St Aloysius College (Autonomous)
Mangaluru

Re-accredited by NAAC "A^{++}" Grade

Course structure and syllabus of

B.Sc.

CHEMISTRY

Under NEP Regulations, 2021

¸À0vÀ C¯ÉÆÃ²AiÀÄ¸ï PÁ¯ÉÃdÄ
(¸ÁéAiÀÄvÀÛ)
ªÀÄ0UÀ¼ÀÆgÀÄ– 575 003, PÀ£ÁðlPÀ
www.staloysius.edu.in

ST ALOYSIUS COLLEGE (AUTONOMOUS)
P.B. NO. 720, MANGALURU – 575 003, KARNATAKA, INDIA
Phone: +91- 0824-4117701, 4117702, 4117703, 4117704
Email: principal@staloysius.edu.in
aloysius.principal@gmail.com

Re-accredited by NAAC with '**A++**' Grade with CGPA 3.67/4 (Cycle 4)
Recognised as Centre for Research Capacity Building under UGC-STRIDE Scheme
Recognised under DBT – BUILDER Scheme, Government of India
College with "STAR STATUS" Conferred by DBT, Government of India
Recognised by UGC as "College with Potential for Excellence"

Date: 21-12-2022

NOTIFICATION

Sub: Syllabus of **B.Sc. Chemistry** under NEP Regulations, 2021.
(As per Mangalore University guidelines)

Ref: 1. Decision of the Academic Council meeting held on 18-12-2021 vide Agenda No: 6
2. Decision of the Academic Council meeting held on 09-07-2022 vide Agenda No. 14
3. Decision of the Academic Council meeting held on 02-09-2023 vide Agenda No. 3
4. Office Notification dated 21-02-2022
5. Office Notification dated 17-08-2022
6. Office Notification dated 26-09-2023

Pursuant to the above, the Syllabus of **B.Sc. Chemistry** under NEP Regulations, 2021 which was approved by the Academic Council at its meeting held on 18-12-2021, 09-07-2021 & 02-09-2023 is hereby notified for implementation with effect from the academic year **2021-22**.

PRINCIPAL ST ALOYSIUS COLLEGE MANGALORE 575 003 AUTONOMOUS **REGISTRAR**

To:

1. The Chairman/Dean/HOD.
2. The Registrar Office
3. Library

A meeting of the Board of Study in UG CHEMISTRY was held on 20.11.2021

Following members were present for the meeting.

1. Dr Ronald Nazareth (Chairman)
2. Prof Jagadish Prasad
3. Dr Vishwanatha P
4. Ms Helen Serrao
5. Dr Richard Gonsalves
6. Dr Nandini Shet
7. Dr Ashwini
8. Dr Rachael Natasha Mary
9. Ms Deepa Vasanth
10. Ms Sahana
11. Ms Divya Deepthi
12. Ms Crystal Menezes
13. Dr Laveena Dsouza
14. Ms Apeksha – Student representative

MEMBERS OF BOARD OF STUDIES

Chairman

Dr Ronald Nazareth, St Aloysius College (Autonomous), Mangaluru - 575 003.

University Nominee

Prof Jagadish Prasad D, Department of Chemistry, Mangalore University, Mangalagangothri.

Meritorious Alumnus

Dr Manoj Mathews, Department of PG studies and Research in Chemistry, St. Joseph's College (Autonomous), Devagiri, Kozhikode, Kerala – 673 008.

Representative from Industry/corporate sector/Allied area

Ms Meghana, Integrated Product Development, Dr Reddy's Laboratories Limited, Telangana State.

Subject Experts

Dr Vishwanatha P**,** Associate Professor and Head, Department of Chemistry, SDM College (Autonomous), Ujire – 574 240.

Mrs Helen Serrao, Department of Chemistry, St Agnes College (Autonomous), Mangaluru – 575 002.

Members of the Department

Dr Richard A Gonsalves, St Aloysius College (Autonomous), Mangaluru

Dr Nandini Shet, St Aloysius College (Autonomous), Mangaluru

Dr Ashwini, St Aloysius College (Autonomous), Mangaluru

Dr Rachael Natash Mary, St Aloysius College (Autonomous), Mangaluru

Ms Deepa Vasanth, St Aloysius College (Autonomous), Mangaluru

Ms Sahana, St Aloysius College (Autonomous), Mangaluru

Ms Divya Deepthi Monteiro St Aloysius College (Autonomous), Mangaluru

Dr Roshan F D'Souza, St Aloysius College (Autonomous), Mangaluru

Ms Crystal Vivita Menezes, St Aloysius College (Autonomous), Mangaluru

Dr Laveena DSouza, St. Aloysius College (Autonomous), Mangaluru

Student Representative

Ms Mahima Rodrigues, II B.Sc, St Aloysius College (Autonomous), Mangaluru

A meeting of the Board of Study in UG CHEMISTRY was held on 22.02.2023

Following members were present for the meeting.

Chairman

Dr Ronald Aquin Nazareth, St Aloysius College (Autonomous), Mangaluru-575003.

University Nominee

Dr Mahagundappa R Maddani, Assistant Professor, Department of Chemistry Mangalore University Mangalagangothri -574199

Meritorious Alumnus

Mr Manoj Mathew, Assistant Professor, Research & PG Dept of Chemistry, St Josephs College (Autonomous), Devagiri, Kozhikode, Kerala-673008

Representative from Industry/ Corporate sector/ Allied area

Mr Reon Sylvester , Aragen Life Sciences Pvt Ltd, Survey No. 125 & 126, IDA Mallapur Hyderabad 500 076, India.

Subject Experts

Dr Edwin D'Souza, Assistant Professor, St Philomena College, Puttur

Dr A Chitharanjan Hegde, Professor, Department of Chemistry, NITK, Surathkal.

Members of the Department

Dr Richard Gonsalves, St Aloysius College (Autonomous), Mangaluru

Dr Nandini Shet, St Aloysius College (Autonomous), Mangaluru

Dr Ashwini, St Aloysius College (Autonomous), Mangaluru

Dr Rachael Natasha Mary, St Aloysius College (Autonomous), Mangaluru

Ms Deepa Vasanth, St Aloysius College (Autonomous), Mangaluru

Ms Sahana, St Aloysius College (Autonomous), Mangaluru

Dr Ranjitha , St Aloysius College (Autonomous), Mangaluru

Ms Divya Deepthi Monteiro, St Aloysius College (Autonomous), Mangaluru

Dr Roshan Fedrick D'Souza, St Aloysius College (Autonomous), Mangaluru

Ms Vilisha Rodrigues, St Aloysius College (Autonomous), Mangaluru

Dr Laveena Precilla D'Souza, St Aloysius College (Autonomous), Mangaluru

Ms Meghana, St Aloysius College (Autonomous), Mangaluru

Student Representative

Mr Glen Philip Sequeira, II Bsc, St Aloysius College (Autonomous), Mangaluru

STRUCTURE UNDER NEP

Course Code	Title of the course	Category of course	Teaching hours per week	ESE	CIA	Total Marks	Credits
SEMESTER I							
G 502 DC1.1	ANALYTICAL AND ORGANIC CHEMISTRY- I	DSC	4	60	40	100	4
G 502 DC2.1P	ANALYTICAL AND ORGANIC CHEMISTRY PRACTICALS-I	DSC	4	25	25	50	2
G 502 OE1.1	CHEMISTRY IN DAILY LIFE	OE	3	60	40	100	3
SEMESTER II							
G 502 DC1.2	INORGANIC AND PHYSICAL CHEMISTRY-I	DSC	4	60	40	100	4
G 502 DC2.2P	INORGANIC AND PHYSICAL CHEMISTRY PRACTICALS-I	DSC	4	25	25	50	2
G 502 OE1.2	MOLECULES OF LIFE	OE	3	60	40	100	3
SEMESTER III							
G 502 DC1.3	ANALYTICAL AND ORGANIC CHEMISTRY- II	DSC	4	60	40	100	4
G 502 DC2.3P	ANALYTICAL AND ORGANIC CHEMISTRY PRACTICALS-II	DSC	4	25	25	50	2
G 502 OE1.3	STRUCTURE, BONDING AND CONCEPTS IN ORGANIC CHEMISTRY	OE	3	60	40	100	3
SEMESTER IV							
G 502 DC 1.4	INORGANIC AND PHYSICAL CHEMISTRY-II	DSC	4	60	40	100	4
G 502 DC 2.4P	INORGANIC AND PHYSICAL	DSC	4	25	25	50	2

