BHARATHIDASAN UNIVERSITY  **TIRUCHIRAPPALLI - 620 024.**

B.Sc. CHEMISTRY

CHOICE BASED CREDIT SYSTEM –

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (CBCS - LOCF)

(Applicable to the candidates admitted from the academic year 2022-23 onwards)

(NAAN MUDHALVAN SCHEME was implemented from 2nd to 6th Semester)

Sem.	Part	Course	Title	Ins. Hrs	Credit	Exam. Hours	Marks Int.	Marks Ext.	Total
I	I	Language Course – I (Tamil $/Other Languages + #)		6	3	3	25	75	100
	II	English Course - I		6	3	3	25	75	100
	III	Core Course – I (CC)	General Chemistry I	5	5	3	25	75	100
		Core Practical – I (CP)	Volumetric Analysis	4	4	3	40	60	100
		First Allied Course – I (AC)	Botany I / Computer Science I / Zoology I / Mathematics I	4	4	3	25	75	100
		First Allied Practical – I (AP)	Botany / Computer Science / Zoology	3	-	-	-	-	-
		First Allied Course – I (AC)	Mathematics II						
	IV	Value Education		2	2	3	25	75	100
	TOTAL			**30**	**21**	**-**	**-**	**-**	**600**
II	I	Language Course - II (Tamil $/Other Languages + #)		6	3	3	25	75	100
	II	English Course - II		4	3	3	25	75	100
	III	Core Course – II (CC)	General Chemistry II	5	5	3	25	75	100
		Core Practical – II (CP)	Applied Experiments in Volumetric Analysis	4	4	3	40	60	100
		First Allied Practical (AP)	Botany / Computer Science / Zoology	3	2	3	40	60	100
		First Allied Course – II (AC)	Mathematics II			3	25	75	100
		First Allied Course – II (AC)	Botany II / Computer Science II / Zoology II	4	4	3	25	75	100
		First Allied Course – III (AC)	Mathematics III						
		Add on Course – I ##	Professional English I	6*	4	3	25	75	100
	IV	Environmental Studies		2	2	3	25	75	100
	VI	Naan Mudhalvan Scheme (NMS) @@	Language Proficiency for Employability - Effective English	2	2	3	25	75	100
	TOTAL			**30**	**29**	**-**	**-**	**-**	**900**

III	I	Language Course – III (Tamil $/Other Languages + #)		6	3	3	25	75	100
	II	English Course - III		6	3	3	25	75	100
	III	Core Course – III (CC)	General Chemistry III	5	5	3	25	75	100
		Core Practical - III (CP)	Semimicro Analysis	4	4	3	40	60	100
		Second Allied Course – I (AC)	Physics I	4	4	3	25	75	100
		Second Allied Practical – I (AP)	Physics	3	-	-	-	-	-
		Add on Course – II ##	Professional English II	6*	4	3	25	75	100
	IV	Non-Major Elective I @ - Those who choose Tamil in Part I can choose a non-major elective course offered by other departments. Those who do not choose Tamil in Part I must choose either a) Basic Tamil if Tamil language was not studied in school level **or** b) Special Tamil if Tamil language was studied upto 10th & 12th std.	Drugs and Cosmetics	2	2	3	25	75	100
	VI	Naan Mudhalvan Scheme (NMS) @@	Digital Skills for Employability – Microsoft Digital Skills	-	2	3	25	75	100
	TOTAL			**30**	**27**	**-**	**-**	**-**	**800**
IV	I	Language Course –IV (Tamil $/Other Languages + #)		6	3	3	25	75	100
	II	English Course – IV		6	3	3	25	75	100
	III	Core Course - IV (CC)	General Chemistry IV	5	5	3	25	75	100
		Core Practical - IV (CP)	Organic Qualitative Analysis and Organic Preparation	4	4	3	40	60	100
		Second Allied Practical – I (AP)	Physics	3	2	3	40	60	100
		Second Allied Course – II (AC)	Physics II	4	4	3	25	75	100
	IV	Non-Major Elective II @ - Those who choose Tamil in Part I can choose a non-major elective course offered by other departments. Those who do not choose Tamil in Part I must choose either a) Basic Tamil if Tamil language was not studied in school level **or** b) Special Tamil if Tamil language was studied upto 10th & 12th std.	Chemistry in Everyday Life	2	2	3	25	75	100
	VI	Naan Mudhalvan Scheme (NM) @@	Employability Skills - Employability Skills	-	2	3	25	75	100
	TOTAL			**30**	**25**	**-**	**-**	**-**	**800**

V	III	Core Course - V (CC)	Inorganic Chemistry	5	5	3	25	75	100
		Core Course – VI (CC)	Organic Chemistry I	5	5	3	25	75	100
		Core Course – VII (CC)	Physical Chemistry I	5	5	3	25	75	100
		Core Practical -V (CP)	Physical Chemistry	4	4	3	40	60	100
		Major Based Elective – I (Any one)	1. Analytical Chemistry 2. Material and Nano Chemistry	5	4	3	25	75	100
	IV	Skill Based Elective I	Food Chemistry	4	2	3	25	75	100
		Soft Skills Development		2	2	3	25	75	100
	VI	Naan Mudhalvan Scheme (NMS) @@	Advanced Technology for Employability in Life science – Good Manufacturing Practices 1 Quality Assurances	-	2	3	25	75	100
	TOTAL			**30**	**29**	**-**	**-**	**-**	**800**
VI	III	Core Course - VIII (CC)	Organic Chemistry II	6	5	3	25	75	100
		Core Course - IX (CC)	Physical Chemistry II	6	5	3	25	75	100
		Core Practical – VI (CP)	Gravimetric Analysis and Determination of Physical Constant	4	4	3	40	60	100
		Major Based Elective - II (Any one)	1. Nuclear, Industrial Chemistry & Metallic State 2. Polymer Chemistry	5	4	3	25	75	100
		Project		4	3	-	20	80	100
	IV	Skill Based Elective – II	Dyeing Techniques and Water Treatment	4	2	3	25	75	100
	V	Gender Studies		1	1	3	25	75	100
		Extension Activities*		-	1	-	-	-	-
	VI	Naan Mudhalvan Scheme (NMS) @@	EV Battery Management	-	2	3	25	75	100
	TOTAL			**30**	**27**	**-**	**-**	**-**	**800**
GRAND TOTAL				**180**	**158**	**-**	**-**	**-**	**4700**

List of Allied Courses

First Allied Course (any one)	**Second Allied Course**
Botany	Physics
Computer Science	
Mathematics	
Zoology	

$ For those who studied Tamil upto 10th +2 (Regular Stream).

+ Syllabus for other Languages should be on par with Tamil at degree level.

Those who studied Tamil upto 10th +2 but opt for other languages in degree level under Part- I should study special Tamil in Part – IV.

The Professional English – Four Streams Course is offered in the 2nd and 3rd Semester (only for 2022-2023 Batch) in all UG Courses. It will be taught apart from the Existing hours of teaching / additional hours of teaching (1 hour /day) as a 4 credit paper as an add on course on par with Major Paper and completion of the paper is must to continue his / her studies further. (As per G.O. No. 76, Higher Education (K2) Department dated: 18.07.2020).

* The Extra 6 hrs / cycle as per the G.O. 76/2020 will be utilized for the Add on Professional English Course.

@ NCC Course is one of the Choices in Non-Major Elective Course. Only the NCC cadets are eligible to choose this course. However, NCC Course is not a Compulsory Course for the NCC Cadets.

** Extension Activities shall be outside instruction hours.

@@ Naan Mudhalvan Scheme.

SUMMARY OF CURRICULUM STRUCTURE OF UG PROGRAMMES

Sl. No.	Part	Types of the Courses	No. of Courses	No. of Credits	Marks
1.	I	Language Courses	4	12	400
2.	II	English Courses	4	12	400
3.	III	Core Courses	8	40	800
4.		Core Practical	7	29	700
5.		Allied Courses I & II	4	16	400
6.		Allied Practical	2	4	200
7.		Major Based Elective Courses	2	8	200
8.		Add on Courses	2	8	200
9.		Project	1	3	100
10.	IV	Non-Major Elective Courses (Practical)	2	4	200
11.		Skill Based Elective Courses	2	4	200
12.		Soft Skills Development	1	2	100
13.		Value Education	1	2	100
14.		Environmental Studies	1	2	100
15.	V	Gender Studies	1	1	100
16.		Extension Activities	1	1	--
17.	VI	Naan Mudhalvan Scheme	5	10	500
	Total		**48**	**158**	**4700**

PROGRAMME OBJECTIVES

The programme enable the students

1. To understand basic facts and concepts in chemistry while retaining the exciting aspects of chemistry to develop interest in the study of chemistry as a discipline.
2. Todemonstrate, solve and understanding the major concept in organic, inorganic, physical, industrial, nuclear, polymer, food, pharmaceutical, cosmetics and environmental chemistry. (All disciplines of chemistry).
3. To develop the skill to solve the problems and think methodically, independently and draw the logical conclusion.
4. To understand the importance of the elements in the periodic table including their physical and chemical nature and role in the daily life.
5. To understand concepts of chemistry and apply scientific information to solve problems in all situation so that they get a strong foundation in chemistry.
6. To understand the concepts of chemistry to inter relate and interact to the other subject like mathematics, physics, biological science etc.
7. To develop skills in the proper handling of apparatus, chemicals and instruments.
8. To be exposed to the different processes used in industries and their applications.
9. To learn the laboratory skills and to transfer and interpret knowledge entirely in the working environment.
10. To achieve the skills required to succeed in graduate school, professional school and the chemical industry like cement industries, agro product, paint industries, rubber industries, petrochemical industries, food processing industries, fertilizer industries.
11. To expand the knowledge in available opportunities related to chemistry in the government services through public service commission particularly in the field of food safety, health inspector, pharmacist etc.
12. To discuss how science and its applications interact with social, economic, political, environmental, cultural and ethical factors.

PROGRAMME OUTCOMES

On successful completion of B.Sc. Chemistry programme, students are expected to

- Gain complete knowledge about all fundamental aspects of chemistry
- Apply chemistry knowledge to solve problems in various fields of chemistry.
- Get a skill for effective and safe handling of apparatus, chemicals and instruments in a laboratory.
- Carry out experiments in the area of organic analysis, Volumetric analysis, inorganic semi-micro analysis, conductometric & potentiometric equipment
- Use technologies and instrumentation together to explore new areas of research.
- Get enormous job opportunities at chemical, pharmaceutical and food product industries.
- Appear in competitive exams conducted by service commissions such as UPSC and TNPSC
- Gain knowledge in the emerging field of nanochemistry and polymer chemistry.

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First Year **CORE COURSE I** **Semester I**

GENERAL CHEMISTRY I

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To learn the arrangement of elements in the periodic table and to understand the periodic properties
- To learn the laboratory hygiene, safety measures, principles of qualitative and quantitative analysis
- To learn the various methods of preparation, structure and stability of reaction intermediates.
- To understand the chemistry of cycloalkanes, alkenes and alkynes.
- To learn the types, preparation and properties of sols, colloids and emulsions and the determination of molecular weight of macromolecules

UNIT – I PERIODIC TABLE AND PERIODIC PROPERTIES:

1.1. Quantum Numbers, Filling up of atomic orbitals: Pauli's exclusion principle, Aufbau Principle, Hunds rule of maximum multiplicity – electronic configuration. Stability associated with half-filled and completely filled orbitals.

1.2. Periodic properties of elements – variation of atomic volume, atomic and ionic radii, ionization potential, electron affinity, electro negativity along periods and groups. Pauling scale of electro negativity.

1.3 Classification of elements into s, p, d and f blocks.

UNIT- II LABORATORY HYGIENE, SAFETY MEASURES AND ANALYTICAL METHODS:

2.1 Storage and handling of chemicals – Corrosion, flammable, explosive, carcinogenic and toxic chemicals. Simple first aid procedures for accidents involving acids, alkalis, bromine, fire burns and cut by glass.

2.2 Solubility product, common ion effect, complexation, oxidation-reduction reactions involved in identification of anions and cations – separation of cations into groups – Semi micro analysis of simple salts.

2.3 Volumetric analysis – preparation of standard solutions – normality, molarity and molality - titrimetric reactions – acid-base, redox, precipitation and complexometric titrations – indicators – effect of change in

2.4 pH – selection of suitable indicators.

