Kuvempu University

Bachelor of Science (B.Sc.) Semester Scheme

Curriculum Structure for Undergraduate Programme for 2024-25

Case-1: 3 Majors with a General Degree in all 6 Semesters

Curriculum Framework for UG Programmes as suggested by KSHEC, Govt. of Karnataka

(As per G.O. No.: ED 166 UNE 2023, Bengaluru, dated: 08-05-2024)

Total Credits required for the award of Degree as per KSHEC: 128 (Min) and 150 (Max) for UG Degree.

Allocation of credits in Kuvempu University for UG-Science programmes

Case-1: 3 Subjects Combination in all 6 Semesters

Sl. No.	Subject Category	No. of Credits
1.	Major Courses	90
2.	Two Languages	24
3.	Constitutional Values	04
4.	Electives/Optional	04
5.	Compulsory Courses	06
Total		**128**

Semester-wise allocation of credits in Kuvempu University for UG Science programmes (Three Subjects Combination)

Year	Semester	Credits	Total Credits
1.	I	23	**46**
	II	23	
2.	III	23	**48**
	IV	25	
3.	V	17	**34**
	VI	17	
Total		**128**	**128**

Semester-wise allocation of credits in Kuvempu University for UG Science programmes for framing syllabus of One Major Subject in Three Major Subjects

Combination (Case - 1 Stream)

Year	Semester	Credits	Total Credits
1	I	05	**10**
	II	05	
2	III	07*	**16**
	IV	09@	
3	V	07#	**14**
	VI	07#	
Total		**40**	**40**

**Total number of credits including Major papers (T+P) and Elective/Optional papers.* *@Total number of credits including Major papers (T+P), Elective/Optional papers and Compulsory Course (Practical Knowledge/Skill).* *#Total number of credits including Major papers (T+P) and Compulsory Course (Practical Knowledge/Skill).*

Kuvempu University

Bachelor of Science (B.Sc.) Semester Scheme

Curriculum Structure of Undergraduate Programme for the year 2024-25

Course / Examination Pattern for One Major Subject (CHEMISTRY)

Sl. No.	Course Code	Title of the Course (Paper)	Subject Category	Teaching Hours/ week	Semester End Examination	Internal Assessment	Total Marks	Credits	Examination Duration
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
I - Semester									
I	**CHET1**	Chemistry - I	Major Course	03	80	20	**100**	03	3 Hrs.
	CHEP1	Chemistry Practical - I	Major Course	04	40	10	**50**	02	3 Hrs.
	Total			**07**	**120**	**30**	**150**	**05**	---
II - Semester									
II	**CHET2**	Chemistry - II	Major Course	03	80	20	**100**	03	3 Hrs.
	CHEP2	Chemistry Practical - II	Major Course	04	40	10	**50**	02	3 Hrs.
	Total			**07**	**120**	**30**	**150**	**05**	---
III - Semester									
III	**CHET3**	Chemistry - III	Major Course	03	80	20	**100**	03	3 Hrs.
	CHEP3	Chemistry Practical - III	Major Course	04	40	10	**50**	02	3 Hrs.
	CHEL3.1 **CHEL3.2**	Medicinal Chemistry Essence of Chemistry in day-to-day Life	Elective - 3.1 Elective - 3.2	02	40	10	**50**	02	2 Hrs.
	Total			**09**	**160**	**40**	**200**	**07**	---
IV - Semester									
IV	**CHET4**	Chemistry - IV	Major Course	03	80	20	**100**	03	3 Hrs.
	CHEP4	Chemistry Practical - IV	Major Course	04	40	10	**50**	02	3 Hrs.
	CHEL4.1 **CHEL4.2**	Electrochemistry, Corrosion and Metallurgy Agricultural and Fuel Chemistry	Elective - 4.1 Elective - 4.2	02	40	10	**50**	02	2 Hrs.
	CHEC4.1	Chemistry Practical Knowledge/Skill – IV	Compulsory Course - 1	04	40	10	**50**	02	3 Hrs.
	Total			**13**	**200**	**50**	**250**	**09**	---
V - Semester									
V	**CHET5**	Chemistry - V	Major Course	03	80	20	**100**	03	3 Hrs.
	CHEP5	Chemistry Practical - V	Major Course	04	40	10	**50**	02	3 Hrs.
	CHEC5.1	Chemistry Practical Knowledge/Skill – V	Compulsory Course - 2	04	40	10	**50**	02	3 Hrs.
	Total			**11**	**160**	**40**	**200**	**07**	---
VI - Semester									
VI	**CHET6**	Chemistry - VI	Major Course	03	80	20	**100**	03	3 Hrs.
	CHEP6	Chemistry Practical - VI	Major Course	04	40	10	**50**	02	3 Hrs.
	CHEC6.1	Chemistry Practical Knowledge/Skill – VI	Compulsory Course - 3	04	40	10	**50**	02	3 Hrs.
	Total			**11**	**160**	**40**	**200**	**07**	---
	Grand Total			**---**	**920**	**230**	**1150**	**40**	---

Course Pattern for CHEMISTRY (Major Subject) at Under Graduate Level:

I – Semester	: CHET1 – Chemistry - I
	: CHEP1 – Chemistry Practical - I
II – Semester	: CHET2 – Chemistry - II
	: CHEP2 – Chemistry Practical - 2
III – Semester	: CHET3 – Chemistry - III
	: CHEP3 – Chemistry Practical - III
	: * CHEL3.1 – Chemistry Elective - III.1 (Medicinal Chemistry)
	: * CHEL3.2 – Chemistry Elective - III.2 (Essence of Chemistry in day-to-day Life)
IV – Semester	: CHET4 – Chemistry - IV
	: CHEP4 – Chemistry Practical - IV
	: CHEC4.1 – Chemistry Practical Knowledge/Skill – 1
	: * CHEL4.1 – Chemistry Elective - IV.1 (Electrochemistry, Corrosion and Metallurgy)
	: * CHEL4.2 – Chemistry Elective - IV.2 (Agricultural and Fuel Chemistry)
	:
V – Semester	: CHET5 – Chemistry - V
	: CHEP5 – Chemistry Practical – V
	: CHEC5.1 – Chemistry Practical Knowledge/Skill – 2
VI – Semester	: CHET6 – Chemistry - VI
	: CHEP6 – Chemistry Practical – VI
	: CHEC6.1 – Chemistry Practical Knowledge/Skill – 3

Note: There shall be two elective papers offered in Semester-III and Semester-IV by every major subject offering departments. Out of this, a student shall choose/select/opt One Elective Paper in each semester (i.e., Semester-III and Semester-IV, respectively).