	CHEMISTRY PRACTICALS-II						
G 502 OE1.4	ELECTROCHEMISTRY, CORROSION AND METALLURGY	OE	3	60	40	100	3
SEMESTER V							
G 502 DC1.5	INORGANIC AND PHYSICAL CHEMISTRY-III	DSC	4	60	40	100	4
G 502 DC2.5P	INORGANIC AND PHYSICAL CHEMISTRY PRACTICALS-III	DSC	4	25	25	50	2
G 502 DC3.5	ORGANIC CHEMISTRY AND SPECTROSCOPY-I	DSC	4	60	40	100	4
G 502 DC4.5P	ORGANIC CHEMISTRY PRACTICALS	DSC	4	25	25	50	2
SEMESTER VI							
G 502 DC1.6	INORGANIC AND PHYSICAL CHEMISTRY-IV	DSC	4	60	40	100	4
G 502 DC2.6P	INORGANIC AND PHYSICAL CHEMISTRY PRACTICALS-IV	DSC	4	25	25	50	2
G 502 DC3.6	ORGANIC CHEMISTRY AND SPECTROSCOPY-II	DSC	4	60	40	100	4
G 502 DC4.6P	ORGANIC CHEMISTRY PRACTICALS	DSC	4	25	25	50	2

PATTERN OF THEORY QUESTION PAPERS

- Question Papers shall consist of Parts A, B and C
- The Syllabus of each paper shall be grouped into four (4) units.
- The question papers shall consist of Parts A, B and C containing questions drawn from each unit.
- Part A shall contain eight short answer type questions carrying 1 mark each drawn from each unit of the syllabus. All questions are to be answered.
- Part B shall contain ten questions carrying 3 marks each drawn from each unit of the syllabus. Eight questions are to be answered.
- Part C shall contain nine questions carrying 4 marks each drawn from each unit. Seven questions are to be answered.

Curriculum Structure for the Undergraduate Degree Program

BSc Chemistry (Discipline Specific Core)

Name of the Degree Program: B.Sc. **Discipline: Chemistry**

Program Articulation Matrix:

This matrix lists only the core courses. Core courses are essential to earn the degree in that discipline/subject. They include courses such as theory, laboratory, project, internships *etc*.

Semester	Title /Name Of the course	Assessment
1	**DSC-1: Analytical and Organic Chemistry-I**	Internal Exams, Continuous Evaluation, Sem Exams
	DSC lab-1: Analytical and Organic Chemistry Practicals-I	Internal Exams, Continuous Evaluation, Sem Exams
2	**DSC-2: Inorganic and Physical Chemistry-I**	Internal Exams, Continuous Evaluation, Sem Exams
	DSC Lab -2: Inorganic and Physical Chemistry Practicals-I	Internal Exams, Continuous Evaluation, Sem Exams
3	**DSC-3: Analytical and Organic Chemistry-II**	Internal Exams, Continuous Evaluation, Sem Exams
	DSC Lab-3: Analytical and Organic Chemistry Practicals-II	Internal Exams, Continuous Evaluation, Sem Exams
4	**DSC-4: Inorganic and Physical Chemistry-II**	Internal Exams, Continuous Evaluation, Sem Exams
	DSC Lab-4: Inorganic and Physical Chemistry Practicals-II	Internal Exams, Continuous Evaluation, Sem Exams
5	**DSC-5: Inorganic and Physical Chemistry-III**	Internal Exams, Continuous Evaluation, Sem Exams

	DSC Lab-5: Inorganic and Physical Chemistry Practicals- III	Internal Exams, Continuous Evaluation, Sem Exams
	DSC-6: Organic Chemistry and spectroscopy-I	Internal Exams, Continuous Evaluation, Sem Exams
	DSC Lab -6: Organic Chemistry Practicals	Internal Exams, Continuous Evaluation, Sem Exams
6	**DSC -7: Inorganic and Physical Chemistry-IV**	Internal Exams, Continuous Evaluation, Sem Exams
	DSC Lab-7: Inorganic and Physical Chemistry Practicals- IV	Internal Exams, Continuous Evaluation, Sem Exams
	DSC-8: Organic Chemistry and Spectroscopy-II	Internal Exams, Continuous Evaluation, Sem Exams
	DSC Lab -8: Organic Chemistry Practicals	Internal Exams, Continuous Evaluation, Sem Exams

COURSE CONTENTS

FIRST SEMESTER	
DSC-1: ANALYTICAL AND ORGANIC CHEMISTRY- I	**56 Hours**
UNIT I	
Introduction to Analytical Chemistry	2 h
Errors in Quantitative Analysis	3 h
Basic Laboratory practices	3 h
General Purification Techniques	6 h
UNIT II	
Titrimetric Analysis	10 h
Gravimetric Analysis	4 h
UNIT III	
Nature of bonding in Organic Molecules	4 h
Mechanism of organic reactions	2 h
Reactive Intermediates	4 h
Carbon-Carbon pi bonds	4 h
UNIT IV	
Dienes	4 h
Nucleophilic substitution at saturated carbon	4 h
Aromatic Electrophilic substitution reaction	3 h
Aromatic Nucleophilic substitution reaction	3 h
DSC LAB-1: ANALYTICAL AND ORGANIC CHEMISTRY PRACTICALS-I	
SECOND SEMESTER	
DSC-2: INORGANIC AND PHYSICAL CHEMISTRY-I	**56 Hours**
Unit I	
Quantum Mechanics- I	14 h
UNIT II	
Chemistry of s block elements	8 h
Chemistry of p block elements	6 h
UNIT III	
Gaseous state	8 h
Liquid state	6 h

UNIT IV	
Liquid Crystals	4 h
Solid state	10 h
DSC LAB - 2: INORGANIC AND PHYSICAL CHEMISTRY PRACTICALS-I	
THIRD SEMESTER	
DSC-3: ANALYTICAL AND ORGANIC CHEMISTRY- II	**56 Hours**
Unit I	
Quantitative Analysis- Instrumental Methods	8 h
Flame Photometry	2 h
Nephelometry and Turbidimetry	4 h
Unit II	
Separation Methods: Chromatography	10 h
Solvent Extraction	4 h
Unit III	
Polynuclear Aromatic Hydrocarbons	4 h
Reaction intermediates	7 h
Methods for Identifying reaction mechanism	3 h
Unit IV	
Stereochemistry of Organic Compounds	14 h
DSC LAB-3: ANALYTICAL AND ORGANIC CHEMISTRY PRACTICALS-II	
FOURTH SEMESTER	
DSC-4: INORGANIC AND PHYSICAL CHEMISTRY-II	**56 Hours**
Unit I	
Structure and Bonding I	3 h
Classification of Ionic structures	7 h
Covalent Bond	4 h
Unit II	
Structure and Bonding II	3 h
Molecular Orbital Theory	7 h
Metallic Bonding	4 h
Unit III	
First law of Thermodynamics	4 h
Second law of Thermodynamics	4 h

Third law of Thermodynamics	2 h
Surface Chemistry	4 h
Unit IV	
Chemical Kinetics	7 h
Electrochemistry I	7 h
DSC LAB - 4: INORGANIC AND PHYSICAL CHEMISTRY PRACTICALS-II	
FIFTH SEMESTER	
DSC-5: INORGANIC AND PHYSICAL CHEMISTRY-III	**56 Hours**
UNIT I	
Chemistry of *d*-block and *f*-block	7 h
Chemical bonding	7 h
UNIT II	
Coordination compounds	10 h
HSAB concept	4 h
UNIT III	
Dilute Solutions and Colligative Properties	6 h
Electrochemistry II	8 h
UNIT IV	
Nuclear Chemistry	6 h
Quantum mechanics -II	8 h
DSC LAB-5: INORGANIC AND PHYSICAL CHEMISTRY PRACTICALS-III	
DSC-6: ORGANIC CHEMISTRY AND SPECTROSCOPY	**56 Hours**
Unit I	
Heterocyclic compounds	14 h
UNIT II	
Carbohydrates	8 h
Amino acids and peptides	6 h
UNIT III	
Molecular spectroscopy	2 h
Rotational spectroscopy	4 h
Vibrational spectroscopy	5 h
Raman spectroscopy	3 h
UNIT IV	

Nuclear Magnetic Resonance (NMR) spectroscopy	8 h
UV spectroscopy	6 h
DSC LAB - 6: ORGANIC CHEMISTRY PRACTICALS	
SIXTH SEMESTER	
DSC -7: INORGANIC AND PHYSICAL CHEMISTRY-IV	**56 Hours**
UNIT I	
Metal-Ligand equilibria in solution	10 h
Bioinorganic Chemistry	4 h
Unit II	
Electronic spectra of coordination compounds	12 h
Magnetic properties of coordination compounds	2 h
UNIT III	
Binary Mixtures	4 h
Phase Equilibrium	5 h
Thermo-analytical methods	5 h
UNIT IV	
Radiation Chemistry	6 h
Chemical Dynamics II	8 h
DSC LAB-7: INORGANIC AND PHYSICAL CHEMISTRY PRACTICALS-IV	
DSC -8: ORGANIC CHEMISTRY AND SPECTROSCOPY	**56 Hours**
Unit I	
Aromatic Substitution Reactions	7 h
Vitamins	7 h
UNIT II	
Addition reactions	4 h
Rearrangements	5 h
Synthetic Polymers	5 h
UNIT III	
Symmetry and Group Theory in Chemistry:	6 h
Photochemistry	8 h
UNIT IV	
Photoelectron Spectroscopy	3 h
Electron Paramagnetic Resonance Spectroscopy	8 h

Atomic Absorption Spectroscopy	3 h
DSC LAB 8: ORGANIC CHEMISTRY PRACTICALS	

BSc Chemistry (Discipline Specific Core)

FIRST SEMESTER

Course Title: **DSC-1: Analytical and Organic Chemistry-I**	
Course Code: G 502 DC1.1	
Total Contact Hours: 56	Course Credits: 4
Formative Assessment Marks: 40	Duration of ESA/Exam: 2.5 hrs
Summative Assessment Marks: 60	

Course Outcomes (COs): At the end of the course the student should be able to understand,

CO 1: The concepts of chemical analysis, accuracy, precision and statistical data treatment.