UNIT - III ALKANES, REACTIVE INTERMEDIATES AND METHODS FOR REACTION MECHANISMS:

3.1 Introduction: Inductive, mesomeric, electromeric effects and hyper conjugation – structure of organic molecules based on sp3, sp2 and sp hybridization. Alkanes – sources of alkanes – general preparation – general properties – conformational analysis of ethane and n-butane.

3.2 Carbocations, Carbanions and Carbenes: Generation and stability of reactive

intermediates – Correlation of reactivity with structure of reactive intermediates. Free radicals: Generation, stability, identification methods – Free radical halogenations reactions and their mechanism.

3.3 Homolytic and Heterolytic cleavages of bonds, Characteristics of nucleophilic, electrophilic and free radical reactions.

UNIT- IV CHEMISTRY OF CYCLOALKANES, ALKENES, DIENES AND ALKYNES:

4.1 Preparation of cycloalkanes – Chemical properties – Relative stability of cyclopropane to cyclooctane – Baeyer's Strain theory – Limitations – Mono and di-substituted cyclohexanes.

4.2 Alkenes: Nomenclature – Petroleum source of alkenes and aromatics – General methods of preparation of alkenes – Chemical properties – Markovnikov's rule and peroxide effect-Uses – Elimination reactions and its mechanisms (E_1, E_2).

4.3 Dienes: Structures and properties – conjugated dienes – stability and resonance– electrophilic addition – 1,2 addition and 1,4 addition. Alkynes: Nomenclature – General methods of preparation – Physical properties – Chemical properties – Uses.

UNIT – V COLLOIDS AND MACROMOLECULES:

5.1 Definition and types of Colloids- preparation, Purification (dialysis, electro dialysis and ultra-filtration) and stability of colloids, gold number.

5.2 Properties of colloids- kinetic, optical and electrical properties.

5.3 Emulsions – Types of emulsions, preparation, properties and applications, Donnan membrane equilibrium.

5.4 Osmosis – reverse osmosis and desalination. Macromolecules- Molecular weight of macromolecules- determination of molecular weight by osmotic pressure and light scattering methods.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Chart preparation on laboratory hygiene with safety measures and s, p, d and f block elements separately with their common properties and applications. Best chart can be placed in the laboratory for students perusal.

REFERENCES:

1. R.D. Madan, "Modern Inorganic Chemistry", 2nd edition, S. Chand & Company Ltd., 2000.
2. P.L. Soni, "Text book of Inorganic Chemistry", 20th revised edition, Sultan Chand & Sons, 2000.
3. B.R. Puri, L.R. Sharma, K.K. Kalia, Principles of Inorganic Chemistry, 23rd edition, New Delhi, ShobanLalNagin Chand & Co., (1993).
4. J.D. Lee, 'Concise Inorganic Chemistry', 20th revised edition, Sultan Chand & Sons, 2000.

5. R. Gopalan, P.S. Subramanian & K. Rengarajan, "Elements of Analytical Chemistry", 2nd edition, Sultan Chand & Sons, 1000.
6. Morrison, R.T. and Boyd, R.N., Bhattacharjee, S. K. Organic Chemistry (7th edition), Pearson, India, (2011).
7. Bahl, B.S. and Bahl, A., Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2010).
8. Jerry March, "Advanced Organic Chemistry, Reaction, Mechanism and Structure", 7th Edition, Wiley Inter Science (2013).
9. Puri B.R., Sharma L.R. and Pathania M.S. Principles of Physical chemistry, (35th edition), New Delhi: ShobanLalNaginchand and Co. (2013)
10. Glasstone S. and Lewis D., Elements of Physical Chemistry, London, Mac Millan& Co Ltd.
11. https://oms.bdu.ac.in/ec/admin/contents-/316_20211123075240176.pdf
12. https://kanchiuniv.ac.in/coursematerials/Dr.%20RP%20%20Carbocationspdf

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To predict periodic properties and position of elements in the periodic table.
- To apply theoretical aspects in qualitative and quantitative analysis and work safe and hygienically in laboratories.
- To prepare and predict the stability and reactivities of reaction intermediates.
- To prepare & explain the properties of colloids and emulsions.
- To determine the Molecular Weight of macromolecules.

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First Year **CORE PRACTICAL I** **Semester I**

VOLUMETRIC ANALYSIS

Code: **(Practical)** **Credit: 4**

COURSE OBJECTIVES:

- To learn the techniques of titrimetric analyses.
- To know the estimation of several cations and anions.
- To know the estimation using neutralization and redox principle.

TITRIMETRIC QUANTITATIVE ANALYSIS:

1. Estimation of HClVsNaOH using a standard oxalic acid solution.
2. Estimation of Na_2CO_3VsHCl using a standard Na_2CO_3 solution.
3. Estimation of Iron (II) sulphateVs $KMnO_4$ using a standard Mohr's salt solution.
4. Estimation of oxalic acid Vs $KMnO_4$ using a standard oxalic acid solution.
5. Estimation of copper (II) sulphate by $K_2Cr_2O_7$ solution.
6. Estimation of $KMnO_4$Vsthio using standard $K_2Cr_2O_7$ solution.

REFERENCES:

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

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To understand the use of volumetric pipette, burette and analytical balance.
- To Explain the principles of volumetric analysis,
- Toprepare standard solution to find out the concentrations of unknown analyte,
- To understand the selection of indicators and can apply the knowledge in chemical experiments.

Scheme of Valuation **Max. Marks**

Record **- 5 (marks)**
Procedure Writing **-10 (marks)**

Results
< 1 % - 45 marks
1-2 % - 35 marks
2-3 % - 25 marks
3-4 % - 15 marks
> 4 % - 10 marks

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First Year **CORE COURSE II** **Semester II**

GENERAL CHEMISTRY II

Code: **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To understand the principles of bonding and theories of chemical bonding.
- To understand the chemistry of S-block and Zero group elements.
- To learn the concepts of inorganic semi micro qualitative analysis.
- To understand the aromatic character of benzene type molecules and to learn the reaction mechanisms involved in haloalkanes and halobenzenes.
- To understand the properties of atoms, characteristics, effect of radiations and the significance of wave functions.

UNIT - I CHEMICAL BONDING:

1.1. Ionic bond – formation, variable electro valency – Lattice energy, Born – Haber Cycle. Covalent bond - formation, variable covalency, maximum covalency, covalent character in ionic bond – Fajans' Rule. Polarization – partial ionic character of a covalent bond.

1.2 VB theory, MO theory – Basic principles of bonding and antibonding orbitals, applications of MOT to H_2, He_2, N_2& O_2 – molecular orbital sequence, comparison of VB & MO Theories.

1.3 Hybridization – Formation of $BeCl_2$& BCl_3. VSEPR theory of simple inorganic molecules – $BeCl_2$, $SiCl_4$, PCl_5, SF_6, IF_7, XeF_6, BF_3& H_2O.

1.4 Hydrogen bonding – Intermolecular & Intramolecular H_2 – bonding and consequences.

UNIT - II CHEMISTRY OF s-BLOCK AND ZERO GROUP ELEMENTS:

2.1 General characteristics of s-block elements – comparative study of elements – alkali metals and their hydroxides, oxides and halides, alkaline earth metals and their oxides, carbonates and sulphates.

2.2 Diagonal relationship of Li & Mg, Be & Al, chemistry of NaOH, KI & Mg $(NH_4)PO_4$.

2.3 Qualitative Inorganic Analysis – Dry Test, flame test, cobalt nitrate test wet confirmatory test for acid radicals, interfering acid radicals–elimination of interfering acid radicals.

2.4 Zero group elements – position in the periodic table, occurrence, isolation, applications, compounds of Xe - XeF_4, XeF6& $XeOF_4$.

UNIT - III CHEMISTRY OF BENZENE AND BENZENOID COMPOUNDS:

3.1 Aromaticity – Huckle's rule - structure of benzene – Benzene-preparation, chemical properties and uses. Aromatic electrophilic substitution reactions and mechanism – Orientation and reactivity in substituted benzenes.

3.2 Polynuclear aromatic hydrocarbons – Nomenclature, Naphthalene from coal tar and petroleum – Laboratory preparation, Structure of Naphthalene, Aromatic character, Physical properties, Chemical properties, Uses. Mechanism of Aromatic electrophilic substitution – Theory of orientation and reactivity.

3.3 Anthracene, Phenanthrene from coal tar and petroleum, Laboratory preparation, Molecular Orbital structures, Aromatic Characters, Physical Properties, Chemical properties and uses. Preparation of biphenyls, Physical and Chemical properties and uses.

UNIT - IV ALKYL AND ARYL HALOGENS:

4.1 Nomenclature of haloalkanes – structure - general preparations of haloalkanes - physical and chemical properties and uses.

4.2 Nucleophilic aliphatic substitution reaction mechanisms (SN1 and SN2) – Stereo chemical aspects.

4.3 Halobenzenes: Theory of orientation and reactivity - general preparation – properties - uses. Electrophilic and nucleophilic aromatic substitution reaction mechanisms.

UNIT – V ATOMIC STRUCTURE AND BASIC QUANTUM MECHANICS:

5.1 Rutherford's and Bohr's model an atom- Bohr's theory and origin of hydrogen spectrum. Somerfield's extension of Bohr's theory.

5.2 Electromagnetic radiation- definitions for λ, υ and velocity.

5.3 Dualism of light -Particle nature of radiation- black body radiation and Planck's quantum theory, photoelectric effect and Compton effect of matter.

5.4 De Broglie hypothesis and Davisson and Germer experiment. Heisenberg's uncertainty principle. Schrodinger wave equation (Derivation not needed). Physical significance of Ψ and Ψ^2.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

An assignment on applications of hydrogen bonding, various atomic models and evidences for dualism of light. Chart preparations for molecular orbital theory diagram. An exposure to virtual laboratory experiments.

REFERENCES:

1. R.D. Madan, "Modern Inorganic Chemistry", 2nd edition, S. Chand & Company Ltd., 2000.
2. P.L. Soni, "Text book of Inorganic Chemistry", 20th revised edition, Sultan Chand & Sons, 2000.
3. B.R. Puri, L.R. Sharma, K.K. Kalia, Principles of Inorganic Chemistry, 23rd edition, New Delhi, ShobanLalNagin Chand & Co., (1993).
4. J.D. Lee, 'Concise Inorganic Chemistry', 20th revised edition, Sultan Chand & Sons, 2000.
5. R. Gopalan, P.S. Subramanian & K. Rengarajan, "Elements of Analytical Chemistry", 2nd edition, Sultan Chand & Sons, 1991.

6. Morrison R.T. and Boyd R.N., Bhattacharjee S. K. Organic Chemistry (7th edition), Pearson India, (2011).
7. Bahl B.S. and Bahl A., Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2010).
8. Jerry March, "Advanced Organic Chemistry, Reaction, Mechanism and Structure", 7th Edition, Wiley Inter Science (2013).
9. Puri B.R., Sharma L.R. and Pathania M.S. (2013) Principles of Physical Chemistry, (35th edition), New Delhi: ShobanLalNaginchand and Co.
10. Bahl B.S., ArunBahl and Tuli G.D. (2012). Essentials of Physical Chemistry, New Delhi: Sultan Chand and Sons.
11. https://oms.bdu.ac.in/ec/courses.php?subject=B.Sc.%20(CHEMISTRY)
12. http://www.chem.ualberta.ca/~vederas/Chem_164/handouts/pdf/sub_elim_rxn.pdf

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To explain the principles and theories of chemical bonding.
- To explain the chemistry of S-block elements and Zero group elements.
- To apply the concept of common ion effect, solubility product in inorganic Semi micro qualitative analysis
- To explain the reaction mechanism of haloalkanes and halobenzene.
- To explain atomic models. Atomic spectrum and dual nature of light black body radiation and significances of wavefunctions.

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First Year **CORE PRACTICAL II** **Semester II**

APPLIED EXPERIMENTS IN VOLUMETRIC ANALYSIS

Code: **(Practical)** **Credit: 4**

COURSE OBJECTIVES:

- To learn the applications of volumetric analysis in consumer product.
- To learn the applications of complexometric titrations.
- To understand estimation of hardness, alkalinity and chlorine in water.

TITRIMETRIC QUANTITATIVE ANALYSIS:

1. Estimation of total hardness of water by EDTA method.
2. Estimation of chloride ion in water (in acidic and alkaline medium).
3. Estimation of calcium in commercial milk powder by EDTA method.
4. Estimation of Mg (II) in water by EDTA method.
5. Estimation of chlorine in bleaching powder.
6. Estimation of saponification value of an oil.
7. Preparation of distilled and deionized water.

