hours/Week	Total Hours	Credits	Total Marks
II	2	30	2	100

### Course Objectives

1. To study the Sources of foods, its types and constituents.
2. To know about Mal nutrition, poor nutritional status and guidelines for good health.
3. To study about Food poisoning and Food adulteration.
4. To study about Food spoilage and Food preservation.
5. To know about Sources, requirement and deficiency diseases of vitamins and minerals.

### **UNIT – I FOOD SOURCES**

1.1. Sources of foods, types, constituents of foods-carbohydrate, protein, fats.Oils, colours, flavours and natural toxicants.

### **UNIT – II NUTRITION**

Definition of nutrition, nutrients, functions. Nutritional status – Definition, signs of good and poor nutritional status.

Mal nutrition- Definition, forms, causes and remedy.

Health –Definition, guidelines for good health.

### **UNIT – III FOOD POISONING AND ADULTERATION**

3.1. Food poisoning- Sources, causes and remedy.

3.2 Causes and remedies for acidity, gastritis, indigestion and constipation

3.3. Food adulteration- Types of adulterants- intentional and incidental, effects and detection.

### **UNIT – IV FOOD PRESERVATION AND PROCESSING**

Food spoilage, causes of food spoilage, types of Food spoilage

Food preservation-preservation and processing by heating - sterilization, pasteurization.



## UNIT – V VITAMINS AND MINERALS

Sources, requirement and deficiency diseases of A, C, K, E1 and B6 and B12

Mineral elements in food-source, function, deficiency diseases and daily requirements of Sodium , Potassium , Magnesium , Iron, Sulphur , Phosphorous ,Zinc and Cobalt

### Reference Books

1. Seema **Yadav**, **Food Chemistry**, Anmol publishing (P) Ltd, New Delhi
2. Car H. Synder, **The Extraordinary Chemistry for ordinary thing**, John Wiley & sons inc., New York, 1992.
3. B.Sivasankar, **Food Processing and Preservation** – PHI Learning (P) Ltd, New Delhi-11001.
4. B.Srilakshmi, **Nutrition science**. Third edition, New age International (P) Ltd. New Delhi, Chennai.

### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Define Sources of foods	K1
CO2	Understand the concept of Mal nutrition	K2
CO3	Illustrate the importance of Food poisoning and Food adulteration	K3
CO4	Analyze the Food spoilage and Food preservation	K4
CO5	Evaluate the Sources, requirement and deficiency diseases of vitamins and minerals	K5&K6

**K1– Remember, K2 – Understand, K3 – Apply, K4 –Analyze, K5 – Evaluate, K6 – Create**

**Mapping of COs with POs**

<b>PO</b> <b>CO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>CO1</b>	S	H	H	H	M
<b>CO2</b>	S	M	M	H	H
<b>CO3</b>	M	H	H	H	H
<b>CO4</b>	H	M	M	M	S
<b>CO5</b>	S	S	M	M	S
<b>CO6</b>	H	H	S	S	M

**S** - Strong**H** - High**M** - Medium**L** – Low



Program: B.Sc. Chemistry				
Core – III		Course Code: 21UCH3C03		Course Title: General Chemistry – III
Semester III	Hours/Week 5	Total Hours 75	Credits 4	Total Marks 100

### Course Objectives

1. The students will be able to understand general trends in the chemistry behind d-block elements.
2. The students will be able to know the important compounds and important applications of compounds of boron and carbon.
3. To explain the typical physical and chemical properties of the transition metals
4. To identify simple compound classes for transition metals and describe their chemical properties
5. Students to understand organic reaction mechanism of name reactions
6. To understand the concepts of thermodynamics and its laws
7. To understand the entropy change in reversible and irreversible reaction
8. To understand the physical significance of third law of thermodynamics

### **UNIT I – Transition Elements and qualitative analysis**

1.1 Principles of Qualitative analysis- Basic principles of inorganic semi micro analysis. Principles involved in  $\text{Na}_2\text{CO}_3$  extract preparation, Common ion effect, Solubility product and their applications in Qualitative analysis. Separation of cations into Groups.