CO 2: The errors in chemical analysis and methods of minimizing.

CO 3: The preparation of standard solutions and dilution of stock solution.

CO 4: The concept of volumetric and gravimetric analysis and deducing the conversion factor for determination.

CO 5: General purification techniques and different types of chromatographic methods.

CO 6: Handling of toxic chemicals, concentrated acids and organic solvents and practice safety procedures.

CO 7: The concepts of organic reactions and techniques of writing the movement of electrons, bond breaking, bond forming and reactive intermediates involved.

CO 8: The concepts of aromaticity, resonance and hyperconjugation.

CO 9: Understand the preparation of alkanes, alkenes, dienes and their reactions.

CO 10: Understand the mechanism of nucleophilic, electrophilic reactions.

Unit – I

Introduction to Analytical Chemistry **2 Hrs**

Language of analytical chemistry: Definitions of analysis, determination, measurement, techniques and methods. Classification of analytical techniques. Qualitative analysis; Sample size and techniques - macro, semi-micro and micro. Type of tests - wet, dry and spot tests (terms, definition and examples) Quantitative analysis - Volumetry, Gravimetry and Instrumental analytical methods.

Errors in quantitative analysis **3 Hrs**

types of errors - determinate and indeterminate, methods of minimizing errors. Accuracy - absolute error, relative error. Precision – mean deviation, relative mean deviation, standard deviation, t-test, F-test and Q-test. Significant figures. Rules for computation of results; Problems.

Basic laboratory practices **3 Hrs**

Calibration of glassware (pipette, burette and volumetric flask), Sampling (solids and liquids), weighing, drying, dissolving, Acid treatment, Rules of work in analytical laboratory, General rule for performing quantitative determinations (volumetric and gravimetric), Safety in Chemical laboratory, Rules of fire prevention and accidents, First aid.

General purification techniques **6 Hrs**

sublimation, distillation – types; crystallization – Principle with examples; applications.

Chromatography - Introduction; classification - types of chromatography, partition and adsorption, Rf value. Chromatographic methods for the separation, concentration and identification of organic compounds - Thin layer, paper and column chromatography principles. Solvent extraction - basic principles and applications.

Nernst distribution law - definition and its derivation; Partition coefficient; Distribution constant, factors affecting distribution constant, validity of Distribution Law, Modification of distribution law when molecules undergo (a) association (b) dissociation.

Unit – II

Titrimetric analysis **10 Hrs**

Basic principle of titrimetric analysis. Classification, Preparation and dilution of reagents/solutions. Normality, Molarity and Mole fraction. Use of $N_1V_1 = N_2V_2$ formula, Preparation of ppm level solutions from source materials (salts). Standard solutions – primary and secondary standards

Acid-base titrimetry: Titration curves for strong acid vs strong base, weak acid vs strong base and weak base vs strong acid titrations; Indicators.

Complexometric titrimetry: Indicators for EDTA titrations - theory of metal ion indicators, titration methods employing EDTA - direct, back, displacement and indirect determinations; Application-determination of hardness of water.

Redox titrimetry: Balancing redox equations ($KMnO_4$ vs oxalic acid; $K_2Cr_2O_7$ *vs* Mohr's salt), calculation of the equilibrium constant of redox reactions, titration curves; Redox indicators; calculation of standard potentials using Nernst equation. Applications.

Precipitation titrimetry: Titration curves, titrants and standards, indicators for precipitation titrations involving silver nitrate - Volhard's and Mohr's methods and their differences.

Gravimetric Analysis: **10 Hrs**

Requisites of precipitation, mechanism of precipitation, Factors influencing precipitation, co-precipitation, post-precipitation; Advantages of organic reagents over inorganic reagents, reagents used in gravimetry (8-hydroxyquinoline and dimethylglyoxime).

Unit – III **4 Hrs**

Classification and nomenclature of organic compounds, Hybridization (sp^3, sp^2 and sp); Shapes of organic molecules, Influence of hybridization on bond properties.

Nature of bonding in Organic molecules

Formation of Covalent bond, Types of chemical bonding, localized and delocalized, conjugation and cross conjugation, concept of resonance, electronic displacements: Inductive effect, Electromeric effect, Resonance effect and Hyperconjugation - explanation with examples. Concept of aromaticity, Huckel rule, anti-aromaticity explanation with examples. Strengths of Organic acid and bases - comparative study with emphasis on factors effecting pK values. Relative strength of aliphatic and aromatic carboxylic acids - acetic acid and chloroacetic acid, acetic acid and propionic acid, acetic acid and benzoic acid, aliphatic and aromatic amines. Steric effect.

Mechanisms of Organic Reactions **2 Hrs**

Notations used to represent electron movements and directions of reactions – Types of arrows (curved, fish-hook, double headed), formal charges. Types of bonds breaking - homolytic and heterolytic. Types of reagents - Electrophiles, nucleophiles, nucleophilicity and basicity. Types of organic reactions - substitution, addition, elimination, rearrangement reactions; explanation with examples.

Reactive intermediates **4 Hrs**

Carbocations, carbanion, free radicals, formation and their order of stability. Rearrangement of carbocations, 1,2-hydride and 1,2-methyl shift (by taking dehydration of 2-methylbutan-1-ol and 3,3-dimethyl-2-butanol as examples). Preparation of carbenes, concept of singlet and triplet carbene. Addition reactions of singlet and triplet carbenes. Concept of nitrenes and benzyne.

Carbon-carbon pi bonds **4 Hrs**

Formation of alkenes by elimination reaction. Mechanism of E1, E2 reactions. Saytzeff and Hofmann eliminations. Addition of HBr to propene, Free radical addition of HBr to propene. Addition of halogens to alkenes - carbocation and halonium ion mechanism. Stereospecificity of halogen addition. Ozonolysis (ethene and propene); Addition of hydrogen halides to alkenes, mechanism. Hydrogenation, hydration, hydroxylation and epoxidation of alkenes, explanation with examples.

Unit – IV

Dienes **4 Hrs**

Nomenclature, classification - isolated, conjugated and cumulated; Structure - hybridization; methods of preparation of 1,3-butadiene – dehydration and dehydrohalogenation. Addition reactions of 1,3-butadiene - polymerization; Mechanism of 1,2- and 1,4- addition of bromine and hydrogen bromide, effect of temperature, free radical addition to 1,3-butadiene; Diels-Alder reaction and its importance; 1,3-Dipolar cycloaddition and pericyclic reactions – explanation with examples.

Nucleophilic substitution at saturated carbon **4 Hrs**

Mechanism of S_N1 and S_N2 reactions with suitable examples (hydrolysis of *t*-butyl bromide and methyl bromide, respectively). Energy profile diagrams, Stereochemistry and factors effecting S_N1 and S_N2 reactions. Neighbouring group participation.

Aromatic Electrophilic substitution reactions **3 Hrs**

Mechanisms, σ and π complexes, Halogenation, Nitration, Sulphonation, Friedel Crafts alkylation and acylation with their mechanism. Activating and deactivating groups. Orientation influence, *ortho-para* ratio.

Aromatic nucleophilic substitution reaction **3 Hrs**

S_NAr and Benzyne mechanism with suitable examples. Relative reactivities of alkyl halides *vs* allyl, vinyl and aryl halide.