REFERENCES:

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

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

1. To Apply the principles of complexometric titrations,
2. To understand the conditions of complex formation.
3. To prepare the buffer solutions at a required pH
4. To select the correct titrimetric procedure along with standard and nonstandard solutions.
5. To perform all sorts of volumetric calculations.

Scheme of Valuation	**Max. Marks**
Record	- 5 (marks)
Procedure Writing	-10 (marks)
Results	
< 1 %	- 45 marks
1-2 %	- 35 marks
2-3 %	- 25 marks
3-4 %	- 15 marks
> 4 %	- 10 marks

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Second Year **CORE COURSE III** **Semester III**

GENERAL CHEMISTRY III

Code **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To learn the chemistry of p-block elements.
- To study about the preparations and properties of compounds of oxygen, Sulphur, halogens and interhalogens.
- To understand the arrangement of atoms in space, isomers and the nomenclature.
- To learn the gas laws, properties of real gases and types of molecular velocities.
- To learn the types, structure and properties of solids and liquid crystals.

UNIT – I CHEMISTRY OF p-BLOCK ELEMENTS:

1.1 General characteristics of p-block elements. Comparative study of elements of III A & their compounds. Compounds of boron –boric acid, borax, borazole.

1.2 Extraction of Al and Pb - alums, alloys of Al. Chemistry of oxides of carbon – CO, CO_2. Allotropic forms of carbon.

1.3 Compounds of nitrogen and phosphorous – $NH_2.NH_2$, H_2NOH, hydrazoic acid, N_2– Cycle, fixation of N_2, PH_3 and P_2O_5.

UNIT – II COMPOUNDS OF OXYGEN, SULPHUR AND HALOGENS:

2.1 Peracids of sulphur, Thionic acids, sodium thiosulphate – preparation, properties, structure and uses.

2.2 Classification of oxides – acidic, amphoteric, neutral oxides, peroxides and superoxides.

2.3 Interhalogen compounds, Pseudo halogens, Oxyacid of halogens, Polyhalides and basic nature of iodine.

UNIT – III STEREOCHEMISTRY:

3.1 Principles of symmetry-symmetry elements (Cn, Ci and Sn) asymmetry and dissymmetry – isomerism – constitutional isomers – stereoisomers - enantiomers - diastereomers – geometrical isomerism -constitutional isomers – stereoisomers -enantiomers - diastereomers - geometrical isomers – meso and dl compounds used in stereochemistry.

3.2 D, L notations to express configurations – chirality-optical isomerism – optical activity – polarimeter – specific rotation.

3.3 Stereo selectivity, stereo specificity in organic reactions with examples. Resolution of racemic mixture – Walden Inversion – conformational analysis of cyclohexane - asymmetric induction.

UNIT – IV GASEOUS STATE:

4.1 Gases – Boyle's law, Charle's law and Avagadro's law- ideal gas equation.
4.2 Real Gases- deviation from ideal behaviour – van der Waals equation of states- derivation –significance of critical constants- law of corresponding states- compressibility factor.
4.3 Inversion temperature and liquefaction of gases- Linde and Claude – demagnetization methods.
4.4 Maxwell's distribution of molecular velocities (Derivation not needed). Types of molecular velocities- mean, most probable and root mean square velocities-Inter relationships. Collision diameter mean free path and collision number.

UNIT – V SOLID STATE AND LIQUID CRYSTALS:

5.1 Classification of solids- Isotropic and anisotropic crystals- elements of symmetry- basic seven crystal systems- laws of crystallography representation of planes- miller indices, space lattice and unit cell.
5.2 X-ray diffraction- derivation of Bragg's equation- determination of structures of NaCl by Debye Scherrer (powder method) and rotating crystal methods.
5.3 Types of crystals, close packing of identical solid spheres, interstitial sites, limiting radius ratios (derivation not needed), radius ratio rule and shapes of ionic crystals, structures of NaCl, CsCl and ZnS.
5.4 Semiconductors- intrinsic and extrinsic semiconductors- n and p-type semiconductors. Liquid crystals- types and applications.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

An assignment on general characteristics of p-block elements. Chart preparation for various symmetry elements – best can be placed for the students perusal. An exposure to crystallography software.

REFERENCES:

1. B.R. Puri, L.R. Sharma, K.K. Kalia, Principles of Inorganic Chemistry, 23rd edition, New Delhi, ShobanLalNagin Chand & Co., (1993).
2. R.D. Madan, "Modern Inorganic Chemistry", 2nd edition, S. Chand & Company Ltd., 2000.
3. J.D. Lee, 'Concise Inorganic Chemistry', 20th revised edition, Sultan Chand & Sons, 2000.
4. Gurdeep Raj, 'Advanced Inorganic Chemistry', 20th revised edition, Sultan Chand & Sons, 2000.
5. Morrison R.T. and Boyd R.N., Bhattacharjee S. K. Organic Chemistry (7th edition), Pearson India, (2011).
6. Bahl B.S. and Bahl A., Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2010).
7. Glasstone S. and Lewis D., Elements of Physical Chemistry, London, Mac Millan& Co Ltd.
8. Puri B.R., Sharma L.R. and Pathania M.S. (2013) Principles of Physical

Chemistry, (35th edition), New Delhi: ShobanLalNagin Chand and Co.
9. https://cbpbu.ac.in/userfiles/file/2020/STUDY_MAT/CHEM/liquid%20crystal.pdf.
10. https://youtu.be/hH2Zfucp0oo.
11. https://oms.bdu.ac.in/ec/courses.php?subject=B.Sc.%20(CHEMISTRY)

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To explain the chemistry of p block elements.
- To prepare and to predict the structure and properties of compounds of oxygen, sulphur, halogens & interhalogen compounds.
- To predict the absolute and relative configuration of organic molecules.
- To isolate, resolve the mixture of conformational isomers
- To explain the gas laws, properties of real gases and types of molecular velocities.
- To explain the types, structure and properties of solids and liquid crystals.

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Second Year	**CORE PRACTICAL III**	**Semester III**
	SEMIMICRO ANALYSIS (P)	
Code	**(Practical)**	**Credit: 4**

COURSE OBJECTIVES:

- To learn the techniques of semimicro qualitative analysis of inorganic salt mixtures.
- To learn confirmatory tests to identify several cations and anions.
- To learn the principles of qualitative analysis of inorganic salts.

SEMIMICRO INORGANIC QUALITATIVE ANALYSIS

Analysis of a mixture containing two cations and two anions of which one will be an interfering acid radical. Semimicro methods using the conventional scheme with hydrogen sulphide may be adopted.
Cations to be Studied: lead, copper, bismuth, cadmium, iron, aluminum, 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.

REFERENCES:

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

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To understand the systematic steps to perform a qualitative analysis and the logical sequence of each step.
- To understand chemical equilibria involving acid/base, redox, precipitation and complexation.
- To understand the purpose of elimination of interfering acid radical, separation of groups and identifying cations and anions in aqueous solutions.
- To plan, execute and record all the experimental results.

Note:

Internal Marks: 40
External marks:60

Marks Distribution for external

: Practical - 55 marks
: Record - 5 marks
: Total - 60 marks

4 radicals correct with suitable tests:	55 marks
3 radicals correct with suitable tests:	40 marks
2 radicals correct with suitable tests:	30 marks
1 radical correct with suitable tests:	15 marks
Spotting	05 marks

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Second Year **NON-MAJOR ELECTIVE I** **Semester III**

DRUGS AND COSMETICS

Code **(Theory)** **Credit: 2**

- To learn the terminologies used in drugs.
- To know the different types of drugs and to understand their mode of action
- To learn the methods of preparation of house hold cleaning reagents and cosmetics.

UNIT – I TERMINOLOGIES OF DRUGS:

Definition of the terms-drug, pharmacophore, pharmacodynamics, pharmacopoeia, pharmacology, bacteria, virus, fungus, actinomycetes, metabolites, antimetabolites, LD_{50}, ED_{50}.Therapeutic index and its significance.

UNIT – II ANTIBIOTICS:

Antibiotics – Definition-classifications - Antibiotics-penicillin, ampicillin, structure, mode of action and uses.

UNIT – III ANTIPYRETIC ANALGESICS:

Analgesics – definition and actions – narcotic and non – narcotic – morphine, heroin – structure, mode of action and uses.

Antipyretic analgesics – salicylic acid derivatives – methyl salicylate,aspirin.Anti inflammatory agents – structure ,mode of action and uses.

UNIT – IV PREPARATION OF DOMESTICALLY USEFUL PRODUCTS:

Preparation of washing powder, cleaning powder, phenoyls (white, black, yellow and rose colouredphenoyls). Liquid blue and soap oil.

UNIT – V COSMETICS:

Preparation of shampoo, Face powder, soap-manufacturing of soap (kettle process and hydrolysis process).

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

General quiz/seminar/Assignment on - Types, symptoms and preventive measure of communicable diseases– COVID -19, HIV, Malaria and influenza. Small scale preparation training to prepare phenyl, soap and aspirin in the laboratory.

REFERENCES:

1. Industrial Chemistry (Including Chemical Engineering) by B.K. Sharma,2016, Goel Publishing House, 16th Revised and Enlarged Edition.
2. A Text book of Pharmaceutical Chemistry by Jayashree Ghosh, 2010, S. Chand & company Ltd, New Delhi.
3. A Textbook of Pharmaceutical Chemistry by Dr.S. Lakshmi,2004, S. Chand & company Ltd, New Delhi.
4. https://oms.bdu.ac.in/ec/courses.php?subject=B.Sc.%20(CHEMISTRY)

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To state the terminologies used in drugs,
- To explain the mode of action of antibiotics.
- To explain the mode of action of antipyretic and analgesics.
- To prepare domestically useful products like soaps, detergents and cosmetics.

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Second Year **CORE COURSE IV** **Semester IV**

GENERAL CHEMISTRY IV

Code **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

1. To learn the general characteristics of d and f block elements.
2. To know the principles of metallurgy.
3. To understand the reactions of organometallic compounds, alcohols, phenols and ethers.
4. To learn the fundamental concepts of first law of thermodynamics, to relate heat, work and energy and to calculate work from pressure – volume relationships.
5. To learn the fundamental concepts of rate of the reaction, determination of order of the reaction and theories of reaction rates

UNIT – I d-BLOCK, f- BLOCK ELEMENTS AND METALLURGY:

1.1 General characteristics of d-block elements, comparative study of zinc group elements, extraction of Mo & Pt - Alloys of copper, amalgams and galvanization

1.2 General characteristics of f-block elements – Lanthanide contraction and its consequences. Extraction of Th.

1.3 Metallurgy: Occurrence of metals – concentration of ores – froth floatation, magnetic separation, calcination, roasting, smelting, flux, aluminothermic process, purification of metals – electrolysis, zone refining, van Arkel de-Boer process.

UNIT – II CHEMISTRY OF ORGANOMETALLIC COMPOUNDS:

2.1 Introduction – preparation of organomagnesium compounds- physical and chemical properties- uses. Organozinc compounds – general preparation, properties and uses.

2.2 Organolithium, organocopper compounds – preparation, properties and uses.

2.3 Organolead, organophosphorus and organoboron compounds– preparation, properties and uses.

UNIT – III CHEMISTRY OF ALCOHOLS, PHENOLS AND ETHERS:

3.1 Nomenclature – industrial source of alcohols – preparation of alcohols: hydration of alkenes, oxymercuration, hydroboration, Grignard addition, reduction – physical properties – chemical properties - uses – glycols from dihydroxylation, reduction, substitution reactions and glycerol and their uses.

3.2 Preparation of phenols including di- and trihydroxy phenols – physical and chemical properties - uses – aromatic electrophilic substitution mechanism – theory of orientation and reactivity.

3.3 Preparation of ethers: dehydration of alcohols, Williamson's synthesis – silyl

ether. epoxides from peracids - Sharpless asymmetric epoxidation – reactions of epoxides– uses – introduction to crown ethers – structures – applications.