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Continuous Assessment / Internal Assessment / Formative Assessment
Major Subject (Chemistry)

Sl. No.	Continuous Assessment / Internal Assessment	Maximum Marks
(1)	(2)	(3)
1.	Two Session Tests with a proper record for assessment (5+5 = 10)	**10**
2.	Assessment of Skill Development activities / Seminars / Group Discussion / Assignment etc., with proper record	**05**
3.	Attendance with proper record*	**05**
TOTAL MARKS		**20**

*** Attendance Marks-breakup**

<75% - 00 Marks
75-80% - 01 Mark
80-85% - 02 Marks
85-90% - 03 Marks
90-95% - 04 Marks
>95% - 05 Marks

Continuous Assessment / Internal Assessment / Elective / Optional (III & IV Semesters)/ Compulsory Courses (Practical Knowledge/Skill) (IV, V & VI Semesters)

Sl. No.	Continuous Assessment / Internal Assessment	Maximum Marks
(1)	(2)	(3)
1.	Two Session Tests with a proper record for assessment (2+2 = 4)	**04**
2.	Assessment of Skill Development activities / Seminars / Group Discussion / Assignment etc., with proper record	**03**
3.	Attendance with a proper record*	**03**
TOTAL MARKS		**10**

***Attendance Marks-breakup**

<75% - 00 Marks
75-80% - 01 Mark
85-90% - 02 Marks
90-100% - 03 Marks

Practical Examination: I - VI Semesters (Major Subject: Chemistry)

Description	Marks
Experimentation	35
Viva Voice	05
Total	**40**

Internal Assessment for Practical Paper I - VI semesters (Major Subject: Chemistry)

Description	Marks
Attendance	05
Record/Journal	05
Total	**10**

Theory Examination and Question Paper Pattern for One Major Subject (Chemistry)
(I - VI Semesters)

B.Sc. Semester-I/II/III/IV/V/VI Degree Examination: 2024-25
(Semester Scheme; New Syllabus: 2024-25)

Subject: Chemistry

Paper Code – _____ : Title - _____

Time: 3 Hours. **Max. Marks: 80**

Instructions to candidates:

1) All sections are compulsory.
2) Draw neat and labeled diagrams wherever necessary.
3) Figures to the right indicate marks.

Section - A

1. Answer **all** the following questions: **(10×2=20)**

a)
b)
c)
d)
e)
f)
g)
h)
i)
j)

Section – B

Answer **any Six** of the following: (TWO Questions from each Unit) **(6×5=30)**

2.
3.
4.
5.
6.
7.
8.
9.

(**Note:** 5 Marks question may be divided into 2 + 3, if required)

Section - C

Answer **any Three** of the following: **(3×10=30)**

10. From Unit-I
11. From Unit-II
12. From Unit-III
13. From Unit-IV

(**Note:** 10 Marks question may be divided into 3 + 7 or 4 + 6 or 5 + 5, if required)

Theory Examination and Question Paper Pattern for Elective / Optional Papers

B.Sc. Semester - III / IV Degree Examination: 2024-25

(Semester Scheme; New Syllabus: 2024-25)

(Paper – Elective / Optional Paper for III & IV Semesters)

Subject: Chemistry Elective

Paper Code _____: Title_____

Time: 2 Hours **Max. Marks: 40**

Instructions to candidates:

1) All sections are compulsory
2) Draw neat and labeled diagrams wherever necessary.
3) Figures to the right indicate marks.

Section - A

Answer **all** the following questions: **(5×2=10)**

1.
2.
3.
4.
5.

Section - B

Answer **any Six** of the following: **(6×5=30)**

6.
7.
8.
9.
10.
11.
12.
13.

(**Note:** 5 Marks question may be divided into 2 + 3, if required)

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THEORY PAPER MODEL

SEMESTER – I/II/III/IV/V/VI

Major Course: Chemistry

Major Course; Paper-I: CHET1 (Paper Title) Chemistry - I

Total Hours of Teaching - 48

Course Objectives:

a)
b)
c)
d)
e)

Course Outcome: On successful completion of the course, the student will able to:

a)
b)
c)
d)
e)
f)

UNIT 1: **(12Hrs)**
UNIT 2: **(12Hrs)**
UNIT 3: **(12Hrs)**
UNIT 4: **(12Hrs)**

Suggested References/Textbooks (Provide a minimum of Six Reference Books, out of which at least should be latest books):

1.
2.
3.
4.
5.
6.
7.
8.

THEORY PAPER MODEL

EL/OP Theory Papers (Semesters III & IV):

Major Course: Chemistry

CHEL3.1 / CHEL3.2: (Paper title) Chemistry Elective – III.1 / III.2

CHEL4.1 / CHEL4.2: (Paper title) Chemistry Elective – IV.1 / IV.2

Total Hours of Teaching - 32

Course Objectives:

a.

b.

c.

d.

e.

f.

Course Outcome: On successful completion of the course, the student will able to

a.

b.

c.

d.

e.

f.

UNIT 1:	**(8Hrs)**
UNIT 2:	**(8Hrs)**
UNIT 3:	**(8Hrs)**
UNIT 4:	**(8Hrs)**

Suggested References/Textbooks (Provide a minimum of Six Reference Books, out of which at least should be latest books):

1.

2.

3.

4.

5.

6.

7.

8.

Kuvempu University

Jnanasahyadri, Shankaraghatta - 577451

Syllabus for B.Sc. Programme (Semester Scheme) 2024-2025

(As per G.O. No.: ED 166 UNE 2023, Bengaluru, dated: 08-05-2024)

Case-1: 3 Majors with a General Degree in all 6 Semesters

Major Subject: Chemistry

III – Semester Theory Paper

Theory Paper: CHET3 - Chemistry-III **Total teaching Hours: 48**

UNIT - I: ANALYTICAL CHEMISTRY **Total Hours: 12**

Chapter-1: Chromatography-II and Solvent extraction

Gas Chromatography (3 Hours)

Introduction and overview of GSC and GLC: Instrumentation, sample injection systems, columns, detectors- TCD, FID, β-ray ionization detectors, temperature programming, applications- quantitative and qualitative analysis.

High performance liquid chromatography (2 Hours)

Introduction, superiority of HPLC, instrumentation and applications.

Chapter-2: Solvent extraction (5 Hours)

Definition, principle and efficiency of extraction, distribution law, mechanism of extraction: extraction by solvation and chelation, determination of distribution ratio, sequence of extraction process, factors affecting extraction-pH, oxidation state, modifiers, synergistic, masking and salting out agents, batch extraction, continuous extraction, discontinuous extraction, counter current extraction. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non-aqueous media.

Chapter-3: Inorganic qualitative analysis (2 Hours)

Basic principle, common ion effect, solubility, solubility product, preparation of original solution, classification of basic radicals in groups, separation of basic radicals, removal of interfering anions (phosphate and borate), detection of acid radicals.