References:

1. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt.Ltd.(2007).
2. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York (2005).
3. Analytical Chemistry, G.D. Christian, 6th edition, Wiley-India (2007).
4. Practical Volumetric Analysis, Peter A C McPherson, Royal Society of Chemistry, Cambridge, UK (2015).
5. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Finar, I. L. Organic Chemistry (Volume I), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
7. McMurry, J. E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
8. Organic Reaction mechanism by V. K. AhIuwalia and K. Parashar (Narosa Publishers).
9. Organic Chemistry by S. M. Mukherji, S. P. Singh and R. K. Kapoor. (Narosa Publishers)
10. A Guide book to mechanism in Organic Chemistry by Peter sykes. Pearson.
11. Advanced Organic Chemistry by J. Singh, L. D. S. Yadav (Pragati Prakashan).
12. A Textbook of Organic Chemistry by A. Bahl and B. S. Bahl, 22nd Edition, 2019 (S. Chand Publications).

DSC LAB-1: ANALYTICAL AND ORGANIC CHEMISTRY PRACTICALS

Course Title: **DSC LAB-1: Analytical and Organic Chemistry Practicals-I**	
Course Code: **G 502 DC2.1P**	
Total Contact Hours: 4 hrs /week	Course Credits: 2
Formative Assessment Marks: 25	Duration of ESA/Exam: 4 hrs
Summative Assessment Marks: 25	

PART – A Analytical Chemistry

1. Calibration of glassware, pipette, burette and volumetric flask.
2. Preparation of standard decinormal solution of sodium carbonate and standardization of hydrochloric acid and estimation of sodium hydroxide in solution.
3. Preparation of standard decinormal solution of potassium biphthalate and standardization of sodium hydroxide solution and estimation of hydrochloric acid in solution.
4. Determination of oxalic acid and sodium oxalate / sulfuric acid in a given mixture using standard $KMnO_4$/NaOH solution.
5. Preparation of standard decinormal solution oxalic acid and standardization of potassium permanganate solution and estimation of Mohr's salt in solution.
6. Preparation of standard decinormal solution of ferrous ammonium sulphate (Mohr's salt) and standardization of potassium dichromate solution and estimation of ferric chloride in solution.
7. Estimation of ferrous and ferric in a mixture.
8. Determination of sodium carbonate and sodium bicarbonate in a mixture.
9. Determination of alkali content in antacid tablet using HCl.
10. Determination of alkali present in soaps/detergents.
11. Standardization of EDTA solution and determination of hardness of water.
12. Standardization of silver nitrate and determination of chloride in a water sample (demonstration).
13. Determination of chlorine in bleaching powder using iodometric method.

PART - B Organic Chemistry

1. Selection of suitable solvents for Purification/Crystallization of organic compounds.
2. Preparation of acetanilide from aniline using Zn/acetic acid (Green method).
3. Synthesis of p-nitro acetanilide from acetanilide using nitrating mixture.
4. Bromination of acetanilide (i) Conventional method and/or (ii) with ceric ammonium nitrate and potassium bromide (Green method).
5. Hydrolysis of methyl *m*-nitrobenzoate to *m*-nitrobenzoic acid (Conventional method)
6. Synthesis of diazoaminobenzene from aniline (conventional method).
7. Preparation of dibenzalacetone (Green method).
8. Diels Alder reaction between furan and maleic acid (Green method).

BSc Semester 1

Title of the Course: OE-1: CHEMISTRY IN DAILY LIFE Course Code: G 502 OE1.1

Number of Theory Credits	Number of lecture hours / semester	Number of practical credits	Number of practical hours/semester
3	42	-	-

Unit – I 14 Hrs

Dairy Products: Composition of milk and milk products. Analysis of fat content, minerals in milk and butter. Estimation of added water in milk. Beverages: Analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy, determination of methyl alcohol in alcoholic beverages.

Food additives, adulterants, and contaminants- Food preservatives like benzoates, propionates, sorbates, disulphites. Artificial sweeteners: Aspartame, saccharin, dulcin, sucralose, and sodium cyclamate. Flavors: Vanillin, alkyl esters (fruit flavors), and monosodium glutamate.

Artificial food colorants: Coal tar dyes and non-permitted colors and metallic salts. Analysis of pesticide residues in food.

Unit – II 14 Hrs

Vitamins: Classification and Nomenclature. Sources, deficiency diseases, and structures of Vitamin A1, Vitamin B1, Vitamin C, Vitamin D, Vitamin E & Vitamin K1.

Oils and fats: Composition of edible oils, detection of purity, rancidity of fats and oil. Tests for adulterants like argemone oil and mineral oils. Halphen test.

Soaps & Detergents: Definition, classification, manufacturing of soaps and detergents, composition and uses.

Unit – III 14 Hrs

Chemical and Renewable Energy Sources: principles and applications of primary & secondary batteries and fuel cells. Basics of solar energy, future energy storer.

Polymers: Basic concept of polymers, examples for polymers with their monomers, Classification of polymers according to mechanical properties, General classification (thermosetting and thermoplastic; condensation and addition polymers), organic polymers, inorganic polymers, copolymers (definition with examples) Applications of polymers– plastics, elastomers, fibres medical fields. Problems of plastic waste management. Strategies for the development of environment-friendly polymers.

References:

1. B. K. Sharma: Introduction to Industrial Chemistry, Goel Publishing, Meerut (1998).
2. Medicinal Chemistry- Ashtoush Kar.
3. Analysis of Foods – H.E. Cox: 13.
4. Chemical Analysis of Foods – H.E. Cox and Pearson.
5. Foods: Facts and Principles. N. Shakuntala Many and S. Swamy, 4thed. New Age International (1998)
6. Physical Chemistry – P l Atkins and J. de Paula – 7thEd. 2002, Oxford University Press.
7. Handbook on Fertilizer Technology by Swaminathan and Goswamy, 6th ed. 2001, FAI.
8. Organic Chemistry by I. L. Finar, Vol. 1 & 2. 9. Polymer Science and Technology, J. R. Fired (Prentice Hall).

Pedagogy

Formative Assessment	
Assessment Occasion/ type	**Weightage in Marks**
Internal Test	40
Sem End Exam	60
Total	100

SECOND SEMESTER

Course Title: **DSC-1: Inorganic and Physical Chemistry-I**	
Course Code: G 502 DC1.2	
Total Contact Hours: 56	Course Credits: 4
Formative Assessment Marks: 40	Duration of ESA/Exam: 2.5 hrs
Summative Assessment Marks: 60	

Course Outcomes (COs): At the end of the course the student should be able to understand,

CO 1: Basics of Quantum mechanics, quantum numbers and its significance

CO 2: Rules governing electronic configuration of elements

CO 3: Variation in properties of s and p block elements

CO 4: Deviation of real gases from ideal gases.

CO 5: Molecular velocities associated with gases

CO 6: Properties of liquids and its determination.

CO 7: Concept of refractive index and its determination

CO 8: Different types of crystal systems.

CO 9: The structure of liquid crystals and its applications.

Unit – I

Quantum Mechanics-I **14 Hrs**

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance.

Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of *s*, *p*, *d* and *f* orbitals. Contour boundary and probability diagrams.

Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations- Electronic configurations of the elements (Z=1-30), effective nuclear charge,

shielding/screening effect, Slater's rules. Variation of effective nuclear charge in Periodic Table.

Unit - II

s and *p* block elements 8 Hrs

Variation of the following properties with reference to *s* and *p*-block elements: atomic radii (van der Waals); ionic and crystal radii; covalent radii; ionization enthalpy - successive ionization enthalpies and factors affecting ionization energy - applications of ionization enthalpy; electron gain enthalpy – trends; electronegativity - Pauling's, Mulliken's, Allred Rachow's and Mulliken-Jaffé's electronegativity scales - variation of electronegativity with bond order, partial charge, hybridization.

Chemistry of *s*-Block Elements

Hydrogen - isotopes; hydrides – types (ionic, covalent, interstitial, polymeric, complex), preparation and properties; structure of NaH and BeH_2; applications of complex hydrides ($LiAlH_4$, $NaBH_4$). Comparison of standard reduction potentials and reducing properties of alkali metals and alkaline earth metals. Complexation tendencies of alkali metals with crown ether, cryptates. Diagonal relationship - reasons for diagonal relationship, comparison of the properties of Li with Mg and Be with Al.

Chemistry of *p*-Block Elements 6 Hrs

Comparative study of *p*-Block elements and their compounds. Boranes – Diborane (Preparation, properties, structure and bonding), B_4H_{10}, B_5H_9 - structure; Styx number, Wade's rule – closo-, nido- and arachno-boranes. Silicates - types, basic units, structure and applications of zeolites. Noble gases - structure and bonding in Clathrates, XeF_2, XeF_4, XeF_6 and XeO_3.

Unit – III

Gaseous State 8 Hrs

Elementary aspects of kinetic theory of gases, Ideal and real gases. Boyle temperature (derivation not required), Molecular velocity, collision frequency, collision diameter, Collision cross section, collision number and mean free path and coefficient of viscosity, calculation of σ and η, variation of viscosity with temperature and pressure.

Maxwell's Boltzmann distribution law of molecular velocities (Most probable, average and root mean square velocities). Relation between RMS, average and most probable velocity and

average kinetic energies. (Mathematical derivation not required), law of equipartition of energy.