1.2. Transition Elements – position in the Periodic Table-General characteristics of d-block elements .Occurrence, extraction, properties and uses of Titanium, Zirconium, Molybdenum, Tungstun.

1.3 Chemistry of Titanium dioxide, Vanadium pentoxide , Zirconium dioxide , Ammonium molybdate and Molybdenum blue.

### **UNIT II – Reaction Mechanism II**

2.1. Mechanism of –Kolbe’s reaction,Reimer-Tiemann reaction, Gattermann, Lederer-Manasse and Houben-Hoesch reactions.



2.2. Define–Example - Mechanism of claisen condensation reaction, Hofmann rearrangement, cannizzaro reaction, perkins reaction.

2.3. Mechanisms of Mannich, Stobbe, Darzen, Wittig and Reformatsky reactions.

### **UNIT III – Carboxylic acids Hydroxy acids.**

3.1 Mono carboxylic acids –preparation ,properties , & uses –Formic acid , Acetic acid - crotonic, and cinnamic acids.

3.2. Hydroxy acids-classification – preparation and reactions of Glycolic acid, Malic acid and Citric acid-Action of heat on  $\alpha$  and  $\delta$  acids.

3.3. Dicarboxylic acids-preparation and properties of oxalic, malonic, succinic, and adipic acids.

### **UNIT IV – Acid derivatives & Esters.**

4.1 Preparation, properties& uses of Acetic anhydride, Acetyl chloride & Acetamide.

4.2. Synthetic uses of Ethylaceto acetate & Diethyl malonate.

4.3. Tautomerism-definition-keto-enol and amido-imido tautomerisms.

### **UNIT V – Second law of thermodynamics-II**

5.1. Work and free energy functions-Maxwell’s relationships criteria for reversible and irreversible processes -Gibbs-Helmholtz equation.

5.2. Partial molar free energy. Clapeyron equation-Clapeyron- Clausius equation-Applications of Clapeyron-Clausius equation.

5.3. Third law of thermodynamics Nernst heat theorem-statement of III law-Evaluation of absolute entropy from heat capacity measurements-Test for the validity of the law.

### **Text Books**

1. Puri B R, Sharma L R and Kalia K K, Principles of Inorganic Chemistry, 23rd Ed., (1993) Shoban Lal Nagin Chand & Co., New Delhi.
2. Bhal B S and Arun Bhal, Advanced Organic Chemistry, 12th Ed., (1997), Sultan Chand & Co., New Delhi.
3. Puri B R, Sharma L R and Kalia K K, Principles of Physical Chemistry, 23rd Ed., (1993) Shoban LalNagin Chand & Co., New Delhi.



### Reference Books

1. Lee J D, Concise Inorganic Chemistry, 5th Ed., (2106), Black Well Science, UK.
2. Morrison R T, Boyd R N and Batcharjee S K, Organic Chemistry, 7th Ed., (2109), Pearson New York
3. Peter Atkins and Julio De Paula, Atkin's Physical Chemistry, 4th Ed., (2106), Oxford University Press, New Delhi.

### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	The students will be able to explain the fundamental concepts in coordination chemistry of transition metals	K1
CO2	Understand the concept of organic reaction mechanism via cation or anion in some molecules	K2
CO3	The Students should be familiar with the basic knowledge of the Synthetic uses of acid derivatives and esters	K3
CO4	The students will develop the ability of effective solving practical problem of thermodynamics	K4
CO5	Evaluate the techniques of thermochemistry	K5&K6
CO6	Formulate the structure and bonding reactions shown by organic molecules	K5&K6

**K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create**



**Mapping of COs with POs**

<b>PO CO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>CO1</b>	S	H	H	M	S
<b>CO2</b>	S	H	M	H	H
<b>CO3</b>	H	M	S	S	M
<b>CO4</b>	H	H	H	M	S
<b>CO5</b>	S	S	M	H	S
<b>CO6</b>	H	S	S	S	S