References:

1. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes, M. Thomas, B. Sivasankar, 6th Edition, Pearson Education, New Delhi, India, 2012.
2. Instrumental Methods of Chemical Analysis, H. Kaur, Pragathi Prakashan, New Delhi, India, 2021.
3. Introduction to Chromatography- Theory and Practice, V.K. Srivatsan and K.K. Srivatsan, S. Chand Company Ltd. 4th Edition, 1991.

4. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, E.J. Holler, S.R. Crouch, 8th Edition, Thomson Asia Pvt. Ltd., Singapore, 2004.
5. Instrumental Analysis, D.A. Skoog, E.J. Holler, S.R. Crouch, 11th Indian Reprint, Cengage Learning India Pvt. Ltd., New Delhi, 2012.
6. Analytical Chemistry – Theory and Practice, R.M. Verma, 3rd Edition, CBS Publishers and Distributors, New Delhi, India, 2007.
7. Analytical Chemistry, Gray D. Christian, 5th Edition, John Wiley and Sons, Inc., 1994.

UNIT - II: INORGANIC CHEMISTRY **Total Hours: 12**

Chapter-1: Non-aqueous solvents (5 Hours)

Classification, comparative account of water and liquid ammonia as solvents (striking similarities and factors which make them good polar solvents).Reactions in liquid ammonia and water, acid base neutralisation, oxidation-reduction, complex formation, ionisation of acetic acid. Solvolysis, solvation, Solubility of ionic solids – its dependence of lattice energy and solvation energy. Solutions of alkali metals in liquid ammonia, advantages and disadvantages of liquid NH_3 as solvents.

Chapter-2: p-block elements (7 Hours)

BF_3-Properties, structure, Lewis acid (electron acceptor property) relative strength of trihalides of boron, effects of back bonding.

Hydrides of Boron; Diborane - Preparation, properties, structure and bonding and uses. Borazine - Preparation, properties, structure and uses.

Borazines (borazole): Preparation, properties, reaction with water, addition, substitution and pyrolysis of borazine. Structure of borazine, comparison of structure of borazine with benzene, Carbon and silicon – Structural features of diamond and graphite, CO_2 and SiO_2 – Correlation of their properties with structure. Fullerenes- Introduction, preparation, properties and uses. Silicates – Types, structure, ultramarine and zeolites.

References:

1. Principles of Inorganic Chemistry (UGC Syllabus) by B.R. Puri, L.R. Sharma, K.C. Kalia, Milestone Publishers, New Delhi, India, 2018.
2. Theoretical Principles of Inorganic Chemistry by G.S. Manku, Tata McGraw-Hill Publishing Company Ltd. 2006.
3. Modern Inorganic Chemistry by R.D. Madan, S. Chand & Company Ltd. 2012.
4. Advanced Inorganic Chemistry by Sathyaprakash, S. Chand Publishers, 2000.
5. J.E. Huheey, E.A. Keiter and R.L. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, IV Ed., Pearson Education, India, 2006.
6. F.A. Cotton, G. Wilkinson, C.M. Murillo and M. Bochmann, Advanced Inorganic Chemistry, VI Ed., John Wiley and Sons, Inc., New York, 1999.

UNIT - III: ORGANIC CHEMISTRY **Total Hours: 12**

Chapter-1: Arenes and aromaticity (2 Hours)

Molecular orbital structure of benzene, Huckel's rule of aromaticity, anti aromatic, non-aromatic with example. Non-benzonoid aromatic compounds - cyclopentadienyl anion, cycloheptatrienyl cation.

Chapter-2: Substitution and elimination reactions (6 Hours)

a) Aliphatic substitution reaction. S_N^1, S_N^2 reactions with mechanism, stereochemistry and solvent effect.

b) Aromatic substitution reactions. Nitration, bromination, sulphonation, Friedel-Craft's alkylation and acylation with mechanism. Orienting influence on aromatic substitution reaction. Ring activating and deactivating groups.

c) E_1, E_2 reaction with mechanism. Hoffmann elimination and Saytzeff reaction.

Chapter-3: Phenols (4 Hours)

Classification, nomenclature, methods of preparation from Cumene, Dow process, from diazonium salts. Acidity of phenols- resonance, stabilization of phenoxide ion, compare the acidity of alcohol and phenol. Effect of substituent's on acidity of phenols, electron withdrawing groups (-NO_2, -CN, -CHO, -COOH), electron donating groups (-CH_3, -OCH_3, -NH_2). Reactions of phenols. Fries, Claisen, Reimer-Tiemann, Lederer-Manasse reactions with mechanism.

References:

1. Organic Chemistry, I.L. Finar, ELBS Longmann, Vol. I & II, 1984.
2. Organic Chemistry, B.S. Bahl and Arun Bahl, S. Chand and Sons, New Delhi, 2005.
3. Organic Reaction Mechanism, R.K. Bansal, Wiley Eastern Limited, New Delhi, 1993.
4. Advanced Organic Chemistry, J. March, Wiley Interscience, 1994.
5. Mechanism and Structure in Organic Chemistry, E.S. Gould, Halt, Rinhart & Winston, New York, 1963.
6. A Guide book to mechanism in Organic Chemistry, Peter Sykes, Pearson Education India, 2003.
7. Advanced Organic Chemistry – Part A & B, F.A. Carey and Sundberg, III Edition, Plenum Press, New York, 1990.
8. Advanced General Organic Chemistry, S.K. Ghosh, Book and Allied (P) Ltd, 1998.

UNIT - IV: PHYSICAL CHEMISTRY **Total Hours: 12**

(Note: Numerical problems must be solved wherever necessary)

Chapter-1: Phase equilibria (3 Hours)

Introduction, terms - phase, component and degrees of freedom. Statement and derivation of Gibb's phase rule, phase diagram of one component system, water and sulphur system. Two component systems: KI-water system. Freezing mixture- definition, examples.

Chapter-2: Dilute solutions and colligative properties (4 Hours)

Dilute solutions; Raoult's and Henry's Laws and their Applications.

Colligative properties: Brief review of definition and mathematical expressions of colligative properties. Derivation of relations between the four colligative properties using chemical potential. Determination of molecular mass of the solute using colligative propertes by: (i) Berkeley-Hartley's method; (ii) Beckmann's method and (iii) Walker-Lumsden method. Numerical problems.