Behaviour of real gases: Deviation from ideal gas behaviour. Compressibility factor (Z) and its variation with pressure for different gases. Causes of deviation from ideal behaviour, vander Waals equation of state (no derivation) and application in explaining real gas behaviour. Critical phenomena - Andrews isotherms of CO_2, critical constants and their calculation from van der Waals equation, Continuity of states, Law of corresponding states. Numerical problems.

Liquid State **6 Hrs**

Surface Tension: Definition and its determination using stalagmometer, effect of temperature and solute on surface tension.

Viscosity: Definition, Coefficient of viscosity. Determination of viscosity of a liquid using Oswald viscometer. Effect of temperature, size, weight, shape of molecules and intermolecular forces.

Refraction: Specific and molar refraction - definition and advantages. Determination of refractive index by Abbes Refractometer. Additive and constitutive properties.

Parachor: Definition, Atomic and structure parachor; Elucidation of structure of benzene and benzoquinone. Viscosity and molecular structure. Molar refraction and chemical constitution**.**

Unit – IV

Liquid Crystals **4 Hrs**

Explanation, classification with examples - Smetic, nematic, cholesteric, disc shaped and polymeric. Structures of nematic and cholesteric phases - molecular arrangements in nematic and cholesteric liquid crystals. Applications of liquid crystals in LCD's and thermal sensing.

Solid state **10 Hrs**

Forms of solids: Unit cell and space lattice, anisotropy of crystals, size and shape of crystals, Laws of Crystallography: Law of constancy of interfacial angles, Law of rational indices, Law of symmetry; Symmetry elements – Types: (a) axis of symmetry (b) plane of symmetry (c) centre of symmetry - definition and explanation taking cubic crystal system as an example. Crystal systems, Bravais lattice types and identification of lattice planes. Miller indices and its calculation, X–Ray diffraction by crystals: Bragg's law and derivation of Bragg's equation, Single crystal and powder diffraction methods. Cesium Chloride, Zinc blende structures. Defects in crystals, glasses and liquid crystals. Numerical problems.

References:

1. Concise Inorganic Chemistry: J D Lee, 4th Edn, Wiley, (2021)
2. Fundamentals Concepts of Inorganic Chemistry, Vol 1 and 2, 2nd Edition, Asim K Das, CBS Publishers and Distributors, (2013)
3. Basic Inorganic Chemistry, F A Cotton, G Wilkinson and P. L. Gaus, 3rd Edition. Wiley. India
4. Inorganic Chemistry, 2nd Edn. Catherine E. Housecroft and A.G. Sharpe, Pearson Prentice Hall (2005)
5. Atkins Physical Chemistry.8th Edition. Peter Atkins & Julio De Paula Oxford University Press.
6. Physical Chemistry by Samuel Glasstone, ELBS (1982).
7. A Text book of Physical Chemistry, A S Negi & S C Anand, New Age International Publishers (2007).
8. Principles of Physical Chemistry, Puri, Sharma & Pathania, Vishal Publishing Co.
9. A Text Book of Physical Chemistry P.L.Soni , O.P. Dharmarhaand and U.N.Dash, Sultan Chand and Sons.
10. Advanced Physical Chemistry, Gurdeep Raj, Goel Publishing House (2018).

DSC LAB-2: INORGANIC AND PHYSICAL CHEMISTRY PRACTICALS

Course Title: **DSC LAB-2: Inorganic and Physical Chemistry Practicals-I**	
Course Code: **G 502 DC2.2P**	
Total Contact Hours: 4 hrs /week	Course Credits: 2
Formative Assessment Marks: 25	Duration of ESA/Exam: 4 hrs
Summative Assessment Marks: 25	

PART-A Inorganic Chemistry

Gravimetry

1. Determination of Ba^{2+} as $BaSO_4$
2. Determination of Cu^{2+} as CuSCN
3. Determination of Fe^{2+} as Fe_2O_3
4. Determination of Ni^{2+} as $Ni(DMG)_2$ complex.
5. Determination of Chloride/Silver as AgCl.
6. Determination of Magnesium as oxinate.

PART-B Physical Chemistry

1. Determination of density using specific gravity bottle and viscosity of liquids using Ostwald's viscometer (Ethyl acetate, Toluene, Chloroform, Chlorobenzene or any other non-hazardous liquids)
2. Study of the variation of viscosity of sucrose solution / Glycerol-water mixture with the concentration of solute / mixture.
3. Determination of the density using specific gravity bottle and surface tension of liquids using Stalagmometer (Ethyl acetate, Toluene, Chlorobenzene, any other non-hazardous liquids
4. Study of variation of surface tension of detergent solution with concentration.
5. Determination of the composition of liquid mixture by refractometry (Toluene & Alcohol, Water & Sucrose).
6. Determination of partition/distribution coefficient - i) Acetic acid in water and cyclohexane. ii) Acetic acid in Water and Butanol. iii) Benzoic acid in water and toluene.

BSc Semester 2

Title of the Course: OE – 2: Molecules of Life **Course Code: G 502 OE1.2**

Number of Theory Credits	Number of lecture hours/semester	Number of Practical Credits	Number of practical hours/ semester
3	42	-	-

Unit – I

14 Hrs

Carbohydrates

Classification of carbohydrates, reducing and non-reducing sugars; General properties of glucose and fructose, their open chain structures. Epimers, mutarotation and anomers.

Linkage between monosaccharides, structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation.

Amino Acids, Peptides and Proteins

Classification of amino acids, Zwitterion structure and Isoelectric point, acid-base properties of amino acids. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determination of primary structure of peptides, ion -exchange chromatography.

Unit - II 14 Hrs

Enzymes and correlation with drug action

Mechanism of enzyme action, factors affecting enzyme action, Co-enzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereospecificity).

Enzyme inhibitors and their importance, phenomenon of inhibition (Competitive and Non-competitive inhibition including allosteric inhibition).

Drug action

General principles of drug action, receptor theory. Structure–activity relationships of drug molecules, binding role of –OH group, -NH_2 group, double bond and aromatic ring.

Lipids

Introduction to lipids, classification. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).

Unit - III 14 Hrs

Nucleic Acids

Components of nucleic acids: Adenine, guanine, thymine and cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation.

Concept of Energy in Biosystems

Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells. Introduction to Metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis and free energy change. Conversion of food into energy. Outline of catabolic pathways of Carbohydrate - Glycolysis, Fermentation, Krebs Cycle. Overview of catabolic pathways of Fats and Proteins. Interrelationships in the metabolic pathways of Proteins, Fats and Carbohydrates.

References:

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. *Organic Chemistry* (*Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

4. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.*

5. W. H. Freeman. Berg, J.M., Tymoczko, J.L. & Stryer, L. *Biochemistry*, 2002.

Pedagogy

Formative Assessment	
Assessment Occasion/ type	**Weightage in Marks**
Internal Test	40
Sem End Exam	60
Total	100

THIRD SEMESTER

Course Title: **DSC-3: Analytical and Organic Chemistry-II**	
Course Code: G 502 DC1.3	
Total Contact Hours: 56	Course Credits: 4
Formative Assessment Marks: 40	Duration of ESA/Exam: 2.5 hrs
Summative Assessment Marks: 60	

Course Outcomes (COs): At the end of the course the student should be able to understand,

CO-1: Interrelationship among frequency, wavelength and wave number and importance of validation parameters of an instrumental method.

CO-2: Principle, instrumentation and applications of spectrophotometry, nephelometry and turbidometry

CO-3: Fundamentals of separation methods and principles of paper, thin layer and column chromatography.

CO-4: Learn types of solvent extraction and their applications.

CO-5: Learn nomenclature and reactions of polynuclear aromatic compounds.

CO-6: Concept and importance of intermediates in organic chemistry

CO-7: Concept of stereochemistry and its importance

CO-8: The various projection formulae and the techniques of designating the molecules into R, S, D, L nomenclature.

Unit – I

Quantitative analysis-Instrumental methods **8 Hrs**

Electromagnetic spectrum, absorption of electromagnetic radiation, Definition and units of frequency, wavelength, wave number, Beer's law, Beer-Lambert law derivation, deviations from Beer's law, limitations, construction of calibration graph (Plot of absorbance versus concentration), Evaluation Procedures- standard addition, Internal standard addition, validation parameters-detection limits, sensitivity, dynamic/linearity range, Instrumentation, single beam and double beam spectrophotometers, quantitative applications of colorimetry (determination of Fe, Mo, Cu, Ti and PO_4^{3-}) and numerical problems on Beer's law.

Flame Photometry **2 Hrs**

Principle, Flames used (fuel-oxidant mixtures), Instrumentation, types of burners- Total consumption burner and Laminar flow burner. Qualitative applications; Limitations of Flame Photometry.