S - Strong

H - High

M - Medium

L – Low



Program: B.Sc. Chemistry				
<b>Core Practical – III</b>		<b>Course Code:</b> 21UCH3P03		<b>Course Title:</b> Volumetric Estimations - I
<b>Semester</b> III	<b>Hours/Week</b> 3	<b>Total Hours</b> 45	<b>Credits</b> 3	<b>Total Marks</b> 100

### Course Objective

1. To learn the practical techniques of Acidimetry, Iodimetry & Iodometry.
2. Experimental practice of quantitative volumetric analysis.
3. The objective of the titration is the determination of the concentration or the mass of the minimum formula from the titrated chemical material composing a pure liquid or a solution.
4. The main objective of volumetric analysis is to determine the amount of a substance in a given sample. When dealing with volumetric analysis the concept of concentration cannot be avoided. Molarity i.e. moles per litre or decimeter is widely used unit of concentration.

1. Estimation of Borax – Standard Sodium Carbonate.
2. Estimation of Sodium Hydroxide – Standard Sodium Carbonate.
3. Estimation of Ferrous Sulphate – Standard Oxalic acid.
4. Estimation of Copper – Standard Copper Sulphate.
5. Estimation of Potassium dichromate – Standard Potassium dichromate.

Students must write short procedure for the given estimation in ten minutes during the examinations and submit the paper for evaluation.

### **Reference Books**

1. Vogel's Inorganic Quantitative Analysis by Vogel, Pearson Education (2104).
2. O.P. Pandey, D.N. Bajpai, S. Giri, Practical Chemistry, S. Chand & Company Ltd., (2105).
3. V. Venkateswaran, Veeraswamy.R, Kulandaivelu.A.R. Sultan Chand & Sons (1997).
4. Qualitative Inorganic Analysis by V.V. Ramanujam.



**Course Outcome (COs)**

Upon successful completion students should be able to:

1. Facilitate the learner to make solutions of various molar concentrations. This may include: The concept of the mole; Converting moles to grams; Converting grams to moles; Defining concentration; Dilution of Solutions; Making different molar concentrations.

1. Short procedure	05 Marks
2. Titration 1	10 Marks
3. Titration 2	10 Marks
4. Result	21 Marks
5. Record	10 Marks
6. Viva-voce	05 Marks

Error Calculation:

< 2%	-	21 Marks
2 – 3%	-	15 Marks
3 – 4%	-	10 Marks
>4%	-	05 Marks



Program: B.Sc. Chemistry				
NMEC-I	Course Code: 21UCH3N01		Course Title: Dairy Chemistry	
Semester III	Hours/Week 2	Total Hours 30	Credits 2	Total Marks 100

### Course Objective

1. To provide students with the knowledge of milk
2. To understand the constituents of milk and their physico-chemical properties.
3. The course will allow to critically understand the main phenomena involved in manufacturing of dairy products.

### **UNIT I**

Milk: General composition of milk. Factors affecting the gross composition of milk, physico-chemical change taking place in milk due to processing parameters-boiling, pasteurization-sterilization and homogenization.

### **UNIT II**

1. Milk lipids-terminology and definitions
2. Milk proteins: Physical properties of milk proteins-Electrical properties and hydration, solubility. Reaction of milk proteins with formaldehyde and ninhydrin.
3. Milk carbohydrate-Lactose-Estimation of lactose in milk.
4. Milk vitamins-water and fat soluble vitamins, effect of heat and light on vitamins.
5. Ash and mineral matters in milk.

### **UNIT III**

1. Creams : Definition-composition-chemistry of creaming process-gravitational and centrifugal methods of separation of cream-Factors influencing cream separation (Mention the factors only)-Cream neutralization. Estimation of fat in cream.
2. Butter : Definition-% composition-manufacture-Estimation of fat, acidity, salt and moisture content-Desi butter.