UNIT – IV THERMODYNAMICSI:

4.1 Definitions- system and surrounding- isolated, closed and open system- state of the system- Intensive and extensive variables. Thermodynamic processes-
4.2 reversible and irreversible, isothermal and adiabatic processes- state and path functions.
4.3 Work of expansion at constant pressure and at constant volume. First law of thermodynamics- statement- definition of internal energy (E), enthalpy (H) and heat capacity. Relationship between Cp and Cv.
4.4 Calculation of w, q, dE and dH for expansion of ideal gases under isothermal and adiabatic conditions of reversible and irreversible processes.
4.5 Thermochemistry- relationship between enthalpy of reaction at constant volume (q_v) and at constant pressure (q_p)- temperature dependence of heat of reaction- Kirchhoff's equation.

UNIT – V CHEMICAL KINETICS:

5.1 Rate of reaction- rate equation, order and molecularity of reaction. Rate Laws- rate constants- derivation of first order rate constant and characteristics of zero order, first order and second order reactions- derivation of time for half change (t1/2) with examples.
5.2 Methods of determination of order of reactions- experimental methods- determination of rate constant of a reaction by volumetry, colorimetry and polarimetry.
5.3 Effect of temperature on reaction rate- concept of activation energy, energy barrier, Arrhenius equation. Theories of reaction rates- collision theory- derivation of rate constant of bimolecular reaction- failure of collision theory- Lindemann's theory of unimolecular reaction.
5.4 Theory of absolute reaction rates – derivation of rate constant for a bimolecular reaction- significance of entropy and free energy of activation. Comparison of collision theory and absolute reaction rate theory (ARRT).

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

An assignment on general characteristics organometallic compounds with their applications and recent techniques implemented in metallurgy. Exposure on analysis of alcohols and phenols-hydrometer-breath analysis-chemical tests - active hydrogen method.

REFERENCES:

1. B.R. Puri, L.R. Sharma, K.K. Kalia, Principles of Inorganic Chemistry, 23rd edition, New Delhi, ShobanLalNagin Chand & Co., (1993).
2. R.D. Madan, "Modern Inorganic Chemistry", 2nd edition, S. Chand &

Company Ltd., 2000.
3. J.D. Lee, 'Concise Inorganic Chemistry', 20th revised edition, Sultan Chand & Sons, 2000.
4. Morrison R.T. and Boyd R.N., Bhattacharjee S. K. Organic Chemistry (7th edition), Pearson ndia, (2011).
5. Bahl B.S. and Bahl A., Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2010).
6. Puri B.R., Sharma L.R. and Pathania M.S. (2013) Principles of Physical Chemistry, (35th edition), New Delhi: ShobanLalNagin Chand and Co.
7. Samuel Glasstone (1974), Thermodynamics for Chemists (3rd printing), East- West Edn.
8. Puri B.R., Sharma L.R. and Pathania M.S. (2013), Principles of Physical Chemistry, (35th edition), New Delhi: ShobanLalNagin Chand and Co.
9. Gurtu J.N. and AmitGurtu (1979), Chemical Kinetics, 5th Edn, Mittal K.K.
10. https://nptel.ac.in/courses/104101128
11. https://youtu.be/AVDSQ0xaBJI
12. https://oms.bdu.ac.in/ec/courses.php?subject=B.Sc.%20(CHEMISTRY)

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To explain the general characteristics of d and f block elements.
- To apply the principles of metallurgy for extraction of metals from ores
- To explain the reactions of organometallic compounds, alcohols, phenols and ethers.
- To relate heat, work and energy and to calculate work from pressure – volume relationships.
- To determine order of the reaction and to explain theories of reaction rates.

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Second Year **CORE PRACTICAL IV** **Semester IV**

ORGANIC QUALITATIVE ANALYSIS AND ORGANIC PREPARATION

Code **(Practical)** **Credit: 4**

COURSE OBJECTIVES:

- To learn the techniques of qualitative analysis of organic compounds
- To know the preparation methods of them.
- To learn the identification of functional groups in organic compounds.

I ORGANIC QUALITATIVE ANALYSIS:

Analysis of Simple Organic compounds.

(a) Characterization of functional groups
(b) Confirmation by preparation of solid derivatives / characteristic colour reactions.

Note: Mono –functional compounds are given for analysis. In case of bi-functional compounds, students are required to report any one of the functional groups.

II ORGANIC PREPARATION: (ANY FOUR)

Preparation of Organic Compounds involving the following chemical conversions.

1. Oxidation 2. Reduction 3. Hydrolysis 4. Nitration 5. Bromination 6. Diazotization 7. Osazone formation.

REFERENCES:

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

COURSE OUTCOMES:

Upon successful completion of this course the students would be able to

1. Understand the fundamental methods and procedures adopted in organic analysis.
2. Perform systematic qualitative organic analysis of common organic compounds
3. Detect of special elements N, S and halogens
4. Apply chemical tests to identify unknown chemical species
5. Synthesise simple organic compounds on a laboratory scale.
6. Perform Isolation and purification of organic compounds.

Note:

Internal Marks : 40
External marks: 60

Marks Distribution for external

Record:	- 5 marks
Organic Analysis:	-35 marks
Aromatic/Aliphatic	-5 marks
Saturation unsaturation	- 5 marks
Element test	- 7 marks
Functional group	-13 marks
Derivative	- 5 marks
Organic preparation:	- 20 marks
Total:	- 60 marks

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Second Year **NON-MAJOR ELECTIVE II** **Semester IV**

CHEMISTRY IN EVERY DAY LIFE

Code **(Theory)** **Credit: 2**

COURSE OBJECTIVES:

- To learn the scientific and chemical principles in water chemistry
- To learn the applications of chemistry in agriculture.
- To learn additives and adulterants used in of food chemistry,
- To know the chemicals used in cosmetics and other materials used in everyday life.
- To understand the chemical used and properties of polymers, fibers and dyes.

Unit-I: Water chemistry:

1.1 Water **–** Characteristics of water, soft water and hard water.
1.2 Removal of hardness – Purification of water by ion exchange and reverse osmosis methods.
1.3 Water pollution: Sources and effects of water pollution (Domestic, Industrial, Agricultural) -Eutrophication.

UNIT – II AGRICULTURAL CHEMISTRY:

2.1 Plant nutrients –Requisites of good fertilizers - Effect of Nitrogen on plant growth, deficiency symptoms - examples for nitrogenous fertilizers: - Effect of Phosphorous on plant growth, deficiency symptoms – -examples for phosphatic fertilizers.
2.2 Effect of potassium on plant growth, deficiency symptoms - examples for potassium fertilizers – Functions of secondary and micro nutrients.
2.3 Pesticides: Classification on the basis of mode of action, types of pests and Chemical nature with examples – safety measures while using pesticides.
2.4 Fungicides, Herbicides, Acaricides, Rodenticides, Repellants, Fumigants, Defoliants (Definitions and Examples).

UNIT – III FOOD CHEMISTRY:

3.1 Food classification and functions- Digestion in mouth, stomach and intestine. Absorption- spoilages, preservation techniques (canning, dehydration, freeze–drying. salting, pickling, pasteurizing, fermenting and carbonating).
3.2 Mineral and water as food-role of water in physiology – water balance – permitted colours (Riboflavin, beta-carotene and amaranth) – description and uses.
3.3 Food additives – colouring (Natural and synthetic colours)-List of permitted colours (Curcumin, Riboflavin, Beta-carotene, Plain Caramel and amaranth)- description and uses.
3.4 Flavouring agents – Anti oxidants – Emulsifiers- Acidulants and beverages. Soft drinks aerated water (ingredients and side effects).

UNIT – IV COSMETICS AND OTHER MATERIALS:

4.1 Cosmetics – Face powder – constituents, uses, side effects. Nail polish, hair dye – composition and side effects.
4.2 Tooth powder – composition and manufacture. Lotions.
4.3 Preparation of phenyl, liquid blue and incense sticks.
4.4 Cleaning agents: Soaps- types and cleaning action – detergents – types – merits and

demerits of soap and detergents –chemical definitions of shampoo, washing powder and bleaching powder.

UNIT – V MATERIAL CHEMISTRY:

5.1 Polymers: Addition polymerization, condensation polymerization, thermoplastics-Vulcanization of rubber.
5.2 Fibers: Natural fibers (cellulosic and pretentious) –Semi synthetic (Rayon) Synthetic fibers (Poly ester, Nylon and Acrylic) –Pretreatment of fibers (Sizing, Desizing, Bleaching).
5.3 Dyes and Dyeing process: Difference between dye and pigment -Witt's colour theory, classification of dyes based on application (Direct, Vat, Acid, Reactive, Mordant and Disperse).

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Assignment and general quiz on - Sources, structure and biological functions of Vitamins – A, B complex, C and D, Carbohydrates and proteins. Hand on training to detect food adulterants in –milk, honey, ground nut oil, turmeric powder, chilli powder.

REFERENCES:

1. K. Kumarasamy, A. Alagappa Moses and M. Vasanthy, "Environmental studies", Bharathidasan University, Thiruchirappalli.
2. Alex Ramani, "Food Chemistry", MJP publishers (2009), Chennai.
3. Jayashree Gosh, "Text book of Pharmaceutical Chemistry" New Delhi, S. Chand & Company Ltd.,(2003).
4. K.BagavathiSundari, "Applied Chemistry" MJP Publishers, (2006) Chennai.
5. A Thankamma Jacob (1979), A Text Book of Applied Chemistry, 1st edition, McMillan India Ltd.
6. Hesse P.R, A text book of soil chemical analysis John Murray, New York, 1971.
7. Buchel K.H, Chemistry of Pesticides, John Wiley & Sons New York 1983.
8. https://oms.bdu.ac.in/ec/search-results.php

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To prepare demineralized and desalinized water.
- To explain the importance and requirements of good pesticides, fertilizers and fungicides used in agriculture.
- To explain food additives and their carcinogenic effects.
- To know the types of polymers and plastics with examples.
- To explain theory of dying processes
- To explain chemical composition of cosmetics

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Third Year **CORE COURSE V** **Semester V**

INORGANIC CHEMISTRY

Code **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To understand the basics and theories of coordination compounds.
- To study a few biologically important coordination compounds.
- To understand the preparation and properties of nitrosyl compounds
- To learn the basic principles and applications of magnetic properties.

UNIT–I COORDINATION COMPOUNDS I:

1.1 Introduction - Types of ligands: unidentate, bidentate and polydentate ligands, chelating ligands and chelates- IUPAC nomenclature of coordination compounds.

1.2 Isomerism in coordination compounds: Structural isomerism, hydrate isomerism, coordination isomerism, ionization isomerism, linkage isomerism, coordination position isomerism.

1.3 Stereoisomerism: Geometrical isomerism of four and six coordinate complexes, optical isomerism of four and six coordinate complexes, Werner and Sidgwick theories, methods of detecting complex formation.

UNIT – II COORDINATION COMPOUNDS II:

2.1 Theories of coordination compounds: Valence bond theory, limitations of valence bond theory, crystal field theory – splitting of d orbitals in octahedral, tetrahedral and square planar fields, CFSE, factors affecting CFSE, colour, geometry and magnetic properties of coordination compounds, Jahn – Teller distortion (an elementary idea).

2.2 Molecular orbital theory: Molecular orbital diagram for $[Co(NH_3)_6]^{3+}$. Ligand field theory. (An elementary treatment only).

UNIT – III COORDINATION COMPOUNDS III:

3.1 Labile and inert complexes, stability of coordination compounds – thermodynamic and kinetic stability, relationship between stepwise formation constant and overall formation constant, factors affecting the stability of complexes.

3.2 Unimolecular and biomolecular nucleophilic substitution reactions in octahedral and square planar complexes, trans effect – theories of trans effect and applications.

3.3 Few biologically important coordination compounds: Chlorophyll, hemoglobin and vitamin B_{12}.

UNIT – IV METAL CARBONYLS AND ORGANOMETALLIC COMPOUNDS:

4.1 Metal carbonyls: Mono and binuclear carbonyls of Cr, Co and Mn – preparation, structure, reactions, bonding and uses.

4.2 Structure and bonding in -metal alkenyl and-metal alkynyl complexes of $[PtCl_3(C2H_4)]$ $[Co(CO)_6(RC \equiv CR)]$ and ferrocene.