Nephelometry and Turbidimetry **4 Hrs**

Introduction, principle, instrumentations of nephelometry and turbidimetry; effects of concentration, particle size and wavelength on scattering; choice between nephelometry, applications of nephelometry and turbidimetry (determination of SO_4^{2-} and PO_4^{3-})

Unit – II

Separation Methods: Chromatography **10 hrs**

Fundamentals of chromatography: General description, definition, terms and parameters used in chromatography, classification of chromatographic methods, criteria for selection of stationary and mobile phase and nature of adsorbents...

Paper chromatography: Principle, Significance of Rf value and applications.

Column chromatography: Principle, Column efficiency, factors affecting the column efficiency, van Deemter's equation and its modern version

Thin layer chromatography (TLC):

Mechanism, Rf value, efficiency of TLC plates, methodology–selection of stationary and mobile phases, development, spray reagents, identification and detection, qualitative applications.

Ion exchange chromatography:

resins, types with examples- cation exchange and anion exchange resins, mechanism of cation and anion exchange process and applications of ion-exchange chromatography (softening of hard water, separation of lanthanides, industrial applications).

Solvent Extraction: **4 hrs**

Types- batch, continuous, efficiency, selectivity, distribution coefficient, Nernst distribution law, derivation, factors affecting the partition, relationship between % extraction and volume fraction, Numerical problems on solvent extraction. Solvent extraction of iron and copper.

Unit – III

Polynuclear Aromatic Hydrocarbons **4 Hrs**

Examples. Naphthalene – nomenclature of naphthalene derivatives, structure of naphthalene, method of preparation from 4-phenyl-1-butene and Haworth synthesis. Electrophilic

substitution reactions of naphthalene- nitration, sulphonation and Friedel crafts reactions. Reduction and oxidation, structure of anthracene and phenanthrene.

Reaction Intermediates: 7 Hrs

i) Carbocations: Dienone-phenol; and Baeyer-Villiger rearrangement, Beckmann rearrangement.

ii) Carbanions: Perkin Reaction, Aldol condensation, Claisen-Schmith condensation, Knoevenagel condensation.

iii) Free Radicals: Sandmeyer Reaction, Birch reduction, Antimarkownikoff's addition,Wurtz Reaction

iv) Carbenes – Reimer Tiemann reaction, Arndt-Eistert Synthesis

v) Nitrenes: Singlet and Triplet states, their relative stability and Curtius reaction

vi) Arynes: Formation, detection etc, nucleophilic substitution of p-chloro toluene with sodamide

Methods for Identifying Reaction Mechanism 3 Hrs

Product analysis, Isolation and Identification of Intermediates, Stereochemical Evidences, Effect of Catalyst, cross over Experiments, Isotopic studies, Kinetic Studies

Unit –IV

Stereochemistry of Organic Compounds 14 Hrs

Fischer projection, Newmann and Sawhorse projection formulae and their interconversions.

Geometric isomerism (*cis-trans* and *syn-anti* isomerism). Determination of configuration of geometric isomers (dipole moment, melting point and ring formation). E & Z system of nomenclature with C.I.P rules, geometric isomerism in oximes and alicyclic compounds.

Optical isomerism, plane of symmetry, Optical activity, Specific rotation, molecular chirality/asymmetry, stereo genic center, chiral and achiral molecules, enantiomers, properties of enantiomers, molecules with two or more chiral centers, optical activity in Example -Lactic acid and Tartaric acid. Diastereomers, threo and erythro diastereomers, meso structures, resolution of enantiomers (mechanical, Biochemical and chemical), inversion, and racemization, racemic mixture and resolution. Relative and absolute configuration, sequence rules, D/L, R/S systems of nomenclature.

Conformational isomerism — conformational analysis of ethane and 1,2-dichloroethane. Conformations of cyclohexane (Newman projection). Difference between configuration and conformation.

References:

1. Instrumental Methods of Chemical Analysis by Gurdeep R Chatwal, Sham Anand.
2. Instrumental Methods of Chemical Analysis, H Kaur, Pragathi Prakashan (2014).
3. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt.Ltd.(2007).
4. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York (2005).
5. Analytical Chemistry, G.D. Christian, 6th edition, Wiley-India (2007).
6. Practical Volumetric Analysis, Peter A C McPherson, Royal Society of Chemistry, Cambridge, UK (2015).
7. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
8. Finar, I. L. Organic Chemistry (Volume I), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
9. Organic Reaction mechanism by V. K. AhIuwalia and K. Parashar (Narosa Publishers).
10. Organic Chemistry by S. M. Mukherji, S. P. Singh and R. K. Kapoor. (Narosa Publishers)
11. A Guide book to mechanism in Organic Chemistry by Peter sykes. Pearson.
12. Advanced Organic Chemistry by J. Singh, L. D. S. Yadav (Pragati Prakashan).
13. A Textbook of Organic Chemistry by A. Bahl and B. S. Bahl, 22nd Edition, 2019 (S. Chand Publications).

DSC LAB-3: ANALYTICAL AND ORGANIC CHEMISTRY PRACTICALS

Course Title: **DSC LAB-3: Analytical and Organic Chemistry Practicals-III**	
Course Code: **G 502 DC2.3P**	
Total Contact Hours: 4 hrs /week	Course Credits: 2
Formative Assessment Marks: 25	Duration of ESA/Exam: 4 hrs
Summative Assessment Marks: 25	

PART-A (Analytical Chemistry)

1.Colorimetric determination of copper using ammonia solution

2.Colorimetric determination of iron using thiocyanate solution

3.Colorimetric determination of nickel using DMG solution

4.Colorimetric determination of titanium using hydrogen peroxide

5.Colorimetric determination of nitrite in a water sample (diazo coupling Reaction/Griess reagent

6.Separation of Methylene blue and Flourescein by column chromatography

7.Determination of Rf values of two or three component systems by TLC.

8.Separation of different metal ions by paper chromatography (circular and ascending)/ Solvent extraction of iron using oxine solution (demonstration)

PART-B (Organic Chemistry)

Qualitative analysis: Systematic qualitative analysis of monofunctional organic compounds. Such as:

Mono-functional Organic Compounds - Phenol, oxalic acid, urea, benzoic acid, resorcinol, aniline, benzaldehyde, acetophenone, benzophenone, chlorobenzene, bromobenzene, nitrobenzene, benzamide.

BSc Semester 3

Title of the Course: OE-3: Structure, Bonding and Concepts in Organic Chemistry

Course Code: G 502 OE1.3

Number of Theory Credits	Number of lecture hours / semester	Number of practical credits	Number of practical hours/ semester
3	42	-	-

Unit – I

Atomic Structure **14 Hrs**

General Introduction: Importance and scope of Chemistry. Dalton's atomic theory: concepts of elements, atoms and molecules. Discovery of electron, proton and neutron; atomic number, isotopes and isobars. Rutherford's model and its limitations. Bohr's model and its limitations, concept of shells and subshells, dual nature of matter and light, De Broglie's relationship, Heisenberg uncertainty principle, concept of orbitals, quantum numbers, shapes of s, p and d orbitals, rules for filling electrons in orbitals - Aufbau principle, Pauli exclusion principle and Hund's rule, electronic configuration of atoms, stability of half-filled and completely filled orbitals.

Unit - II

Bonding and Concepts in Organic Chemistry – I **14 Hrs**

General introduction, methods of qualitative and quantitative analysis. Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties. Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Homolytic and Heterolytic fission with suitable examples.

Unit - III

Bonding and Concepts in Organic Chemistry – II **14 Hrs**

Electrophiles and Nucleophiles; Nucleophilicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes. Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Aromaticity: Aromaticity and Huckel's rule, Aromaticity in benzenoid and non-benzenoid compounds, annulenes, fullerenes. Alternant and non-alternant hydrocarbons, energy level of molecular orbitals, antiaromaticity, homoaromaticity, non-aromatic compounds.

References:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume I), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. McMurry, J. E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
4. Organic Reaction mechanism by V. K. AhIuwalia and K. Parashar (Narosa Publishers).
5. Organic Chemistry by S. M. Mukherji, S. P. Singh and R. K. Kapoor. (Narosa Publishers)
6. Advanced Organic Chemistry by J. Singh, L. D. S. Yadav (Pragati Prakashan).
7. A Textbook of Organic Chemistry by A. Bahl and B. S. Bahl, 22nd Edition, 2019 (S. Chand Publications).