Chapter-3: Chemical kinetics (5 Hours)

Brief review of rate, order and molecularity, Derivation of expression for the rate constant of a first order reaction, second order reaction with a = b and a ≠ b. Half-life period of a reaction, Determination of order of reaction**:** differential method, method of integration, method of half-life period and isolation method. Arrhenius equation, Activation energy. Calculation of activation energy using integrated Arrhenius equation. Theories of reaction rates: collision theory, transition state theory. Steady state approximation and Lindemann's hypothesis. Experimental determination of kinetics of inversion of cane sugar by polarimetric method. Numarical problems.

References:

1. Physical Chemistry, R.L. Madan, G.D. Tuli, S. Chand & Co., 2010.
2. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma, M.S. Patania, Vishal Publishing Co., 2020.
3. A Textbook of Physical Chemistry, Volume 2, K.L. Kapoor, McMillan Publishers India Limited, 2000.
4. Physical Chemistry, K.J. Laidler and J.M. Meiser, III Ed., Houghton Mifflin Comp., New York, International Edition, 1999.
5. Physical Chemistry, V Ed., G.M. Barrow, Tata McGraw Hill, 1996.

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III - Semester Practical

CHEP3: Chemistry Practicals –III **Total Teaching Hours: 64**

Inorganic qualitative analysis

Systematic semi-micro inorganic qualitative analysis of a salt mixture containing two cations and two anions.

The following radicals may be considered for analysis:

Basic Radicals: Pb^{2+}, Cd^{2+}, Al^{3+}, Zn^{2+}, Mn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, and NH_4^{+}.

Acid Radicals: CO_3^{2-}, HCO_3^{-}, NO_2^{-}, Cl^{-}, Br^{-}, I^{-}, NO_3^{-}, SO_4^{2-}, BO_3^{3-}, PO_4^{3-} .

Note:

1. At least 10 salt mixtures are to be analyzed by each student during the laboratory session.
2. The students have to write the equation and proper explanation wherever necessary.

References:

1. Vogel's textbook of macro and semimicro qualitative inorganic analysys, V Ed., Revised by G. Svehla, Longman, London and New york, 1979.
2. Handbook of Qualitative analysis, Maharudra Chakraborthy, Independently published, 2019.
3. Principle of Qualitative Analysis, I Ed., K.K. Sharma, 2019.
4. Principles of qualitative inorganic analysis, precipitation, separation and identification of cations, Huda S. Alhasan, Nadiyah Alahmadi, Bentham Books, 2021.

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III – Semester Course Objectives and Outcomes

Course Objectives:

1. *To make the students to understand the basic concepts of chromatographic analysis, the fundamentals of solvent extraction, allied aspects of solvent extraction.*
2. *To study the principles of inorganic qualitative analysis, also to know about its applications.*
3. *To impart students with the knowledge of Non-Aqueous Solvents, with respect to their classification, reactions, advantages and disadvantages.*
4. *To make the students to understand the structure, preparation and properties, reactions of d-block elements, particularly w.r.t. Boron and Fluorine compounds.*
5. *To teach the students about structure, aromaticity and allied concepts of arenes.*
6. *To make students to learn fundamentals of substitution and elimination reactions with suitable examples.*
7. *To impart the knowledge about Classification, nomenclature, Methods of preparation and allied reactions of phenols.*
8. *To make the students understand the phase equilibria and phase diagrams of various systems, applications of freezing mixtures.*
9. *To impart students with a thorough knowledge of behaviour of dilute solutions, their colligative properties, the determinations of molecular mass of the solute in dilute solutions by means of colligative properties.*
10. *To introduce the students to the area of measuring the velocity of chemical reactions under the heading of chemical kinetics and to apply the knowledge to measure the rates of chemical changes.*
11. *To develop expertise in experimental skills of Systematic Semi-Micro Inorganic Qualitative Analysis of a salt mixture containing Two Cations and Two Anions, to identify two acid radicals and two basic radicals.*

Course Outcomes:

After the successful completion of III-Semester, the students will be able to;

1. *Understand the basic concepts of chromatographic analysis, to learn the fundamentals of solvent extraction, sequence of extraction and qualitative and quantitative aspects of solvent extraction.*
2. *Study the principles of inorganic qualitative analysis, also to know about its applications.*
3. *Gain the knowledge on non-aqueous solvents, with respect to their classification, reactions, advantages and disadvantages.*
4. *Understand the structure, preparation and properties, reactions of d-block elements, particularly w.r.t. Boron and Fluorine compounds.*
5. *Learn about structure, aromaticity and allied concepts of arenes.*
6. *Know fundamentals of substitution and elimination reactions with suitable examples.*

7. *Have the knowledge about Classification, nomenclature, Methods of preparation and allied reactions of phenols.*
8. *Understand the phase equilibria, phase transformations and to learn the development and analysis of phase diagrams. To teach the students realize the importance and applications of freezing mixtures.*
9. *Have a thorough knowledge of behaviour of dilute solutions, their colligative properties, the determinations of molecular mass of the solute in dilute solutions by means of colligative properties*
10. *Learn completely the measurement of rates of chemical changes using simple laboratory set up and with a thorough knowledge of fundamental and theoretical aspects of chemical kinetics.*
11. *Analyze a mixture of inorganic salts in order to identify two cations and two anions by applying the method of systematic semimicro qualitative analysis.*

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III – Semester Elective Papers

CHEL3.1-Chemistry Elective-III.1: Medicinal Chemistry

Total Teaching Hours: 32

UNIT-I: Clinical Health and Biochemical Analysis: Definition of Health, WHO standard, Sterilization of surgical instruments. Biochemical analysis of urine and serum. Blood - Composition, grouping and Rh factor. **(6 Hours)**

UNIT-II: Common Drugs: Antibiotics, Antipyretics, Analgesics, Anti-inflammatory agents, Sedatives, Antiseptics, Antihistamines, Tranquilizers, Hypnotics and Antidepressant drugs - Definition, Examples, uses and side effects. **(5 Hours)**

UNIT-III: Vital Ailments and Treatment: Blood pressure - hypertension and hypotension, Diabetes, Cancer, AIDS - Causes, symptoms and medicines. **(2 Hours)**

UNIT-IV: First Aid and Safety: Treatment of shock, haemorrage, cuts and wounds. Burns - classification and first aid. Asbestos, silica, lead paints, cement, welding fumes and gases - Hazard alert and precautions for safety. **(3 Hours)**

Unit–V: Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti- inflammatory agents (Aspirin, paracetamol, lbuprofen). **(8 Hours)**

Unit–VI: Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine). Fermentation Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid. **(4 Hours)**

Unit-VII: Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, Lysine, Glutamic acid, Vitamin B_2, Vitamin B_{12} and Vitamin C. **(4 Hours)**

References:

1. Fundamentals of Medicinal Chemistry, Rohini Kadam, Ashish Uke, Anurag Luharia, Manish Deshmukh, Gaurav Mishra, Monika Luhariam, IP Innovative Publication Pvt. Ltd., 2023.
2. A Textbook of Medicinal Chemistry-III, A Rajendiran, Ajay Kumar Gupta and Anju Singh, Shashwath Publishers, 2023.
3. An Introduction to Medicinal Chemistry, Graham L. Patrick, Oxford University Press, 2023.
4. Hawk's Physiological Chemistry, B.L Oser, Tata-McGraw - Hill Publishing Co. Ltd., 1995.
5. Biochemistry, S.C Rastogi, Tata McGraw Hill Publishing Co., 1993.