4.3 Binary metallic compounds: borides, carbides, and nitrides – classification, preparation, properties and uses.

UNIT – V NITROSYL COMPOUNDS AND MAGNETIC PROPERTIES:

5.1 Nitrosyl compounds: Classification-nitrosyl chloride and sodium nitroprusside - preparation, properties and structure.
5.2 Magnetic properties-meaning of the terms-magnetic susceptibility-magnetic moment-types of magnetism-Gouy balance-applications of magnetic properties.
5.3 Dipole moment-determination, application in the study of simple inorganic molecules.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

General quiz/seminar on- structure, magnetic, electrical properties, biological functions of the cis-platin.Therapeutic importance of iron, cobalt, copper, silver and gold complexes.

REFERENCES:

1. R.D. Madan, "Modern Inorganic Chemistry", 2nd edition, S. Chand & Company Ltd., 2000.
2. W.U. Malik, G.D. Tuli and R.D. Madan, S.Chand and Company Ltd., 'Selected topics in Inorganic Chemistry', 7th edition, 2001.
3. Gopalan R, Text Book of Inorganic Chemistry, 2nd Edition, Hyderabad, Universities Press, (India), 2012.
4. P.L. Soni, 'Text Book of Inorganic Chemistry', 20th revised edition, Sultan Chand & Sons, 2000.
5. B.R. Puri, L.R. Sharma, K.C. Kalia, 'Principles of Inorganic Chemistry', 21st edition, Vallabh Publications, 2004-2005.
6. J.E. Huheey, 'Inorganic Chemistry', 4th edition, Pearson Education. Inc. 1993.
7. F.A. Cotton, 'Advanced Inorganic Chemistry', 6th edition, John Wiley & Sons, Pvt. Ltd., 2003 – 2004.
8. R. Gopalan, P.S. Subramanian and K. Rengarajan, 'Elements of Analytical Chemsitry', 2nd edition, Sultan Chand & Sons, 1991.
9. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
10. https://archive.nptel.ac.in/content/storage2/courses/104106064/lectures.pdf

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To predict different types of isomerism exhibited by a coordination compounds
- To explain the various theories of coordination compounds to explain their geometry, stability and magnetic properties.
- To explain kinetics and thermodynamic stability of coordination complexes
- To explain preparation, magnetic properties and structure of metal carbonyls.
- To explain preparation, magnetic properties and structure of nitrosyls.

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Third Year **CORE COURSE VI** **Semester V**

ORGANIC CHEMISTRY I

Code **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To learn the reactions of carbonyl compounds, carboxylic acids, amines, heterocycles.
- To know the oxidizing and reducing agents for synthesis.
- To understand chemistry of heterocyclic compounds and dyes.

UNIT–I CHEMISTRY OF CARBONYL COMPOUNDS:

1.1 Nomenclature - structure of carbonyl compounds - chemical properties - nucleophilic addition mechanism at carbonyl group (eg: HCN, ROH, RNH_2)- acidity of alpha hydrogen – keto-enol tautomerism (proof for the two forms).

1.2 Reduction and oxidation reactions of carbonyl compounds – paraformaldehyde, meta formaldehyde - uses of aliphatic carbonyl compound - Claisen condensation – Aldol condensation – Robinson annulation.

1.3 General methods of preparation of aromatic carbonyl compounds - physical and chemical properties – uses - Effect of aryl group on the reactivity of carbonyl group.

UNIT – II CHEMISTRY OF CARBOXYLIC ACIDS:

2.1 Nomenclature - Acidity of carboxylic acids based on substituent effect - comparison of acid strengths of halogen substituted acetic acids - acid strengths of substituted benzoic acids.

2.2 Preparation, properties and uses of acid derivatives: acid chloride, anhydrides, esters, amides - chemistry of compounds containing active methylene group – synthesis and synthetic applications of acetoacetic ester and malonic ester.

2.3 Preparation of dicarboxylic acid - physical and chemical properties - uses. Introduction to oils and fats - fatty acids - manufacture of soap - mechanism of cleaning action of soap.

UNIT – III CHEMISTRY OF NITROGEN COMPOUNDS:

3.1 Nomenclature - nitro alkanes - alkyl nitrites - differences - aromatic nitro compounds - preparation and reduction of nitro benzene under different conditions, TNT.

3.2 Amines – effect of substituents on basicity of aliphatic and aromatic amines - Reactions of amino compounds (primary, secondary, tertiary and quaternary amine compounds) - Mechanism of carbylamines reaction, diazotization and comparison of aliphatic and aromatic amines.

3.3 Diazonium compounds - preparation and synthetic applications of diazomethane, benzene diazonium chloride and diazo acetic ester.

UNIT – IV CHEMISTRY OF HETEROCYCLIC COMPOUNDS AND DYES:

4.1 Introduction – nomenclature of heterocyclic compounds having not more than two heteroatoms such as oxygen, nitrogen and sulphur - structure, synthesis and properties of furan, pyrrole, thiophene. Pyridine – structure, preparation - compare the basicity of pyridine with pyrrole and amines.

4.2 Quinoline - structure and Skraup synthesis. Isoquinoline – structure and Napieralski synthesis and Indole – structure and Ficher-indole syntheses.

4.3 Dyes - color and constitution – chromophore - auxochrome - classification according to application and structure - preparation and uses of - methyl orange, fluorescein, Alizarin, Indigo and malachite green dyes.

UNIT – V REAGENTS FOR OXIDATION AND REDUCTION REACTIONS:

5.1 Oxidation: Osmium tetroxide – Chromyl chloride – Ozone – DDQ – Dioxiranes.
5.2 Lead tetraacetate - selenium dioxide – DMSO either with Ac_2O or oxalyl chloride – Dess-Martin reagent.
5.3 Reduction: Catalytic hydrogenation using Wilkinson Catalyst – Reduction with LAH, $NaBH_4$, tri-tertiarybutoxy aluminum hydride, $NaCNBH_3$, hydrazines.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

An assignment on the topics- significance of keto-enoltautomerism in biochemical reactions, fatty acids composition of vegetable oils and its contribution to dietary energy intake and health impact on dietary intake of fatty acids, industrial applications of diazotization, role of heterocyclic compounds in medicines, redox reactions in everyday life.

REFERENCES:

1. Finar I.L., Organic Chemistry, Vol 1&2, (6th edition) England, addison Wesley Longman Ltd. (1996).
2. Morrison R.T. and Boyd R.N., Bhattacharjee S. K. Organic Chemistry (7th edition), Pearson India, (2011)
3. Bahl, B.S. and Bahl, A., Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2010)
4. Pine S.H., OrganicChemistry, (5th edition) New Delhi, McGraw – Hill International Book Company (1987)
5. Seyhan N. Ege, Organic Chemistry, (5th edition) New York, Houghton Mifflin Co., (2005).
6. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
7. https://youtu.be/EaGWcnsm05A
8. http://acl.digimat.in/nptel/courses/video/104101127/lec5.pdf
9. http://www.adichemistry.com/inorganic/organometallic/catalysis/wilkinson/wilkinsons-catalyst.html

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To categorize different types of reactions of carbonyl compounds based on the reactive species and products
- To correlate acidity of carboxylic acids based on substituents
- To distinguish the basicity of aromatic amines and aliphatic amines based on substituents
- To compare the properties and reactivities of five, six membered and fused hetero cyclic compounds
- To identify suitable reagent for specific reactions of oxidation and reduction
- To classify the dyes according to application and structure

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Third Year **CORE COURSE VII** **Semester V**

PHYSICAL CHEMISTRY I

Code **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To know the various concepts of photochemistry and group theory.
- To learn the second law of thermodynamics, Carnot cycle, Carnot theorem, entropy, free energy and Maxwell's relations.
- To learn the third law of thermodynamics, van't Hoff isotherm, Claudius–Clapeyron equation and Nernst heat theorem.
- To understand the laws and properties of solutions.
- To learn the fundamental concepts of phase rule and its applications to one, two and three component systems.

UNIT – I PHOTOCHEMISTRY AND GROUP THEORY:

1.1 Consequences of light absorption- Jablonski diagram- radiative and non-radiative transitions. Lambert's Beer law, quantum efficiency.

1.2 Photochemical reactions-Comparison between thermal and photochemical reactions. Photosensitization and quenching. Fluorescence, phosphorescence and chemi luminescence. Laser and uses of lasers.

1.3 Group theory – symmetry elements and symmetry operation- group postulates and types of groups- abelian and non abelian – symmetry operation of H_2O molecule.

1.4 Illustration of group postulates using symmetry operations of H_2O molecule - construction of multiplication table for the operation of H_2O molecule – point group- definition- elements (symmetry operations) of the following molecules- H_2O, BF_3 and NH_3.

UNIT – II THERMODYNAMICS II:

2.1 Second law of thermodynamics – need for the law- different statements of the law- Carnot's cycle and efficiency of heat engine- Carnot's theorem- thermodynamic scale of temperature.

2.2 Concept of entropy- definition and physical significance of entropy- entropy as a function of P, V and T – entropy changes during phase changes- entropy of mixing – entropy criterion for spontaneous and equilibrium processes in isolated system.

2.3 Gibb's free energy (G) and Helmholtz free energy (A) – variation of A and G with P, V and T- Gibb's – Helmholtz equation and its applications.

2.4 Thermodynamic equation of state, Maxwell's relations - ΔA and ΔG as criteria for spontaneity and equilibrium.

UNIT – III THERMODYNAMICS III:

3.1 Equilibrium constant and free energy change- thermodynamic derivation of law of mass action- equilibrium constants in terms of pressure and

concentration – NH_3, PCl_5 and $CaCO_3$.

3.2 Thermodynamic interpretation of Lechatelier's principle (Concentration, temperature, pressure and addition of inert gases).

3.3 Systems variable composition- partial molar quantities- chemical potential – variation of chemical potential with T, P and X (mole fraction) – Gibb's Duhem equation. Van't Hoff's reaction isotherm- van't Hoff's isochore. Clapeyron equation and Clausius – Clapeyron equation-Applications.

3.4 Third law of thermodynamics- Nernst heat theorem. Statement of III law and concept of residual entropy – evaluation of absolute entropy from heat capacity data.

UNIT – IV SOLUTIONS:

4.1 Raoult's law, Henry's law, Ideal and non-ideal solutions, completely miscible liquid systems-benzene and toluene. Deviation from Raoult's law and Henry' law. Duhem-Margules equation. Theory of fractional distillation. Azeotropes- HCl – water and ethanol- water system.

4.2 Partially miscible liquids- phenol- water, triethylamine- water and nicotine-water systems. Lower and upper CSTs – effect of impurities on CST. Completely immiscible liquids- principle and applications of steam distillation. Nernst distribution law – derivation.

4.3 Dilute solutions- colligative properties, relative lowering of vapour pressure, osmosis, law of osmotic pressure, derivation of elevation of boiling point and depression in freezing point. Application- determination of molecular mass by Rast method only.

UNIT – V PHASE CHANGES:

5.1 Definitions of terms in the phase rule- derivation and application to one component system – water and sulphur- super cooling, sublimation.

5.2 Two-component systems-solid liquid equilibria, simple eutectic (lead- silver, Bi- Cd), de-silverisation of lead.

5.3 Compound formation with congruent melting point (Mg-Zn) and incongruent melting point (Na-K).

5.4 Solid Solutions-(Ag-Au)-fractional crystallization, freezing mixtures- FeCl3-H_2O systems, $CuSO_4$-H_2O system.

UNIT-VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

A general quiz on classification of molecules as linear planar and non linear based on symmetry elements, applications of colligative properties and phase rule. An assignment on recent advancements in photochemistry and various methods to utilize solar energy to solve energy crisis.

REFERENCES:

1. Gurdeep Chatwal R, Photochemistry, Good publishing House.
2. Raman, K. (1990), Group theory and its application to Chemistry, New Delhi: Tata McGraw-Hill.

3. Samuel Glasstone (1974), Thermodynamics for Chemists (3rd printing), East-West Edn.
4. Rajaram J. and Kuriacose, J.C. (1986) Thermodynamics for students of Chemistry, New Delhi: LalNagin Chand.
5. Puri B.R., Sharma L.R. and Pathania M.S. (2013), Principles of Physical Chemistry, (35th edition),New Delhi: ShobanLalNagin Chand and Co.
6. Glasstone S. and Lewis D., Elements of Physical Chemistry, London, Mac Millan& Co Ltd.
7. Atkins P.W. (1994), Physical chemistry, (5th edition), Oxford University press.
8. Sangaranarayanan, M.V., Mahadevan, V., Text Book of Physical Chemistry, 2nd Edition, Hyderabad, Universities Press, (India) 2011.
9. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
10. https://nptel.ac.in/courses/112104220

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To correlate the photo physical processes and their applications
- To apply the principle of Carnot cycle in all types of heat engines and working fluids
- To compute equilibrium constants of PCl_5, NH_3, $CaCO_3$ at constant pressure and concentration
- To apply colligative properties to determine the molecular weight of solutes
- To predict qualitatively the effect of changing temperature, pressure or concentration on heterogeneous system in equilibrium using Phase diagram
- To apply symmetry operations and find point group of molecules H_2O,BF_3,NH_3

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Third Year	**CORE PRACTICAL V**	**Semester V**
	PHYSICAL CHEMISTRY	
Code	**(Practical)**	**Credit: 4**

COURSE OBJECTIVES:

- To learn the fundamentals of conduct metric and potentiometric titrations.
- To understand the method of determination of molecular weight, CST, TT and rate constant
- To learn to determine rate constant of ester hydrolysis reactions.