**UNIT IV**

1. Milk powder : Definition-need for making powder-drying process-spraying, drum drying, jet drying and foam drying-principles involved in each. Manufacture of whole milk powder by spray drying process-keeping quality of milk powder.
2. Ice cream : Definition-percentage composition-types- ingredients needed - manufacture of ice-cream stabilizers-emulsifiers and their role.

**UNIT V**

Dairy Detergents: Definition-characteristics-classification-washing procedure (modern method) sterilization-chloramin-T and hypochlorite solution.

**Reference Books**

- 1.Outlines of Dairy Technology-Sukumar De
- 2.Principles of Dairy Chemistry-Robert Jenness & S.Patarn.
- 3.Indian Dairy products-K.S. Rangappa and K.T. Achaya.

**Course Outcomes (COs)**

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	At the end of the course the students will be able to evaluate milk and derivatives in terms of quality, applied technology	K1
CO2	Students will also have acquired a critical and up-to-date view of the main technical issues of the industry and of the dairy sector	K2
CO3	Students will be able to describe the composition of milk, identify the approximate content of individual types present, and describe physicochemical characteristics of the main components	K3
CO4	Student will be able to explain how dairy products (such as fluid milk, yogurt, butter, powder, cheese) are made and the key functions of the processing steps involved.	K4

**K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create**



**Mapping of COs with POs**

<b>PO CO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>CO1</b>	S	H	H	M	S
<b>CO2</b>	H	H	M	H	H
<b>CO3</b>	H	M	H	S	M
<b>CO4</b>	H	H	H	M	S
<b>CO5</b>	S	S	M	H	S
<b>CO6</b>	H	S	H	S	H

S - Strong

H - High

M - Medium

L – Low



Program: B.Sc. Chemistry				
Core – IV		Course Code: 21UCH4C04		Course Title: General Chemistry – IV
Semester IV	Hours/Week 5	Total Hours 75	Credits 4	Total Marks 100

### Course Objectives

1. In order to study nuclear reactions to understand the trends in properties and reactivity of the nuclear chemistry.
2. To explain the typical physical and chemical properties of the elements.
3. To identify simple compound classes of phenol and describe their chemical properties.
4. To make the students understand the amines and their derivatives.
5. The students should know that that equivalent weight of an acid and base can be find out from their molecular weight and the acidity and basicity of that compound.
6. The student should understand that there are different methods of expressing concentration of a solution such as mass percent, ppm, normality, molarity, and molality.

### **UNIT I – Nuclear Chemistry**

1.1. Nuclear stability-n/p ratio-nuclear forces-Exchange theory. Natural radioactivity-modes of decay-Geiger Nuttal rule. Mass defect and binding energy. Nuclear fission and nuclear fusion – Stellar energy.

1.2. Application of radioactive isotopes- C-14 dating, rock dating- isotopes as tracers-study of reaction mechanism (e.g. ester hydrolysis). Nuclear reactors - types-common features like fuels, moderators, coolant control materials, reactor shielding- uses-Nuclear reactors in India.

### **UNIT II – PHENOLS**

2.1 Classification of phenols – Preparation of phenol from chlorobenzene, Cumene – Reactions with mechanism: Schotten – Bauman, Bucherrer reaction and Liebermann reaction. 2.2 Preparation of Nitro phenol, Picric acid, Catechol, Resorcinol, Quinol, Pyrogallol and Phloroglucinol.



### UNIT III – Amines and their derivatives

3.1. Aliphatic amines-separation of amines by Hinsberg's & Hofmann methods- preparation and properties of dimethyl amine, trimethyl amine, (ethylene diamine and hexamethylenediamine).

3.2. Diazonium compounds - diazotisation mechanism-diazonium ion as a weak electrophile-preparation and synthetic uses of diazoacetic ester & diazomethane.