Course Objectives:

1. *To learn the basic idea of clinical health, drugs and about common drugs.*
2. *To learn about treatment of diseases, first aid and safety.*
3. *To understand drug discovery and about various vital drugs.*

Course Outcomes:

After the successful completion of this course, the students will be able to;

1. *Gain the basic knowledge of clinical health drugs and common drugs.*
2. *Understand the treatment of diseases, first aid and safety.*
3. *Study the drug discovery and about various vital drugs.*

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CHEL3.2-Chemistry Elective-III.2: Essence of Chemistry in day-to-day Life

Total Teaching Hours: 32

Unit-I: Water Chemistry (4 Hours)

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

UNIT-II: Food Chemistry (10 Hours)

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

UNIT-III: Cosmetics and other materials (8 Hours)

Cosmetics – Face powder – constituents, uses, side effects. Nail polish, hair dye – composition and side effects. Tooth powder – composition and manufacture. Lotions. Preparation of phenyl, liquid blue and incense sticks. 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-IV: Material Chemistry (10 Hours)

Polymers: Addition polymerization, condensation polymerization, thermoplastics, vulcanization of rubber. Fibers: Natural fibers (cellulosic and pretentious) –Semi synthetic (Rayon) Synthetic fibers (Poly ester, Nylon and Acrylic) – Pretreatment of fibers (Sizing, Desizing, Bleaching). 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).

References:

1. Environmental Chemistry, A.K. De, New Age International, 2018.
2. Food Chemistry, Alex Ramani, MJP publishers, Chennai, 2009
3. Text book of Pharmaceutical Chemistry, Jayashree Gosh, New Delhi, S. Chand & Company Ltd., 2003.
4. Applied Chemistry, K. Bagavathi Sundari, MJP Publishers, Chennai, 2006.
5. A Text Book of Applied Chemistry, 1st Ed., A Thankamma Jacob, McMillan India Ltd. 1979.
6. A text book of soil chemical analysis, Hesse P.R, John Murray, New York, 1971.

Course Objectives:

1. *To learn the scientific and chemical principles in water chemistry.*
2. *To learn additives and adulterants used in of food chemistry.*
3. *To know the chemicals used in cosmetics and other materials used in everyday life.*
4. *To understand the chemical used and properties of polymers, fibers and dyes.*

Course Outcomes:

After the successful completion of this course, the students will be able to;

1. *Prepare demineralized and desalinized water.*
2. *Explain food additives and their carcinogenic effects.*
3. *Know the types of polymers and plastics with examples.*
4. *Explain theory of dying processes.*
5. *Understand and explain the chemical composition of cosmetics.*

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IV – Semester Theory Paper

Theory Paper: CHET4 - Chemistry-IV **Total Teaching Hours: 48**

UNIT - I: ANALYTICAL CHEMISTRY **Total Hours: 12**

Chapter-1: Titrimetric analysis (4 Hours)

Precipitation titrations: precipitation reactions, determination of end point (formation of coloured precipitate, formation of soluble coloured compound, adsorption indicator), standard $AgNO_3$ soln., standardization of $AgNO_3$ soln. – potassium chromate indicator-Mohr's titration, determination of chloride and bromide, determination of iodide. Problems based on analysis.

Chapter-2: Surface Tension and Viscometry (2 Hours)

Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer, effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

Chapter-3: Ultracentrifugation (4 hours)

Centrifugation, centrifugal force, sedimentation, centrifugal decantation, centrifuges, selection of centrifuge tubes, preparative, density gradient and isopycinic centrifugation. Analytical sedimentation, sedimentation coefficient, sedimentation velocity-Application of the technique in biological separation; membrane separation-principle and applications.

Chapter-4: Ultrafiltration, Zone refining techniques (2 hours)

Principles, instrumentation and applications.

References:

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Edition, Saunders College Publishing, New York. Crouch VIII, 2005.
2. Analytical Chemistry, G.D. Christian, V Edition, John Wiley & Sons, Inc, India. 2001
3. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, VI Edition, Third Indian Reprint, Pearson Education Pvt. Ltd., New Delhi, 2003.
4. Analytical Chemistry Principles, John H. Kennedy, II Edition, Saunders College Publishing, California, 1990.
5. Introduction to Instrumental Analysis, R.D. Braun, McGraw Hill Publisher, 1987.
6. Instrumental Methods of Chemical Analysis, B.K. Sharma, Goel publishing House, Meerut, 1972.
7. Instrumental Methods of Analysis, Willard, Merritt and Dean, VII Edition, Jr. F.A. Publication, 1981.

UNIT - II: INORGANIC CHEMISTRY **Total Hours: 12**

Chapter-1: Glass, Cement and Paints (4 Hours)

Glass: Raw materials, manufacture by tank furnace method, colouring agents, annealing of glass, types of glasses – soda glass, potash glass, flint glass, pyrex glass (their composition and uses).

Cement: Raw materials, manufacture by dry process, mechanism of setting. Role of water and gypsum in setting process.

Paints: Constituents and their functions, manufacture of white lead by chamber's process and electrolytic process**.**

Chapter-2: Metallurgy (8 Hours)

Thermodynamics of metallurgy, Ellingham's diagrams- features, applications and limitations, extraction of lead - self-reduction process and nickel from pentalendite, extraction of manganese from pyrolusite from aluminothermite process extraction of gold by hydrometallurgical process, refining of gold by quartation process, beryllium from beryl via sodium beryllium fluoride, Thorium from Monazite sand and Uranium from Pitchblende by acid digestion process.

References:

1. Principles of Inorganic Chemistry by B.R. Puri, L.R. Sharma, K.C. Kalia, Vishal Publishers, New Delhi, India, 2018.
2. Industrial Chemistry by B K Sharma, Goel Publishing House, Eighteenth edition, 2014.
3. Modern Inorganic Chemistry by R.D. Madan, S. Chand & Company Ltd. 2012.
4. Advanced Inorganic Chemistry by Sathyaprakash, S. Chand Publishers, 2000.
5. Inorganic Chemistry: Principles of Structure and Reactivity, J.E. Huheey, E.A. Keiter and R.L. Keiter, IV Edition, Pearson Education, India, 2006.
6. Advanced Inorganic Chemistry, F.A. Cotton, G. Wilkinson, C.M. Murillo and M. Bochmann, VI Edn., John Wiley and Sons, Inc., New York, 1999.