LIST OF EXPERIMENTS:

1. Critical Solution Temperature
2. Effect of impurity on Critical Solution Temperature
3. Transition Temperature
4. Rast Method
5. Phase Diagram (Simple eutectic system)
6. Kinetics of Ester Hydrolysis
7. Partition Co-efficient
8. Conductometric Acid-Base Titration
9. Potentiometric Redox Titration
10. Determination of cell constant.

REFERENCES:

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

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

1. To apply the principles of physical chemistry to the given system and evaluate the experiments.
2. To understand the colligative properties, chemical kinetics and phase equilibria.
3. To understand the electrochemical methods for acid/base titrations, conductometric/Potentiometric curves and evaluation methods.
4. To describe electrochemical cell and the electrode potentials and explain about reference electrodes.

Internal	: 40
Ext. Evaluation	: 60
Record	: 05
Procedure writing with formula	: 10
Practicals	: 45

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Third Year **MAJOR BASED ELECTIVE I** **Semester V**

1) ANALYTICAL CHEMISTRY

Code **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To learn the purification techniques of solids and liquids.
- To understand data analysis, various separation techniques.
- To learn gravimetric analysis and various thermo analytical methods.
- To learn visible spectrophotometry and colorimetry.
- To know the various electro analytical techniques.

UNIT – I LABORATORY SAFETY AND PURIFICATION OF CHEMICALS:

1.1 Precautions to avoid poisoning-treatment for specific poisons, threshold vapour concentrations-safe limits-laboratory safety measures.
1.2 Waste disposal-fume disposal-precautions for avoiding accidents.
1.3 Purification of solid organic compounds: recrystallisation, extraction, sublimation.
1.4 Purification of liquids: fractional distillation, steam distillation and azeotropic distillation.

UNIT – II DATA ANALYSIS:

2.1 The Mean-significant numbers, the median-precision, accuracy- confidence limits, standard deviation.
2.2 Errors-method for improving accuracy-rejection of data-presentation of tabulated data-Scatter diagram –method of least squares- S.I. units.
2.3 Separation techniques: Precipitation-solvent extraction-chromatography – types, column chromatography-thin layer chromatography.
2.4 Paper chromatography – paper electrophoresis– ion exchange chromatography –Gas liquid chromatography.

UNIT – III GRAVIMETRIC ANALYSIS AND THERMO ANALYTICAL TECHNIQUES:

3.1 Gravimetric analysis - principles-methods of gravimetric analysis - requirement of gravimetric analysis-precipitation-theories of precipitation.
3.2 Types of precipitation – co–precipitation, post precipitation - and precipitation from homogeneous solution-digestion, filtration and washing, drying and ignition. Inorganic and organic precipitating agents.
3.3 Thermo analytical techniques – types-TGA principle-Instrumentation - TGA analysis of CaC_2O_4. H_2O. Differential thermal analysis-principle-DTA of $CaC_2O_4.H_2O$.-factors affecting TGA &DTA.

UNIT – IV VISIBLE SPECTROPHOTOMETRY AND COLORIMETRY:

4.1 Theory of spectrophotometry and colorimetry, Beer-Lambert's law (statement only), Molar absorptivity and absorbance.
4.2 Visual comparators-multiple standard methods, duplication and dilution method, balance method, photoelectric colorimeter, spectrophotometer.
4.3 Criteria for satisfactory colorimetric estimation-advantages of colorimetric estimation, determination of composition of complexes, colorimetric estimation of iron.

UNIT – V ELECTRO ANALYTICAL METHODS:

5.1 Electro gravimetry –theory - electro gravimetric analysis of Fe and Cu.
5.2 Electrolytic separation of metals: principle –separation of copper and nickel, Electro deposition- principle –overvoltage.
5.3 Coulometry -Principle of coulometric analysis –coulometry at controlled potential-apparatus and technique-separation of nickel and cobalt. Amperometry titrations-principle –Instruments –types-applications.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

General quiz on – inter conversion of the units of energy – joules, calories and ergs. Wave properties–wave length, wave number and frequency. Assignment on –electroplating of nickel on steel surface, gravimetric estimation of lactose in milk, preparing rose oil by solvent extraction. Estimation of iron in ground water by colorimetric method. Preparing chart for handling and storage of glassware and chemicals in laboratory.

REFERENCES:

1. Gopalan R, Subramanian PS and Rengarajan K (1993) ``Elements of analytical chemistry" second revised edition, Sultan Chand.
2. Gurdeep R Chatwal, Sham K. Anand (2005) ``Instrumental methods of chemical analysis", Himalaya publishing house.
3. Vogel A.I. Text Book of Quantitative Inorganic analysis," The English Language Book Society, Fourth edition.
4. Douglas A. Skoog, Donald M. West and F. J. Holler, Fundamentals of Analytical chemistry, 7thedition, Harcourt College Publishers.
5. Mendham J., Denny R. C., Barnes J.D., Thomas M., Vogel's Test book of Quantitative Chemical analysis 6th edition, Pearson education.
6. Sharma, B. K., Instrumental methods of chemical analysis, Goel Publishing House, Merrut (1997).
7. https://www.iitk.ac.in/che/pdf/resources/TGA-DSC-reading-material.pdf
8. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000944AC/P001632/M028158/ET/1520585748Q1M21.pdf

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

To apply various analytical techniques to analyse the quality of substances used in day today life.

1. To determine various types of error in analysis of data.
2. To apply chromatographic principle to identify and separate the substances from mixture.
3. To predict the factors affecting gravimetric estimation.
4. To characterize thermal stability of a substance using TGA and DTA.
5. To apply spectroscopic principle to analyse the purity and identify the nature of the substances.

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Third Year **MAJOR BASED ELECTIVE I** **Semester V**

2) MATERIAL AND NANO CHEMISTRY

Code **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To study the types of ionic crystals and defects in solids.
- To learn the different kinds magnetic properties.
- To learn the basic concepts of nanomaterial's and their applications.

UNIT – I IONIC CONDUCTIVITY AND SOLID ELECTROLYTES:

Types of ionic crystals – alkali halides – silver chloride-alkali earth fluovider – simple stoichiometric oxides. Types of ionic conductors – halide ion conductors – oxide ion conductors – solid electrolytes – applications of solid electrolytes. Electrochemical cell – principles – batteries, sensors and fuel cells –Inorganic solids – colour, magnetic and optical properties.

UNIT – II MAGNETIC MATERIALS:

Ferrites: Preparation and their applications in microwave –floppy disk – magnetic bibble memory and applications. Insulating Materials: Classification on the basis of temperature – Polymer insulating materials and ceramic insulating materials. Ferro electric materials: examples – applications of ferroelectrics.

UNIT – III MODERN ENGINEERING MATERIALS:

Metallic glasses – introduction –composition, properties and applications. Shape memory alloys: introduction – examples – application of SMA – advantages and disadvantages. Biomaterials: Introduction –metals and alloys in biomaterials – ceramic biomaterials, composite biomaterials-polymer biomaterials.

UNIT – IV NANOPHASE MATERIALS:

Introduction –techniques for synthesis of nanophase materials–sol-gel synthesis-electro deposition –inert gas condensation-mechanical alloying and applications of nanophase materials-composite materials: Introduction –types.

UNIT – V NANO TECHNOLOGY:

Introduction –importance –various stages of nanotechnology –nanotube technology – nanoparticles –fullerenes-nanodendrimers –nano pore channels, fibres and scaffolds – CVD dismond technology –FCVA technology and its applications – nano imaging techniques.

UNIT – VI CURRENT CONTOURS ((For Continuous Internal Assessment Only):

Assignment on preparation of nanomaterials .Magnetic , electrical properties and

applications of graphenes. General quiz on therapeutic applications ofnano metals and metal oxides.

REFERENCES:

1. Aathony R. West, Solidstate chemistry and its applications, john wiley & Sons (1989).
2. RaghavanV.R., Materials Science and Engineering, Printice Hall (India) Ltd., (2001).
3. Kenneth J. Klabunde, Nanoscale materials in chemistry, A. John Wiley and Sons Inc. Publication.
4. https://nptel.ac.in/courses/118104008
5. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5VgWkgm+I3FGq9cGlsbNmQ==

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To apply solid electrolytes in electrooptical techniques for remote control and communication processes
- To classify and apply magnetic material in electronic and electrical instruments.
- To explain the composition, properties and applications of engineering materials such as glass, composites and biopolymers.
- To synthesisenanomaterials using various top down and bottom up methods
- To compare CVD and FCVD technique for synthesisingnanomaterials
- To explain the applications of nano techniques and nanomaterials in various fields.

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Third Year **SKILL BASED ELECTIVE I** **Semester V**

FOOD CHEMISTRY

Code **(Theory)** **Credit: 2**

COURSE OBJECTIVES:

- To know the importance of food and nutrition.
- To know the chemical composition and importance of balanced diet.
- To learn the food adulterants and identification of them.
- To develop the skill in food processing, food preservation technique and in detecting food adulterants

UNIT – I Nutritional food and biological importance of food:

Definition -food, nutrition, nutritional care and health. classification of food-nutrients as body constituents-digestion and absorption of food. Nutritional problems in India.

UNIT – II Basic chemicals constituents of food:

Classification and Biological functions of carbohydrates, proteins, fats, vitamins, minerals and water.

UNIT – III Food adulteration and health problems:

Common adulterants in food-testing methods of all food adulterants (Ghee, Chilli powder, Oil, Milk, Turmeric powder). and its effect on health.

UNIT – IV Food additives:

Food additives: definition, need and classification of food additives, preservatives-Natural and Artificial, antioxidants, chelating agents, coloring agents, curing agents, Emulsions, flavors, sweeteners, , stabilizer and thickeners, humectants, anti-caking agents, firming agent, clarifying agent, flour bleaching agents.

UNIT – V Processing and preservation of food:

Basic concept of food processing and preservation: Reason of food Spoilage and Scope of food processing preservation; principles of food processing and preservation. Principle and preservation by low temperature: (refrigeration and freezing,). Processing and preservation by drying: factors affecting drying, and types of drying technique (freeze drying, vaccum drying), Processing and preservation by heat: (blanching, pasteurization, sterilization, UHT processing, heating, dehydration, canning,

UNIT – VI Current Contours (For continuous internal assessment only):

Assignments and seminar on Hurdle technology: definition, physical, chemical and microbial hurdles in food processing, guide lines of hurdle technology to prepare stable food products

REFERENCES:

1 Alex Ramani V, Food Chemistry, MJP Publishers, Triplicane, Chennai, 2009
2 Thangamma Jacob, Food adulteration, Macmillan company of India limited, New Delhi, 1976
3 Jeyaraman J, Laboratory manual in biochemisty, Wiley Eastern limited, New Delhi, 1981.
4 Branen AL, Davidson PM &Salminen S. 2001. Food Additives. 2nd Ed.Marcel Dekker.
5 https://aissmschmct.in/wp-content/uploads/2020/08/BSC-HS-Sem-V-Advanced-Food-Prod.-System-HS-301-Chapter-8.pdf

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To explain properties and reactions of carbohydrates, lipids and proteins during storage and processing of food.
- To explain the importance of water for stability and quality of foods.
- To explain food adulterants and their harmful effect to health.
- To classify the food additives and their role and harmful effect to health.
- To give an over view on food and precautions to avoid food infections and food poisoning and precautions to avoid food infections and food poisoning.