### UNIT IV – DATA ANALYSIS AND PURIFICATION TECHNIQUES

4. 1. Data analysis- Idea of significant figures- its importance- Accuracy- Methods of expressing accuracy- Error analysis- Types of Errors Determinate and indeterminate errors - Minimizing Errors, Precision-Methods of expressing precision- Mean, Median, Mean deviation, Standard deviation and Confidence limits.

4.2 Purification techniques- Purification of solids-Crystallization, Fractional Crystallization and Sublimation.

### UNIT V – CHEMICAL EQUILIBRIUM

5.1. Thermodynamic derivation of equilibrium constants-  $K_p$ ,  $K_c$  and  $K_x$  -Relations between  $K_p$ ,  $K_c$  and  $K_x$  - Standard free energy change-Derivation of van't Hoff reaction isotherm.

5.2 De- Donder's treatment of chemical equilibria - concept of chemical affinity (no derivation)- Temperature dependence of equilibrium constant-van't Hoff isochore-Pressure dependence of equilibrium constant.

#### Text Books

1. Puri B R, Sharma L R and Kalia K K, Principles of Inorganic Chemistry, 23rd Ed, (1993) Shoban Lal Nagin Chand & Co., New Delhi.
2. Bhal B S and Arun Bhal, Advanced Organic Chemistry, 12th Ed., (1997), Sultan Chand & Co., New Delhi.
3. Puri B R, Sharma L R and Kalia K K, Principles of Physical Chemistry, 23rd Ed., (1993) Shoban Lal Nagin Chand & Co., New Delhi.

#### Reference Books

1. Lee J D, Concise Inorganic Chemistry, 5th Ed., (2106), Black Well Science, UK.
2. Morrison R T, Boyd R N and Batcharjee S K, Organic Chemistry, 7th Ed., (2109), Pearson New York



3. Peter Atkins and Julio De Paula, Atkin's Physical Chemistry, 4th Ed., (2106), Oxford University Press, New Delhi.

### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	The students will be able to explain the fundamentals of the chemistry of the main group elements, and important real world applications of many of these species.	K1
CO2	Understand the concept of organic reaction mechanism in some organic molecules	K2
CO3	The Students should be familiar with the basic knowledge of the Synthetic uses of acid derivatives and esters	K3
CO4	The students will develop the ability of Basic knowledge of nuclear structure, stable and unstable atomic nuclei, nuclear reactions and different modes of radioactive decay.	K4
CO5	Evaluate the methods for measurements of radioactivity.	K5&K6
CO6	Formulate the Skills in handling and measurement of radioactive material	K5&K6

**K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create**

### Mapping of COs with POs

PO \ CO	PO1	PO2	PO3	PO4	PO5
CO1	S	H	H	M	S
CO2	S	H	M	H	H
CO3	H	M	S	S	M
CO4	H	H	H	M	S
CO5	S	S	M	H	S
CO6	H	S	S	S	S

S - Strong

H - High

M - Medium

L – Low



Program: B.Sc. Chemistry				
<b>Core Practical – IV</b>		<b>Course Code:</b> 21UCH4P04		<b>Course Title:</b> Volumetric Estimations -II
<b>Semester</b> IV	<b>Hours/Week</b> 3	<b>Total Hours</b> 45	<b>Credits</b> 3	<b>Total Marks</b> 100

### Course Objective

1. To learn the practical techniques of Acidimetry, Iodimetry & Iodometry.
2. Experimental practice of quantitative volumetric analysis.
3. The objective of the titration is the determination of the concentration or the mass of the minimum formula from the titrated chemical material composing a pure liquid or a solution.
4. The main objective of volumetric analysis is to determine the amount of a substance in a given sample. When dealing with volumetric analysis the concept of concentration cannot be avoided. Molarity i.e. moles per litre or decimeter is widely used unit of concentration.