Pedagogy

Formative Assessment	
Assessment Occasion/ type	**Weightage in Marks**
Internal Test	40
Sem End Exam	60
Total	100

FOURTH SEMESTER

Course Title: **DSC-4: Inorganic and Physical Chemistry-II**	
Course Code: G 502 DC1.4	
Total Contact Hours: 56	Course Credits: 4
Formative Assessment Marks: 40	Duration of ESA/Exam: 2.5 hrs
Summative Assessment Marks: 60	

Course Outcomes (COs): At the end of the course the student should be able to understand,

CO 1: Identify the possible type of arrangements of ions in ionic compounds

CO 2: Relate different energy parameters like, lattice energy, entropy, enthalpy and solvation energy in the dissolution of ionic solids

CO 3: Write the M.O. energy diagrams for simple molecules

CO 4: The fundamentals of thermodynamics including the laws, the concept of entropy and free energy functions and their applications.

CO 5: The concepts of surface chemistry, catalysis and their applications.

CO 6: The theoretical and experimental aspects of chemical kinetics

CO 7: Electrochemistry dealing with electrolytes in solution

CO 8: Understand the chemistry of alpha, beta, neutron, and gamma radiation and calculate the half-life of a radioisotope.

CO 8: Conductance measurements and applications

Unit – I

Structure and Bonding -I **3 Hrs**

The ionic bond :Structures of ionic solids

Radius ratio rules, Calculation of some limiting radius ratio values, Coordination number 3 (planar triangle), Coordination number 4 (tetrahedral and square planar), Coordination number 6 (octahedral), Close packing.

Classification of ionic structures **7 Hrs**

Ionic compounds of the type AX (ZnS, NaCl, CsCI)

Ionic compounds of the type AX_2 (Calcium fluoride (fluorite) and Rutile structure Layer structures CdI_2 , Cadmium iodide structure

Limitations of radius ratio concept : Lattice energy and Born-Haber cycle, Derivation of Born-Lande equation and its drawbacks, Kapustinskii equation, solvation energy and solubility of ionic solids, polarizing power and polarizability, Fajan's rules with applications. Numerical problems.

Covalent bond **4 Hrs**

Valence bond theory, The Lewis theory,The octet rule, Exceptions to the octet rule, Sidgwick-Powell theory. Valence shell electron pair repulsion (VSEPR) theory, Effect of lone pairs, electronegativity, isoelectronic principle, Examples using VSEPR theory: BF_3 and BF_4^-, NH_3 and NH_4^+, H_2O, PCl_5, CIF_3, SF_4, $I_3^-$and I_3^+, SF_6, and IF_7.

Limitations of VSEPR.

Unit – II

Structure and Bonding -II **3 Hrs**

Concept of resonance, resonance energy, hybridisation, types of hybridization, sp, sp^2, sp^3 dsp^2 dsp^3, d^2sp^3, sp^3d^2 with one example each, and energetics of hybridization. Bent's rule, Limitations of Valence Bond Theory.

Molecular Orbital theory **7 Hrs**

LCAO concept: s-s, s-p, p-p, p-d and d-d combinations of orbitals, bonding, nonbonding and antibonding molecular orbitals, non-bonding combinations of orbitals, Rules for linear combination of atomic orbitals.

Examples of molecular orbital treatment for homonuclear diatomic molecules H_2 molecule, H^+_2 , He_2 molecule, He^+_2 molecule ion, Li_2 molecule, Be_2 molecule B_2 molecule, C_2 molecule, N_2 molecule, N_2^+, O_2 molecule, O_2^- and O_2^{2-}

M.O. energy diagrams of heteronuclear diatomic molecules with examples (NO, NO^+ CO and HCl). Calculation of bond order, relationship between bond order, bond energy and bond length, magnetic properties based on MOT.

Metallic Bonding **4 Hrs**

General properties of metals : Conductivity, Lustre, Malleability and cohesive force Crystal structures of metals and Bond lengths

Theories of bonding in metals:

Free electron theory,Valence bond theory, Molecular orbital or band theory of solids Prediction of conducting properties of conductors. insulators and semiconductors, extrinsic and intrinsic semiconductors using M.O. theory.

Unit – III

First Law of Thermodynamics **4 hrs**

Thermodynamic Processes, Reversible and Irreversible Processes, Nature of Heat and Work,Internal Energy, First Law of Thermodynamics, Enthalpy of a System,Work done in isothermal and adiabatic expansion of an ideal gas, Numerical problems, Joule -Thomson Expansion, Relation between Joule-Thomson coefficient and other thermodynamic parameters.

Second law of Thermodynamics **4 hrs**

Concept of entropy, thermodynamic scale of temperature, Statements of the Second Law of Thermodynamics, molecular and statistical interpretation of entropy, Calculation of entropy change for reversible and irreversible processes, Free Energy Functions: Gibbs and Helmholtz energy, Variation of S, G, A with T, V and P, Numerical problems, Free energy change and spontaneity, Gibbs-Helmholtz equation.

Third Law of Thermodynamics **2 hrs**

Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.

Surface Chemistry **4 hrs**

Adsorption

Types of adsorption isotherms. Freundlich adsorption isotherm (only equation), its limitations. Langmuir adsorption isotherm (derivation to be done) and BET equation (derivation not included).

Catalysis

Types of Catalysis and theories with examples (intermediate compound theory and adsorption theory), Theory of acid base catalysis, Michaelis-Menten mechanism. Heterogeneous catalysis: surface reactions, unimolecular, bimolecular surface reactions. Autocatalysis with examples. Applications: Design process to removal of toxic compounds from industrial wastewater and treatment of portable water requirements.

Unit IV

Chemical Kinetics **7 hrs**

Differential and integrated form of rate expressions up to second order reactions, Derivation of expression of rate constant of second order reaction (a=b and a ≠ b), Problems on rate constant (a=b), Methods of determination of order of a reaction, temperature dependence of reaction rates; Arrhenius equation, activation energy, Numerical problems on Arrhenius equation in calculating energy of activation and rate constants. Collision theory of reaction rates, Lindemann's mechanism, qualitative treatment of the theory of absolute reaction rates. Experimental determination of kinetics of (i) inversion of cane sugar by polarimetric method (ii) spectrophotometric method for the reaction between potassium persulphate and potassium iodide.

Electrochemistry – I **7 hrs**

Arrhenius theory of electrolytic dissociation. Merits and Demerits, Conductance, Specific conductance, equivalent and molar conductivity and their variation with dilution. Molar conductivity at infinite dilution. Numerical problems.

Kohlrausch's law of independent migration of ions and its applications, Debye-Hückel-Onsager equation. Ionic mobilities and their determinations, transference numbers and their relation to ionic mobility's, determination of transference numbers using Hittorf and Moving Boundary methods.

Applications of conductance measurement: (i) degree of dissociation of weak electrolytes (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts (iv) conductometric titrations (acid base titrations only) and (v) Hydrolysis constants of salts. Numerical problems

References:

1. Concise Inorganic Chemistry: J D Lee, 4th Edn, Wiley, (2021)
2. Fundamentals Concepts of Inorganic Chemistry, Vol 1 and 2, 2nd Edition, Asim K Das, CBS Publishers and Distributors, (2013)
3. Basic Inorganic Chemistry, F A Cotton, G Wilkinson and P. L. Gaus, 3rd Edition. Wiley. India
4. Inorganic Chemistry, 2nd Edn. Catherine E. Housecroft and A.G. Sharpe, Pearson Prentice Hall (2005)
5. Atkins Physical Chemistry.8th Edition. Peter Atkins & Julio De Paula Oxford University Press.

6. Physical Chemistry by Samuel Glasstone, ELBS (1982).
7. A Text book of Physical Chemistry, A S Negi & S C Anand, New Age International Publishers (2007).
8. Principles of Physical Chemistry, Puri, Sharma & Pathania, Vishal Publishing Co.
9. A Text Book of Physical Chemistry P.L.Soni , O.P. Dharmarhaand and U.N.Dash, Sultan Chand and Sons.
10. Advanced Physical Chemistry, Gurdeep Raj, Goel Publishing House (2018).

DSC LAB-4: INORGANIC AND PHYSICAL CHEMISTRY PRACTICALS

Course Title: **DSC LAB-4: inorganic and Physical Chemistry Practicals-II**	
Course Code: **G 502 DC2.4P**	
Total Contact Hours: 4 hrs /week	Course Credits: 2
Formative Assessment Marks: 25	Duration of ESA/Exam: 4 hrs
Summative Assessment Marks: 25	

PART-A Inorganic Chemistry

Semi-micro–Qualitative Analysis of Salt Mixtures

Systematic qualitative analysis of mixtures of two simple inorganic salts (containing two cations and two anions).

Anions: CO_3^{2-}, HCO_3^-, SO_3^{2-}, $S_2O_3^{2-}$, S^{2-}, Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, PO_4^{3-}, SO_4^{2-}

Cations: Pb^{2+}, Cd^{2+}, Cu^{2+}, Bi^{3+}, Co^{2+}, Ni^{2+}, Al^{3+}, Fe^{3+}, Mn^{2+}, Zn^{2+}, Ca^{2+}, Ba^{2+}, Sr^{2+}, Mg^{2+}, Na^+, K^+, NH_4^+.