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Third Year | **CORE COURSE VIII** | **Semester VI**

ORGANIC CHEMISTRY II

Code | **(Theory)** | **Credit: 5**

COURSE OBJECTIVES:

- To learn the chemistry of carbohydrates, proteins, vitamins.
- To learn isolation and synthesis of alkaloids and terpenoids.
- To understand the rearrangements and spectroscopy techniques for the elucidation of structures.

UNIT I CHEMISTRY OF CARBOHYDRATES:

1.1 Carbohydrates - classification, properties of mono saccharides (glucose and fructose), structure and configuration of mono saccharides, interconversion.
1.2 Ascending and descending series, mutarotation, epimerization- cyclic structure - determination of size of sugar rings.
1.3 Disaccharides - sucrose, maltose - structure elucidation - polysaccharide - starch and cellulose (elementary treatment).

UNIT – II UNIT II CHEMISTRY OF PROTEINS AND VITAMINS:

2.1 Amino acids – Zwitter ion – isoeletric point - general methods of preparation and reactions of amino acids. Peptides - Peptide linkages – proteins - classification of proteins.
2.2 Structure of proteins - primary structure - end group analysis - Edman method - secondary structure - tertiary structure - denaturation - colour reactions of proteins.
2.3 Nucleic acids - elementary treatment of DNA and RNA - Vitamins - classification, structure and biological importance of vitamins A, B1, B2, B6, B12 and C.

UNIT – III CHEMISTRY OF ALKALOIDS AND TERPENOIDS:

3.1 Chemistry of natural products - alkaloids – classification, isolation - methods for synthesis of coniine, piperine, nicotine and quinine - structural elucidation of nicotine only.
3.2 Terpenoids - classification - isoprene, special isoprene rule, methods for synthesis of citral, limonene, menthol, camphor, structural elucidation of menthol only.

UNIT -IV MOLECULAR REARRANGEMENTS:

4.1 Molecular rearrangements - types of rearrangement (nucleophilic and electrophilic) – mechanism with evidence for the following re-arrangements: pinacol – pinacolone.
4.2 Benzil - benzilic acid, benzidine, Claisen, Fries, Hofmann. Curtius, Lossen, Beckmann and dienone – phenol rearrangements.

UNIT – V ORGANIC SPECTROSCOPY:

5.1 UV - VIS spectroscopy - types of electronic transitions – Instrumentation- solvent effects on λ max - Woodward - Fieser rules for calculation of λ max: dienes only – bathochromic shift and hypochromic shift.
5.2 IR spectroscopy - number and types of fundamental vibrations – selection rules-modes of vibrations and their energies. Instrumentation - position of IR absorption

frequencies for functional groups like aldehyde, ketone, alcohol, acid, amine and amide.

5.3 NMR spectroscopy - principle - chemical shift- factors affecting the chemical shift - inductive effect and hydrogen bonding - TMS, delta scales, splitting of signals - spin-spin coupling, NMR spectrum of EtOH, n -propyl bromide and isopropyl bromide.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Prepare charts on the topic - quantity of carbohydrates, sugars and calorific values in commercially available health drinks and cool drinks, benefits and sources of essential amino acids and vitamins, uses and physiological effects of alkaloids, benefits of terpenoids present in spices, role of Beckmann rearrangement in synthesis of Nylon 66, calculation of λ max for pigments found in plant products.

REFERENCES:

1. Finar I.L., Organic Chemistry, Vol 1&2, (6th edition) England, addison Wesley Longman Ltd. (1996).
2. Morrison R.T. and Boyd R.N., Bhattacharjee S. K. Organic Chemistry (7th edition), Pearson (India)., (2011)
3. Bahl B.S. and Bahl A., Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2010)
4. Pine S.H., Organic Chemistry, (5th edition) New Delhi, McGraw – Hill International Book Company (1987)
5. Seyhan N. Ege, Organic Chemistry, (5th edition) New York, Houghton Mifflin Co., (2005).
6. William Kemp, Organic Spectroscopy, 3rd edition, ELBS.
7. Introduction to Spectroscopy by Pavia, D. L. Lampman, G. M, Kriz, G. S, Vyvyan, J.A. 5th edition, Cengage Learning, (2015)
8. Spectroscopy identification of Organic compounds, Silverstein, R. M, Webster, F. M 7th edition, CRC Press, (2015).
9. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
10. Organic spectroscopy, Sharma Y.R., S.chand& company ltd., 20th edition reprint (2007).

Course Outcomes:

Upon successful completion of this course the students would be able:

- To comprehend the properties, structure and configuration of Carbohydrates
- To apply the biological importance of vitamins in day today life
- To explain the chemistry of alkaloids and terpenoids
- To predict the formation of intermediate and products in rearrangement reactions
- To Illustrate the type of electronic transitions in UV-Visible spectroscopy
- To interpret the NMR and IR spectral data to arrive the structure of molecules.

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Third Year **CORE COURSE IX** **Semester VI**

PHYSICAL CHEMISTRY II

Code **(Theory)** **Credit: 5**

COURSE OBJECTIVES:

- To learn the various concepts of electrochemistry.
- To know the types and theories of catalysis.
- To learn the adsorption isotherms.
- To know the spectroscopic techniques such as IR, UV-visible, Raman and NMR.

UNIT – I ELECTRICAL CONDUCTANCE:

1.1 Conductance in metal and in electrolytic solution- specific conductance and equivalent conductance. Arrhenius theory of electrolytic dissociation and its limitation. Weak and strong electrolyte according to Arrhenius theory. Ostwald's dilution law- Derivation, applications and limitation.

1.2 Effect of dilution on equivalent conductance and specific conductance. Kohlrausch's law and its applications. The elementary treatment of the Debye- Huckel- Onsager equation for strong electrolytes-evidence for ionic atmosphere.

1.3 Transport number and Hittorf's rule. Determination of transport number by Hittrof's method and moving boundary method.

1.4 Application of conductance measurements- conductometric titrations.

UNIT – II ELECTROCHEMICAL CELLS:

2.1 Galvanic cells - reversible and irreversible cells. Conventional representation of electrochemical cells. Electromotive force of a cell and its measurement – computation of E.M.F.– calculation of thermodynamic quantities of cell reactions (□G, □H, □S and K).

2.2 Types of reversible electrodes- gas/metal ion- metal/metal ion, metal/ insoluble salt/anion and redox electrodes, electrode reactions.

2.3 Nernst equation – derivation of cell E. M. F and single electrode potential – standard hydrogen electrode- reference electrodes- standard electrode potentials- sign convention- electrochemical series and its significance.

2.4 Potentiometric titrations -Acid-Base titrations- Oxidation-reduction (Redox) titrations- Precipitation titrations. Corrosion- general and electrochemical theory – passivity-prevention of corrosion.

UNIT – III CATALYSIS AND SURFACE PHENOMENA:

3.1 Catalyst-Definition and Characteristics - Types of catalysis-Homogeneous and heterogeneous, induced, auto, positive and negative catalysis, catalytic poisons and catalytic promoters.

3.2 Enzyme catalysis – Michaelis-menten equation and Michaelis-menten law.

3.3 Adsorption-types-chemical and physical, characteristics of adsorption. Theories of catalysis- intermediate compound formation theory and adsorption theory. Different types of isomerism -Freundlich and Langmuir adsorption isomerism.

UNIT – IV SPECTROSCOPY I:

4.1 Electromagnetic spectrum- the region of various types of spectra. Microwave spectroscopy- rotational spectra of diatomic molecules treated as rigid rotator, condition for a molecule to be active in microwave region.

4.2 Rotational constants (B) and selection rules for rotational transition. Frequency of spectral lines, calculation of inter-nuclear distance in diatomic molecules.

4.3 Infrared spectroscopy- vibrations of diatomic molecules- harmonic oscillators, zero-point energy, dissociation energy and force constant, condition for molecule to be active in the IR region, selection rules for vibrational transition, fundamental bands, overtones and hot bands.

4.4 UV- Visible spectroscopy-conditions- Franck-Condon principle- pre-dissociation-applications.

UNIT – V SPECTROSCOPY II:

5.1 Raman spectroscopy – Rayleigh scattering and Raman scattering. Stokes and anti-stokes lines in Raman spectra, Raman frequency, quantum theory of Raman effect, conditions for a molecule to be Raman active.

5.2 Comparison of Raman and IR spectra – structural determination from Raman and IR spectroscopy, rule of mutual exclusion.

5.3 NMR spectroscopy- nuclear spin and conditions for a molecule to give rise to NMR spectrum – theory of NMR spectra, number of NMR signals, equivalent and non-equivalent protons.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Prepare charts on the topic - quantity of carbohydrates, sugars and calorific values in commercially available health drinks and cool drinks, benefits and sources of essential amino acids and vitamins, uses and physiological effects of alkaloids, benefits of terpenoids present in spices, role of Beckmann rearrangement in synthesis of Nylon 66, calculation of λ max for pigments found in plant products

REFERENCES:

1. B.R., Sharma L.R. and Pathania M.S. (2013), Principles of Physical Chemistry, (35th edition), New Delhi: Shoban Lal Naginchand and Co.
2. Bahl B.S., Arun Bahl and Tuli G.D. (2012). Essentials of Physical Chemistry, New Delhi: Sultan Chand and Sons.
3. Moore W. J. (1972), Physical chemistry, 5th Edition, Orient Longman Ltd.
4. Glasstone S. and Lewis D., Elements of Physical Chemistry, London, Mac Millan& Co Ltd.
5. Colin Bannwell N and Elaine Mc Cash M, Fundamentals of molecular spectroscopy, 4th edition, McGraw hill publishing company limited.
6. Russell S. Drago, (1978), Physical methods in Inorganic chemistry, East-west student edition.
7. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
8. https://oms.bdu.ac.in/ec/courses.php?subject=B.Sc.%20(CHEMISTRY)

Course Outcomes:

Upon successful completion of this course the students would be able:

- To explain the concepts of Electrochemistry and its applications
- To demonstrate the construction of different kinds of electrochemical cells
- To explain the factors influencing enzyme catalysis
- To predict the nature of adsorption using Langmuir adsorption isotherm
- To identify the functional groups and structure of simple molecules using IR spectroscopy
- To interpret the NMR spectra of simple molecules

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Third Year **CORE PRACTICAL VI** **Semester VI**

GRAVIMETRIC ANALYSIS AND DETERMINATION OF PHYSICAL CONSTANT

Code **(Practical)** **Credit: 4**

COURSE OBJECTIVES:

- To learn the techniques of gravimetric analysis.
- To learn the methods for determining physical constants of organic compounds.
- To learn the principle of precipitation techniques and application in gravimetry analysis.

GRAVIMETRIC ANALYSIS:

1. Estimation of Lead as lead chromate.
2. Estimation of Barium as barium chromate.
3. Estimation of Nickel as Nickel - DMG complex.
4. Estimation Calcium as calcium oxalate monohydrate
5. Estimation of Barium as barium sulphate.

ONLY FOR DEMONSTRATION:

1. Estimation of Copper as copper (I) thiocyanate.
2. Estimation of Magnesium as magnesium oxalate.
3. Estimation of Iron as Iron (III) oxide.

DETERMINATION OF PHYSICAL CONSTANTS:

Determination of boiling /melting points of by semimicro method.

REFERENCES:

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

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To recognize the principles of gravimetric analysis.
- To understand the basics of gravimetric analysis of selected cations involving methods, selection of precipitants, nucleation, aggregation of precipitate, removal of contamination and weighing a precipitate.
- To conduct experiments to determine physical constantof unknown compounds.
- To use proper apparatus to minimize the errors.

Mark distribution:

Internal : 40
Ext. Evaluation : 60

Record: - 5 marks

Determination of physical constant: - 10 marks

Gravimetric analysis:

Manipulation - 10 marks

Results error

< 1 %	- 35 marks
1-2 %	-30 marks
2-3 %	-25 marks
3-4 %	-20 marks
> 4 %	- 10 marks

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Third Year **MAJOR BASED ELECTIVE II** **Semester VI**

1) NUCLEAR, INDUSTRIAL CHEMISTRY & METALLIC STATE

Code **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To know the fundamentals of nuclear chemistry.
- To understand the applications of nuclear chemistry.
- To study the metallic bond, theories and applications.
- To understand the applications of inorganic polymers.

UNIT- I NUCLEAR CHEMISTRY I:

1.1 Introduction, nuclear structure – composition of the nucleus, subatomic particles, nuclear forces, nuclear stability – mass defect and binding energy, whole number rule and packing fraction, n-p ratio, odd even rules, nuclear models – liquid drop and shell models, isobars, isotones and isomers.