UNIT - III: ORGANIC CHEMISTRY **Total Hours: 12**

Chapter-1: Aldehydes and Ketones (5 hours)

Nomenclature, structure and reactivity of carbonyl groups in aldehydes, ketones. Methods of preparation of chloral, acrolein, crotonaldehyde.

Reactions of aldehydes and ketones with hydroxyl amine, hydrogen cyanide, 2,4-DNP. Reaction Mechanism of Aldol, Perkin's, Benzoin, Cannizaro, Knoevenagel reaction.Clemmenson reduction, Wolff-Kishner reduction.

Chapter-2: Carboxylic acids (4 Hours)

Nomenclature of mono and dicarboxylic acids. Acidity of carboxylic acids. Effect of substituents on acidity. Comparative study of: i) Acetic acid and formic acid, ii) Acetic acid and benzoic acid, iii) Acetic acid and monochloro acetic acid and iv) 2-chloro butanoic acid and chlorobutanoic acid.

Hydroxy acid, effect of heat on α, β and γ – hydroxy acids.

Derivatives of Carboxylic acids: Preparation and reactions of: (i) acid chlorides, (ii) acid amides and (iii) acid anhydrides.

Chapter-3: Amines (3 Hours)

Nomenclature, Classification with examples. Synthesis of amines by reduction of nitro compounds. Hoffmann's degradation methods with mechanism. Basicity of amines. Comparative study of: i) Methyl amine, dimethyl amine and trimethyl amine, ii) Methyl amine and aniline, iii) Aniline and p-nitroaniline and p-toluidine and iv) Aniline, N-methyl aniline and N, N-dimethyl aniline.

Separation of amines by alkylation, nitrous acid method and Heinsberg's method.

References:

1. Organic Chemistry, I.L. Finar, ELBS Longmann, Vol. I & II, 1984.
2. Organic Chemistry, B.S. Bahl and Arun Bahl, S. Chand and Sons, New Delhi, 2005.
3. Organic Reaction Mechanism, R.K. Bansal, Wiley Eastern Limited, New Delhi, 1993.
4. Advanced Organic Chemistry, J. March, Wiley Interscience, 1994.
5. Mechanism and Structure in Organic Chemistry, E.S. Gould, Halt, Rinhart & Winston, New York, 964.
6. A Guide book to mechanism in Organic Chemistry, Peter Sykes, Pearson Education India.
7. Advanced Organic Chemistry – Part A & B, F.A. Carey and Sundberg, III Edition, Plenum Press, New York, 1990.
8. Advanced General Organic Chemistry, S.K. Ghosh, Book and Allied (P) Ltd, 1998.

UNIT-IV: PHYSICAL CHEMISTRY 12 Hours

Chapter-1: Electrochemistry-I (7 Hours)

Electrolytes, types of electrolytes, Arrhenius theory of electrolytic dissociation, degree of dissociation and dissociation constant, conductance, specific, equivalent, molar conductance, cell constant, Variation of conductance with concentration and equivalent conductance at infinite dilution for strong and weak electrolytes. Debye-Huckel theory of strong electrolytes; symmetry effect and electrophoretic effect. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorff's method. Kohlrausch's law and its applications. (Numerical problems to be solved).

Applications of conductance measurement in determination of (i) degree of dissociation and dissociation constant of weak electrolytes (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts (iv) Hydrolysis constants of salts. Conductometric titrations: strong acid v/s strong base, weak acid v/s strong base, mixture of strong and weak acids v/s strong base. (Numerical problems to be solved)

Chapter-2: Photochemistry (5 Hours)

Laws of photochemistry - Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence. Quantum yield and explanation for photochemical reactions of hydrogen-iodine,

hydrogen-chlorine and hydrogen-bromine. Qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, inter-system crossing), Jablonski diagram. Photosensitized reactions - simple examples, chemiluminescence, bioluminescence.

References:

1. Physical Chemistry; R.L. Madan, G. D. Tuli, S. Chand & Co., 2010.
2. Principles of Physical Chemistry: Puri, Sharma and Pathania, Vishal Publishing Co., 2020.
3. Textbook of Physical Chemistry, Volume 2, K.L. Kapoor, McMillan publishers India Limited, 2000.
4. Physical Chemistry, K.J. Laidler and J.M. Meiser, III Edition, Houghton Mifflin Comp., New, York, International Edition, 1999.
5. Physical Chemistry, V Edition, G.M. Barrow, Tata McGraw Hill, 1996.

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IV – Semester Practical

CHEP4: Chemistry Practicals -IV **Total teaching Hours: 64**

Physical Chemistry (Non-Instrumental) Experiments:

1. Determination of density using specific gravity bottle and viscosity of the given liquid by using Ostwald's viscometer.
2. Determination of density and surface tension of the given liquid by using stalagmometer.
3. Determination of molecular weight of non-volatile solute by Walker-Lumsden method.
4. Determination of percentage of given electrolyte in phenol water system by miscibility temperature method.
5. Determination of percentage of given binary mixture (Glycerol-water) by viscosity method.
6. Determination of rate constant of Fe^{3+} catalyzed decomposition of H_2O_2.
7. Determination of rate constant of saponification of ethyl acetate.
8. Determination of critical solution temperature of phenol water system.
9. Determination of transition temperature of given hydrate salt ($Na_2S_2O_3.5H_2O$).
10. Identification of the given amino acid by paper chromatography.
11. Determination of rate constant of inversion of cane sugar by polarimeter method.

Note: A minimum of EIGHT experiments must be performed and recorded.

References:

1. Experiments in Physical Chemistry, Shoemaker & Garland, McGraw Hill Int. Edn., 1966.
2. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publications Meerut, 1988.
3. Experimental Physical Chemistry, R.C. Behra and B Behra, Tata McGraw, New Delhi, 1983.
4. Experimental Physical Chemistry, V.D. Atavale & Parul Mathur, New Age Int. NY., 2001.
5. Principles of Physical Chemistry - B.R. Puri, L.R. Sharma, M.S. Patania, S. Chand & Co., 1987.