1. Estimation of Oxalic acid – Standard Oxalic acid.
2. Estimation of Ferrous ion using Diphenyl amine /N-Phenylanthranilic acid as indicator.
3. Estimation of Nickel using EDTA.
4. Estimation of Calcium using EDTA.
5. Estimation of Chloride in neutral medium. [Demonstration – Experiment]

Students must write short procedure for the given estimation in ten minutes during the examinations and submit the paper for evaluation.

### **Reference Books**

1. Vogel's Inorganic Quantitative Analysis by Vogel, Pearson Education (2104).
2. O. P. Pandey, D.N. Bajpai, S. Giri, Practical Chemistry, S. Chand & Company Ltd., (2105).
3. V. Venkateswaran, Veeraswamy. R, Kulandaivelu. A.R. Sultan Chand & Sons (1997).



**Course Outcome (COs)**

Upon successful completion students should be able to:

1. Facilitate the learner to make solutions of various molar concentrations. This may include: The concept of the mole; Converting moles to grams; Converting grams to moles; Defining concentration; Dilution of Solutions; Making different molar concentrations.

1. Short procedure	05 Marks
2. Titration 1	10 Marks
3. Titration 2	10 Marks
4. Result	21 Marks
5. Record	10 Marks
6. Viva-voce	05 Marks

Error Calculation:

< 2%	-	21 Marks
2 – 3%	-	15 Marks
3 – 4%	-	10 Marks
>4%	-	05 Marks



Program: B.Sc. Chemistry				
SBEC – II		Course Code: 21UCH4S02		Course Title: Polymer Chemistry
Semester	Hours/Week	Total Hours	Credits	Total Marks
IV	2	30	2	100

### Course Objectives

1. The subject provides an introduction to polymer science with respect to synthesis, polymerization kinetics and network formation/gelation of macromolecules formed by step-growth and chain-growth polymerization.
2. Polymer structure/conformation and transitions from liquid (melt, solutions) to solid states are discussed using equilibrium thermodynamics, kinetics and free volume considerations.
3. Polymer solubility/miscibility and phase diagrams are determined using thermodynamic parameters. Molecular weight determination of polymers is shown using osmotic pressure, viscosimetry
4. An overview of mechanical and rheological properties of polymers is also given.

### **UNIT I**

- 1.1. Basic concepts: Monomer, polymerization, degree of polymerization, repeat units. Classification of Polymers-addition and condensation polymers, natural and synthetic, based on structure, inorganic and organic, thermoplastic and thermosetting resin.
- 1.2. General methods of preparation of polymers. Polymerization through functional groups, multiple bonds and ring opening and Coordination polymerization.

### **UNIT II**

- 2.1. Structure of polymers- linear, branched and cross linked. Homo & hetro copolymers. Blockcopolymers & graft copolymers. Stereochemistry of polymers-Isotactic, Syndiotactic and Atactic
- 2.2. Properties of polymers: The crystalline melting point. The glassy state and glass transition temperature

**UNIT III**

## 3.1. Molecular weight of polymers

Number average molecular weight and weight average molecular weight. Determination of molecular weight by Viscosity and Osmometry methods.

## 3.2. Polymer processing- calendaring, Die casting, blow moulding, and Wet spinning.

**UNIT IV**

4.1. Preparation, properties and uses of Poly olefins-polythene, PTFE, Freons, PVC, polypropylene and polystyrene.

4.2. Natural and synthetic rubbers-Constitution of natural rubber. Butyl, Buna-N, Neoprene, Thiocol, Polyurethane and silicone rubbers.

**UNIT V**

Plastics and Resins Definitions. Thermoplastic and thermo setting resins. Constituents of plastic-fillers, dyes, pigments, plasticizers, Lubricants and catalysts. Uses of thermoplastic resins and thermo setting resins.