1.2 Isotopes – detection, physical and chemical methods of separation, isotopic constitution of elements.

1.3 Radioactivity – introduction – radioactive emanations – characteristics of α, β and γ-rays, disintegration theory, modes of decay-group displacement law, rate of integration and half-life period, disintegration series, Geiger- Nuttal rule.

UNIT- II NUCLEAR CHEMISTRY II:

2.1 Detection and measurement of radioactivity – Wilson cloud chamber, Geiger – Muller counter.

2.2 Particle accelerators – linear accelerator and cyclotron.

2.3 Artificial radioactivity – nuclear transformation – classification of nuclear reactions, fission – atom bomb, fusion – hydrogen bomb, Stellar energy – nuclear reactor – atomic power projects in India.

2.4 Applications of radioisotopes as tracers in reaction mechanism, medicine, agriculture, industry and carbon dating. Hazards of radiations.

UNIT – III METALLIC STATE:

3.1 Metallic bond: Packing of atoms in metals (BCC, CCP, HCP) electron gas, Pauling and band theories, structure of alloys, substitutional and interstitial solid solutions, Hume-Rothery ratios, crystal defects –stoichiometric and non- stoichiometric defects.

3.2 Semiconductors - intrinsic and extrinsic – n-type and p-type. Composition, properties, structure and uses in electronic industry.

UNIT – IV INORGANIC POLYMERS AND THERMO ANALYTICAL METHODS:

4.1 Inorganic polymers – coordination polymers, metal alkyls, phosphonitrilic polymers.

4.2 Silicates – classification into discrete anions – one, two- and three-dimensional structures with typical examples.

4.3 Composition, properties and uses of beryl, asbestos, talc, mica, feldspar and zeolite.

UNIT – V INDUSTRIAL CHEMISTRY:

5.1 Gaseous fuels: Natural gas, gobar gas, water gas, semi water gas, carbureted water gas, producer gas and liquified petroleum gas (LPG) – composition, manufacture and applications.
5.2 Fertilizers: Manufacture of nitrogen, phosphorus, potassium and mixed fertilizers, micro nutrients and their role in plant life.
5.3 Safety matches: Introduction, raw materials and manufacturing method.
5.4 Paints and varnishes: Definition, types and composition.
5.5 Glass: Composition, manufacture, types and uses.
5.6 Cement: Manufacture – wet and dry processes, composition and setting of cement.

UNIT- VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

General quiz/Assignment/Seminar on –Environmental impact of fertilizers, plastics and petroleum refining industries-global warming, ozone layer depletion, smog, fog and acid rain. Case studies on accidents in nuclear and chemical industries.

REFERENCES:

1. R.D. Madan, "Modern Inorganic Chemistry", 2nd edition, S. Chand & Company Ltd., 2000.
2. Gilreath, 'Fundamental concepts of Inorganic Chemistry', 18th Printing, McGraw Hill International Book Company, 1985.
3. S. Glasstone, 'Source book on Atomic Energy', East-West Press, 1967.
4. R.Gopalan, P.S. Subramanian and K. Rengarajan, 'Elements of Analytical Chemistry', Sultan Chand & Sons, 2nd edition, 1991.
5. P.L.Soni, 'Text Book of Inorganic Chemistry', 20th revised edition, Sultan Chand & Sons, 2000.
6. https://www.uou.ac.in/sites/default/files/slm/BSCCH-301.pdf
7. https://zbphysik.univie.ac.at/broda/dokumente/160-Nuclear_Chemistry.pdf
8. Akins, P.w. Physical Chemistry. Oxford, UK. Oxford University press, 8thEdition. (2008).
9. Puri, Sharma, Pathania, Principle of Physical Chemistry. Jalandhar, India. Vishal publication & Co. 47th Edition (2019).
10. https://www.ebooknetworking.net/ebooks/industrial-chemistry-bk-sharma.html

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

1. To identify the mechanisms and characteristics of radioactive decays.
2. To describe the electronic structure of atoms of important semiconductors (Si, Ge, Ga, As) and to distinguish between *intrinsic* and *extrinsic* semiconductors,
3. To explain the origin of energy gap
4. To apply nuclear chemistry in medicine, energy production, environmental protection.
5. To classify and compare the structure, composition of silicates.
6. To compare composition and calorific values of fuels.

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Third Year **MAJOR BASED ELECTIVE II** **Semester VI**

2) POLYMER CHEMISTRY

Code **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To know the chemistry of polymers.
- To study the importance of polymers.
- To study the concepts of polymerization techniques.

UNIT – I INTRODUCTION TO POLYMERS AND RUBBERS:

Basics of polymers – monomers and polymers - definition.classification of polymers on the basis applications - thermosetting and thermoplastics – distinction among plastics. Functionality-Copolymers. Degree of polymerization. Types of polymerization reactions – chain polymerization -free radical and ionic polymerization – coordination and step polymerization reactions- polyaddition and polycondensation – miscellaneous reactions: ring- opening and group transfer polymerization. Basics of rubbers: types - vulcanization of rubber-ebonite- uses of rubbers.

UNIT – II PROPERTIES AND REACTIONS OF POLYMERS:

Properties: Glass transition temperature (Tg) -definition – factors affecting Tg. Relationship between Tg and molecular weight. Importance of Tg. Molecular weight of polymers: number average (Mn), weight average (Mw), sedimentation and viscosity average molecular weights. Reactions: Hydrolysis – hydrogenation – addition – substitutions – cross linking and cyclisations reaction. Polymer degradation- thermal, photo and oxidation degradation of polymers (basics only).

UNIT – III POLYMERIZATION TECHNIQUES AND MOULDING TECHNIQUE:

Polymerization techniques: bulk, solution, emulsion, melt condensation and interfacial polycondensation polymerization. Moulding technique: Injection, compression, extrusion, rotational and calendaring.

UNIT – IV CHEMISTRY OF COMMERCIAL POLYMERS:

Preparation, properties and uses of the polymers: Polyethylene, polypropylene, polystyrene, PVC, teflon and polymethylmethacrylate, polycarbonate, polyurethanes, polyamides (Kevlar), phenol-formaldehyde, urea-formaldehyde resin, epoxy resins, rubber-styrene and neoprene rubbers.

UNIT – V ADVANCES IN POLYMERS:

Biopolymers – biomaterials. Polymers in medical field - High temperature and fire – resistant polymers. Silicones - conducting polymers- carbon fibers. (basic idea only) and polymer composites.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Assignment and seminar on managing plastic wastes - storing, recycling and disposal methods of plastic wastes – challenges and opportunity in recycling of plastics - case studies on environmental impacts of plastic wastes.

REFERENCES:

1. Billmeyer F.W., Text book of polymer science, Jr. John Wiley and Sons, 1984.
2. Gowariker V.R., Viswanathan N.V. and JayaderSreedhar, Polymer Science, Wiley Eastern Ltd., New Delhi, 1978.
3. Sharma, B.K., Polymer Chemistry, Goel Publishing House, Meerut, 1989.
4. Arora M.G., Singh M. and Yadav M.S., Polymer Chemistry, 2nd Revised edition, anmol Publications Private Ltd., New Delhi, 1989.
5. http://web.mit.edu/5.33/www/lec/poly.pdf

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To compare thermoplastics and thermosetting polymers.
- To predict the various mechanism of polymerization
- To describe various techniques of polymerization
- To relate the glass transition temperature and molecular mass of the polymers.
- To synthesise commercially important polymers
- To explain tje applications of biopolymers in medical field.

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Third Year **PROJECT** **Semester-VI**

Code: **Credit: 3**

The candidate shall be required to take up a Project Work by group or individual and submit it at the end of the final year. The Head of the Department shall assign the Guide who, in turn, will suggest the Project Work to the students in the beginning of the final year. A copy of the Project Report will be submitted to the University through the Head of the Department on or before the date fixed by the University.

The Project will be evaluated by an internal and an external examiner nominated by the University. The candidate concerned will have to defend his/her Project through a Viva-voce.

ASSESSMENT/EVALUATION/VIVA VOCE:

1. PROJECT REPORT EVALUATION (Both Internal & External)

   I. Plan of the Project - 20 marks

   II. Execution of the Plan/collection of Data / Organisation of Materials / Hypothesis, Testing etc. and presentation of the report. - 45 marks

   III. Individual initiative - 15 marks

2. Viva-Voce / Internal & External - 20 marks

TOTAL **- 100 marks**

PASSING MINIMUM:

	Vivo-Voce 20 Marks	**Dissertation 80 Marks**
Project	40% out of 20 Marks (i.e. 8 Marks)	40% out of 80 marks (i.e. 32 marks)

A candidate who gets less than 40% in the Project must resubmit the Project Report. Such candidates need to defend the resubmitted Project at the Viva-voce within a month. A maximum of 2 chances will be given to the candidate.

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Third Year **SKILL BASED ELECTIVE II** **Semester VI**

DYEING TECHNIQUES AND WATER TREATMENT

Code **(Theory)** **Credit: 2**

COURSE OBJECTIVES:

- To develop the skills in dyeing.
- To understand the water qualities and treatments.
- To know the sewage treatments.

UNIT – I Pretreatment of fibers and theory of dye:

1.1 Textile fiber pretreatments: Sizing and desizing, purpose, desizing methods (Hot water, Acid and enzymatic) - their merits and demerits - Scouring: classification, method of Kier boiling process.
1.2 Dye chemistry: Witt's theory of colour –important dye stuff intermediates- their names- Difference between dye and pigments.
1.3 Chromophore – auxo chromes –batho chromic shift and hypso-chromic shift -classification of dyes based on application.

UNIT – II Terminologies in dyeing process:

2.1 Technical terms in dyeing: M.L. ratio – % of shade – % of exhaustion – equilibrium absorption.
2.2 Dyeing machineries: Description and uses of Padding mangle and Jigger.
2.3 Textile dyeing processes I: Direct cotton dyeing – effect of temperature, Acid dyeing – effect of electrolytes in acid dyeing.

UNIT – III Process and properties of Dying:

3.1 Textile dyeing processes II: Vat dyeing, Pre – mordant dyeing, Post - mordant dyeing.
3.2 Fastness properties – Definition of Light, Washing Rubbings, Perspiration and sublimation fastness - Evaluation procedures for Light and Washing fastness.

UNIT – IV Sewage water treatment methods:

4.1 Sewage & Domestic wastes and their effects - concepts of BOD and COD.
4.2 Eutrophication and their effects- Biological magnification.
4.3 Water treatment methods: General methods of water treatment – Sewage treatment methods: preliminary, Primary, Secondary, Tertiary treatments.

UNIT – V Processes for treatment of Industrial effluents:

5.1 Industrial effluents: Nature of effluents of Chemical, Food, Drug and material industries. Industrial waste water treatment: preliminary, Primary,

Secondary (Biological) treatment. Aerobic process (Lagooning, Trickling Filters, activated Sludge, oxidation ditch).

5.2 Anaerobic digestion ‑ advantages of Anaerobic process ‑ Disposal of sludge – draw backs and effective steps and Tertiary treatments (adsorption, ion-exchange and ultra-filtration).

UNIT – VI Current Contours (For continuous internal assessment only):

General quiz on - sources and effects of water pollutants-Heavy metals and dyes. Case studies on impact of water pollution due to industrial activities.

REFERENCES:

1. Venkataraman. K. The chemistry of synthetic dyes Vol, I, II, III & IV-, Academic Press N.Y., 1949.
2. Shenai, V.A. ,Chemistry of Textile fibres, vol.I, Sevak publication , Mumbai
3. Shenai, V.A. ,Chemistry of Dyes and Principles of dyeing , vol.II, Sevak publication, Mumbai
4. H.Kaur "Environmental Chemistry" 7th Edition, Pragati Prakashan publisher, 2013
5. A.K.De "Environmental Chemistry" 3rd Edition ,New Age International (P) Ltd.Publisher,1997.
6. https://web.iitd.ac.in/~arunku/files/CVL100_Y16/LecSep1220.pdf

COURSE OUTCOMES:

Upon successful completion of this course the students would be able:

- To perform the pretreatment of grey fabric.
- To get an experience in dyeing of natural fibers with reactive, direct and acid dyes.
- To explain theory and process of dying textile fibers
- To characterize and find the suitable treatment process of sewage water and industrial effluents
- To compare the effect of aerobic and anaerobic treatment of industrial effluents and sewage water.

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