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IV – Semester Course Objectives and Outcomes

Course Objectives:

1. *To make the students understand the basic knowledge of precipitation titrations.*
2. *To impart knowledge about the surface tension and viscometry and factors affecting them.*
3. *To teach the students about the fundamentals of Ultracentrifugation, sedimentation, ultrafiltration and Zone refining techniques, their applications.*
4. *To introduce the students to the areas of materials like glass, cement and paint and their raw materials, composition and manufacture.*
5. *To make students to learn thermodynamics of metallurgy, Ellingham's diagrams- extraction of various metals.*
6. *To make students to learn about the nomenclature, Structure and reactivity of carbonyl compounds.*
7. *To introduce students to the nomenclature of mono and dicarboxylic acids. Acidity of carboxylic acids, effect of substituents on acidity and derivatives of carboxylic acids.*
8. *To introduce the students to the area of basic electrochemistry, which collectively include the concepts of conductance, specific conductance, equivalent conductance, molar conductance, Kohlrausch's law and its applications.*
9. *To make the students understand the laws of photochemical reactions and their applications with suitable examples, the importance of Jablonski diagram to understand the basic aspects of photochemical processes.*
10. *To make the students comfortably perform the experiments to determine the basic physical properties of the substances like density, viscocity, surface tension etc. and also to perform experiments to find out rate constants of certain simple reactions.*

Course Outcomes:

After the successful completion of IV-Semester, the students will be able to;

1. *Understand the basic knowledge of precipitation titrations.*
2. *Have knowledge about the surface tension and viscometry and factors affecting them.*
3. *Learn the fundamentals of Ultracentrifugation, sedimentation, Ultrafiltration and Zonerefiningtechniques, their applications*
4. *Be introduced into the areas of materials like glass, cement and paint and their raw materials, composition and manufacture.*
5. *Learn thermodynamics of metallurgy, Ellingham's diagrams- extraction of various metals.*
6. *Learn about the nomenclature, Structure and reactivity of carbonyl compounds.*
7. *Be introduced into the nomenclature of mono and dicarboxylic acids. Acidity of carboxylic acids, effect of substituents on acidity and derivatives of carboxylic acids.*

8. *Be introduced to the area of basic electrochemistry, which collectively include the concepts of conductance, specific conductance, equivalent conductance, molar conductance, Kohlrausch's law and its applications.*

9. *Understand the basic laws of photochemical reactions and their applications with suitable examples, also to make student realize the importance of Jablonski diagram to understand the basic aspects of photochemical processes.*

10. *To perform the experiments to determine the basic physical properties of the substances like density, viscosity, surface tension etc. and also to perform experiments to find out rate constants of certain simple reactions.*

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IV – Semester Elective Papers

CHEL4.1-Chemistry Elective-IV.1: Electrochemistry, Corrosion and Metallurgy

Total Teaching Hours: 32

UNIT-I: Electrochemistry (10 Hours)

Conductance, specific and molar conductance, Types of electrolytes, conductivity in electrolytic solution, electrolysis, equivalent conductance of weak electrolyte at Infinite dilution. Oxidation -reduction reactions, electrode potential, EMF of an electrochemical cell, cell reaction, Daniel cell, dry Cells - electrolytic and Galvanic cell, Representation of a cell. Standard electrode potential, Nernst equation (No derivation) and its application to chemical cell, Electrochemical series and its importance. Types of Electrodes. Basic Principles of (i) Conductometric titrations - HCl Vs NaOH, CH_3COOH Vs NaOH (ii) Potentiometric titrations: Acid-base titration HCl Vs NaOH, Redox titration (FAS Vs $K_2Cr_2O_7$) Determination of pH using glass electrode. Batteries- Primary and secondary batteries, Battery components and their role. Working of the Lead acid and Lithium storage batteries, Fuel cells.

UNIT-II: Corrosion (10 Hours)

Introduction, definition, Types of corrosion, corrosion rate, factors affecting corrosion rate, Metallic factor-purity, electrode potential of metal, hydrogen over voltage, nature of corrosion product. Environmental factors-Temperature, pH of the medium, humidity, presence of impurities, electrical conductivity, velocity and concentration of the medium. Prevention of Corrosion: Material selection - Metals and alloys, metal purification, non-metallic, Alteration of environment - Changing media, inhibitors, Design-wall thickness, design rules, Coating-Metallic and other inorganic coatings, organic coating. Electroplating: Introduction, Electroplating of chromium (hard and decorative). Electroless plating: Introduction, distinction between electroplating and electrode plating processes. Electroless plating of copper.

UNIT-III: Metallurgy (6 Hours)

Introduction: Ore, minerals, important ores of some common elements in India, General principles of pyrometallurgy, roasting, calcination, gangue, smelting, flux, gravity separation, froth flotation process, leaching. Techniques employed for purification of metal :Distillation process, Bessemerization, Electro-refining ,Van Arkel and De Boer's process.

Alloys and Extraction of metals (6 Hours)

Alloys: Introduction, Classification of alloys, commercially important alloys, gold karats, Production of Ferro alloys- Ferrochrome, Ferromanganese, Uses of alloys. Extraction of Manganese (Pyrolusite), Titanium (Ilmanite) and Uranium.

References:

1. Physical Chemistry, G.M. Barrow, Tata McGraw-Hill, 2007.
2. An introduction to electrochemistry, Samuel Glasstone, East-West edition New Delhi, 1942.
3. Text book of Physical Chemistry, Samuel Glasstone, 2nd Edition, McMillan India Ltd, 1991.

4. Principles and applications of electrochemistry, D.R. Crow, 3rd Edition, Chapmanhall London, 1988.
5. Fundamentals of electrochemical deposition, Milan Paunovic and Mordechay Schlesinger, Wiley Interscience Publications, New York, 1998.
6. Engineering Chemistry, V.R. Kulkarni and K. Ramakrishna Reddy, New Age International, 2015.
7. Electrochemistry and corrosion Science, Nestor Perez, Springer (India) Pvt. Ltd., 2004.
8. Principles and prevention of corrosion, D.A. Jones, Macmillan Pub. Co., 1996.
9. Essential of materials science and engineering, Donald R. Askeland, Thomson Learning, 5th Edition, 2006.
10. Introduction to engineering materials, B.K. Agarwal, Tata McGraw Hill, 1st Edition 2013.
11. Material science and engineering, V. Raghavan, PHI Learning, 5th Edition, 2004.
12. Engineering materials and metallurgy, R.K. Rajput, S. Chand – 1st Edition, 2011.