**Reference Books**

1. V. R. Gowrikar, N.V.Viswanathan: Polymer Science- Wiley Eastern Limited, New Delhi. 1986.
2. R. B. Seymour, Introduction to Polymer Chemistry, MC Craw Hill, New York 1971.
3. S. S. Dara, A Text Book in Engineering Chemistry, S.Chand & Company Ltd, New Delhi.Third Edition, 1992.
4. A Textbook of inorganic polymers, A.K.Bhagi, G.R. Chatwal, Himalaya Publishing House, 1<sup>st</sup> edition (2101)



### Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Students will indicate how the properties of polymeric materials can be exploited by a product designer	K1
CO2	Describe the role of rubber-toughening in improving the mechanical properties of polymers	K2
CO3	Identify the repeat units of particular polymers and specify the isomeric structures which can exist for those repeat units	K3
CO4	Estimate the number- and weight-average molecular masses of polymer samples given the degree of polymerisation and mass fraction of chains present.	K4
CO5	Differentiate between natural and man-made polymers	K5&K6
CO6	Explain polymerization methods and understand polymerization kinetics	K5&K6

**K1– Remember, K2– Understand, K3– Apply, K4 –Analyze, K5– Evaluate, K6 –Create**

### Mapping of COs with Pos

PO \ CO	PO1	PO2	PO3	PO4	PO5
CO1	S	H	H	M	S
CO2	S	H	M	H	H
CO3	H	M	S	S	M
CO4	H	H	H	M	S
CO5	S	S	M	H	S
CO6	H	S	S	S	S

S - Strong

H - High

M - Medium

L – Low



Program: B.Sc. Chemistry				
NMEC – II		Course Code: 21UCH4N02		Course Title: Biological chemistry
Semester	Hours/Week	Total Hours	Credits	Total Marks
IV	2	30	2	100

### Course Objectives

1. To provide the chemical nature of biological macromolecules and the principles of molecular recognition
2. To understand the metabolism of dietary and endogenous carbohydrate, lipid, and protein;
3. An understanding of Nucleic acids and its involvement in disease processes.

#### **UNIT I – Amino acids and Nucleic acids**

Amino acids- classification, essential and nonessential aminoacids and functions.

Nucleic acids-DNA,RNA-constituents, structure and functions.

#### **UNIT II – Carbohydrates and lipids**

Carbohydrates-classification and functions.

Lipids-classification, biological functions and difference between fats and oils.

#### **UNIT III – Vitamins**

Classification, sources, biological function and deficiency diseases of Vitamins A,C,K,E1 and B6.

#### **UNIT IV – Minerals**

Sources, biological functions and deficiency disease of macro minerals-Sodium, Potassium, Calcium, Phosphorous and Magnesium. Micro minerals: Selenium, copper, Iron, Zinc and Manganese.

#### **UNIT V – Enzymes and Hormones**

Enzymes : Classification and functions.



Hormones: Classification and biochemical functions of Adrenalin, Thyroxine, Oxytocin, Insulin and Sex hormones.

### Reference Books

1. S. Jayashree Ghosh, Fundamental concepts of applied chemistry. S.Chand & company 1st Edition 2106.
2. U. Satyanarayana and U.Chakrapani Biochemistry Elsevier India Pvt.Ltd. 4th Edition.
3. P. Palanivelu, Laboratory manual for analytical biochemistry and separation techniques, School of Biotechnology, Madurai Kamaraj University Press, Madurai.
4. Gurdeep Chatwaal, Natural products, Goel Publishing House, New Delhi.

### Course Outcome

1. Understand the principles of various fields of chemistry and biology
2. Illustrate the metabolism of carbohydrates Glycogen metabolism, glucuronic acid cycle etc.
3. Illustrate the metabolism and functions of various hormones and enzymes in our body
4. Describe the chemistry of lipids, proteins, enzyme and its significance

### Mapping of COs with POs

PO CO	PO1	PO2	PO3	PO4	PO5
CO1	S	H	H	M	S
CO2	S	H	M	H	H
CO3	H	M	S	S	M
CO4	H	S	H	M	S
CO5	S	H	M	H	S
CO6	H	S	M	S	M

S - Strong

H - High

M - Medium

L - Low