Course Objectives:

1. *To make the students to understand the concepts of conductance, electrolytes, electrolysis, redox reactions and EMF.*
2. *To introduce the concepts of electrochemical cells, electrodes,electrode potential and applications of electrochemical series.*
3. *To impart the basic principles and applications of conductometric, potentiometric and pH titrations.*
4. *To make the students to understand the types of batteries and fuel cells - their principles, construction and working.*
5. *To understand the concept of corrosion, types of corrosion and its prevention by different methods. To impart the concept electroplating.*
6. *To introduce the basic concepts on ores and minerals, extraction of metals from their ores, and purification.*
7. *To study alloys - classification, production and uses.*

Course Outcomes:

After the successful completion of this course, the students will be able to;

1. *Understand the concept of conductance in electrolytic solutions, electrolysis and redox reactions involved in electrode reactions.*
2. *Learn the different types of electrochemical cells, their symbolical representation and application of electrochemical series.*
3. *Apply conductometric, potentiometric and pH titrations*
4. *Know the principle, construction and working of batteries*
5. *Understand different types of corrosion and its prevention by different methods*
6. *Learn the methods of extraction of metals from their ores and purification*

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CHEL4.2: Chemistry Elective-IV.2: Agricultural and Fuel Chemistry

Total Teaching Hours: 32 Hrs

Unit-I: – Pesticides (10 Hours)

Introduction, Definition, classification of pesticides based on use (target). Toxicity and chemical structure with examples. Adverse effects of pesticides and its impact on environmental pollution.

Synthesis, technical manufacture and uses of representative pesticides in the following classes: Organochlorines (Cypermethrin); Organophosphates (Parathion); Carbamates (Carbaryl); Quinones (Chloranil), Anilides (Alachlor).

Pesticide formulations: Dusts, Granules, Wettable powders, Emulsions and Aerosols.

Biopesticides : Introduction, pesticidal plants of India, role of Neem in plant protection-constituents, Azadirachtin and its role in pest control. Structure and mode of action of Pyrethrins (Pyrethrin-1), Pyrethroids (Permethrin) and nicotinoids (Imidacloprid).

Unit-II: Fertilizers (12 Hours)

Introduction: Need of fertilizers, functions of essential plant nutrients (N, P, K). Classification, composition and uses of fertilizers.

Nitrogenous fertilizers: Ammonium nitrate, Urea, Calcium Cyanamide, Calcium Ammonium Nitrate, Sodium Nitrate, Ammonium Chloride and their uses.

Phosphate fertilizers: Normal super phosphate, Triple superphosphate, Ammonium phosphate and their uses.

Potassium fertilizers: Potassium chloride, Potassium nitrate, Potassium sulphate and uses. **Complex fertilisers:** Diaammonium phosphate and mixed fertilizers their uses. Manufacture of Urea and Super phosphate of lime and their reactions in the soil.

Biofertilizers – Introduction, definition, classification, Rhizobium, Azatobactor, Azospirillium, Azolla, Blue Green Algae, Vermicomposting and uses.

Unit-III: Energy sources (5 Hours)

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific values.

Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke.

Unit-IV: Petroleum, Petrochemical Industry (5 Hours)

Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications.

Fractional Distillation - Principle and process. Petroleum cracking - thermal and catalytic cracking. Petroleum and non-petroleum fuels - LPG, CNG, LNG, bio-gas, fuels derived from biomass. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene and their uses.

References:

1. Chemistry of Pesticides, N.N. Melnikov, Springer-Verlag-Technology & Engineering 2012.

2. Pesticide Synthesis Handbook, Thomas A. Unger, Elsevier, 2000.
3. Pesticides, R. Cremlyn, John Wiley, 1980.
4. Manures and Fetrtilisers, A.K. Kolay, Published by Atlantic 2007.
5. Industrial Chemistry, Stocchi, E., Vol-I, Ellis Horwood Ltd. UK, 1990.
6. Engineering Chemistry, P.C. Jain, M. Jain, Dhanpat Rai & Sons, Delhi.
7. Industrial Chemistry, B.K. Sharma, Goel Publishing House, Meerut 1996.

Course objectives:

1. To make students to understand the knowledge of agricultural chemistry aspects, like pesticides, their toxicity, synthetic aspects.

2. To impart the information about the fertilizers, their types, uses.

3. To learn about energy sources, coal, petroleum and petrochemical industry.

Course Outcomes:

After the successful completion of this course, the students will be able to;

1. Understand the knowledge of agricultural chemistry aspects, such as pesticides, their toxicity, synthetic aspects.

2. Learn the information about the fertilizers, their types, uses.

3. Gather knowledge about energy sources, coal, petroleum and petrochemical industry.

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IV – Semester

Practical Knowledge/Skill based Course – IV (Compulsory Course)

CHEC4.1: Chemistry Practical / Skill based Course

List of Experiments:

PART-A: Quantitative analysis

1. Determination of Urea in Milk.
2. Determination of Acid value in Fats and oils
3. Determination of total acidity of vinegar/waste water by acid-base titration.
4. Determination of creatinine in urine by Spectrophotometry.
5. Determination of calcium in pharmaceuticals by EDTA titration.
6. Determination of iron in pharmaceuticals by volumetric and potentiometric titrations.
7. Determination of copper in copper alloys.
8. Determination of adulteration in food stuffs (Demonstration).
9. Analysis of cement (Demonstration).
10. Detection of starch in different sweet products (eg. Khova/ ice-cream) (Demonstration).

PART-B: Estimations and Separation methods

1. Estimation of aspirin by colorimetric method.
2. Estimation of Phenol/aniline using brominating mixture.
3. Estimation of paracetamol by titrimetric method.
4. Estimation of acetone by haloform method.
5. Estimation of Ascorbic acid by Spectrometry.
6. Estimation of glucose (sugar) by colorimetric method.
7. Estimation of sulphate in water/soil sample by precipitation method.
8. Estimation of MnO_2 present in the given pyrolusite ore.
9. Separation of organic compounds by column chromatography. (Demonstration)
10. Separation of metal ions by using paper chromatography. (Demonstration).

(***Note:*** A minimum of **12** experiments (**06** from Part A and **06** Part-B) are to be carried out).

References:

1. A textbook of Medicinal Chemistry-I, Pragi Arora, Varun Arora, Davinder Kumar, Page no: 282,283. Indian Pharmacopoeia Volume-I, 1996.

2. Separation Procedures in Inorganic Analysis, R. Young, Arnold publishers, 1976.
3. Vogel's textbook of macro and semimicro qualitative analysis, G. Svehla, Longmann, 1979.
4. Practical Inorganic Chemistry, Preparations, reactions and instrumental methods, Geoffrey Pass , Haydn Sutcliffe, Springer, 1974.
5. Systematic Experiments in Chemistry, Arun Sethi, New Age International, 2008.

Course Objectives:

1. To learn the experimental skills on quantitative analysis of specific substances in a given sample.

2. To have a hands on experience on the estimation of organic and inorganic substances in a given sample and on the separation techniques.

Course Outcomes:

After the successful completion of this course, the students will be able to;

1. Acquire experimental skills on quantitative analysis of specific substances in a given sample.

2. *Understand the procedure and skill for the estimation of organic and inorganic substances in a given sample and on the separation techniques*.

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