Part B- Physical Chemistry Practicals

1. Determination of the enthalpy of neutralization of a strong acid with strong base.
2. Verification of Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.
3. The study of kinetics of potassium persulphate and potassium iodide volumetrically.
4. Determination of velocity constant for acid catalyzed hydrolysis of methyl acetate.
5. Determination of velocity constant for the saponification of ethyl acetate ($a = b$) volumetrically.

6. Determination of equivalent conductivity of strong electrolyte.
7. Determination of dissociation constant of weak acid by conductivity method.
8. Conductometric titration of strong acid and strong base.
9. Conductometric titration of weak acid and strong base.
10. Determination of the hydrolysis constant of anilinehydrochloride conductometrically.
11. Determination of solubility product of sparingly soluble salt conductometrically.

BSc Semester 4

Title of the Course: OE – 4: Electrochemistry, Corrosion and Metallurgy

Course Code: G 502 OE1.4

Number of Theory Credits	Number of lecture hours/semester	Number of Practical Credits	Number of practical hours/ semester
3	42	-	-

UNIT- I

Electrochemistry **12 hrs**

Conductance, specific and molar conductance Types of Electrolytes, Conductivity in electrolytic solution, Electrolysis, Kohlrausch's law and its application, Equivalent Conductance of Weak electrolyte at Infinite dilution.

Oxidation -reduction reactions, electrode potential, EMFof 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, CH3COOH Vs NaOH

(ii) Potentiometric titrations: Acid-base titration HCl Vs NaOH, Redox titration (FAS Vs K2Cr2O7)

Determination of P^H using glass electrode.

Batteries **2 hrs**

Primary and Secondary batteries, Battery components and their role. Working of the following Batteries- Lead acid, Lithium Storage, Batteries, Fuel cells.

UNIT -II

Corrosion: 14 hrs

Introduction, definition, Types of Corrosion, Corrosion rate, Factors affecting corrosion rate, Metallic factor-purity, electrode potential of metal, hydrogen over voltage, natureof corrosion product. Environmental Factors-Temperature, pH of the medium, humidity, presence of impurities, electrical conductivity of the medium, velocity of the medium, 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). Electro less plating: Introduction, distinction between electroplating and electroless plating processes. Electroless plating of copper.

UNIT III

Metallurgy 6 hrs

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 Filament.

Extraction of metals: 4 hrs

Extraction of Manganese (Pyrolusite), Titanium (Ilmanite) and Uranium.

Alloys: 4 hrs

Introduction, Classification of alloys, commercially important alloys, gold karats, Production of Ferro alloys; Ferrochrome, Ferro Manganese, Uses of alloys.

References:

1. B. K. Sharma: Introduction to Industrial Chemistry, Goel Publishing, Meerut (1998).
2. Instrumental Methods of Chemical Analysis – Gurudeep R Chatwal, Sham K Anand.
3. Principles of Physical Chemistry, Puri, Sharma & Pathania, Vishal Publishing Co.
4. A Text Book of Physical Chemistry P.L.Soni , O.P. Dharmarhaand and U.N.Dash, Sultan Chand and Sons.
5. An introduction to Electrochemistry – Samuel Glasstone.
6. Atkin's Physical Chemistry,1st Indian Edition 2003, Peter Atkins & Julio de Paula, Oxford Publication.
7. Electrochemistry and Corrosion Science, Nestor Perez, Springer (india) Pvt. Ltd., (2004)
8. Principles and Prevention of Corrosion, D. A. Jones, Macmillan Publ. Co., (1996)

Pedagogy

Formative Assessment	
Assessment Occasion/ type	**Weightage in Marks**
Internal Test	40
Sem End Exam	60
Total	100

FIFTH SEMESTER

Course Title: **DSC-5: INORGANIC AND PHYSICAL CHEMISTRY-III**	
Course Code: **G 502 DC1.5**	
Total Contact Hours: 56	Course Credits: 4
Formative Assessment Marks: 40	Duration of ESA/Exam: 2.5 hrs
Summative Assessment Marks: 60	

DSC-5: INORGANIC AND PHYSICAL CHEMISTRY

Course Outcomes: At the end of the course the student should be able to,

CO 1: Understand the general characteristics of transition elements, oxidation states, colour and magnetic property.

CO 2: Expose the students to new theories of chemical bonding.

CO 3: Know the applications of HSAB concept.

CO 4: Define magnetic behaviour of different metal complexes and explain geometry of the complex based on magnetic moment data.

CO 5: Learn the IUPAC nomenclature and theories of coordination compounds.

CO 6: Learn Nuclear reactions and their applications.

CO 7: Understand quantum mechanical concepts and Schrodinger wave equation and its solutions.

UNIT I

Chemistry of *d*-block and *f*-block Elements **7 Hrs**

Definition, transition elements four series of *d* block elements, general electronic configuration; Position in the periodic table. General characteristic properties - metallic character, ionisation energy, oxidation state, reducing property, colour, catalytic property and complexability. Magnetic property – expression for magnetic moment - spin only formula μ_s, calculation of μ_s for 3*d* series elements, Lande's calculation of theoretical magnetic moment. μ_{s+L}, comparison of magnetic moment μ_s and μ_{s+L} with

experimental value of μ. Comparative study of 4*d* and 5*d* elements with 3*d* elements - ionic radii, oxidation states, magnetic behaviour.

Lanthanides - Occurrence, properties - electronic state, oxidation state, ionic radii; lanthanide contraction, causes and consequences. complex formation, colour and magnetic properties. separation of Lanthanides by ion exchange method. Actinides - general features, electronic configuration, oxidation state, ionic radii, colour of ions, and formation of complex.

Chemical bonding **7 Hrs**

VSEPR model, shapes of molecules-ClF_3, ICl_4-, TeF_5-, I_3-, $TeCl_62$-, XeF_6, IF_7, Bent rules and energetics of hybridization; electronegativity and partial ionic character; Bonds-Multicenter, Synergic and Agostic bonding. Molecular orbital theory: MO diagrams of heteronuclear diatomic (CO, HF, ICl) molecules.

M-M bond and metal atom clusters, halide clusters, bonding in $[Re_2Cl_8]^2$.

UNIT II

Coordination Compounds **10 Hrs**

Nomenclature including bridging ligands; Isomerism in coordination compounds - ionization isomerism, hydrate isomerism, coordinate isomerism, linkage isomerism. Geometrical isomerism and optical isomerism (coordination numbers 4 and 6). Effective atomic number calculations, stability of complexes and factors affecting stability of complexes. Postulates of Valence Bond Theory (VBT); Examples for sp^3, dsp^2, dsp^3, d^2sp^3 and sp^3d^2 hybridization - $[Ni(CO)_4]$, $[Ni(CN)_4]^{2-}$, $[Cu(NH_3)_4]^{2+}$, $[Fe(CO)_5]$, $[Fe(CN)_6]^{3-}$, $[Co(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$. Explanation for magnetic properties. Limitations of VBT. Crystal field theory (CFT) - important concepts of CFT, Crystal field splitting in octahedral and tetrahedral; crystal field stabilization energy (CFSE). Calculation of CFSE; weak and strong field ligands, Factors affecting the crystal field splitting. Limitations of CFT. Distortion of octahedral complex, Ligand Field Theory, MO theory: tetrahedral and octahedral complexes (including *p*- bonding), angular overlap model.

HSAB Concept **4 Hrs**

Basis of HSAB concept, acid-base strength, hardness and softness, symbiosis, applications of HSAB concept; Acid- base concept in non-aqueous media, reactions in BrF_3, N_2O_4, anhydrous H_2SO_4, CH_3COOH.

UNIT III

Dilute Solutions and Colligative Properties **6 Hrs**

Ideal and non-ideal solutions - thermodynamic properties (ΔG, ΔH and ΔS) of ideal solutions, Activity and Activity coefficients, colligative properties – Definition and an elementary account of the four colligative properties. Raoult's Law of relative lowering of vapour pressure. Osmosis - Laws of osmotic pressure.

Elevation in boiling point and depression in freezing point. Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental determination of molecular weight by Walker-Lumsden method and Beckmann's method. van't Hoff factor, Abnormal molar mass, Degree of dissociation and association of solutes. Problems.

Electrochemistry II **8 Hrs**

Galvanic cells. Reference electrodes, Calomel, Quinhydrone, Ag-AgCl and glass electrode (Construction, Electrode reaction, Nernst equation), E.M.F. of cells and its measurements by potentiometric method, calculation of electrode potential, computation of cell EMF, relation between ΔG° and K for cell reaction, calculations,
Concentration cells; electrolyte concentration cells with/without transport, liquid junction potential, calculations. Applications of concentration cells: Determination of (a) valency of ions, (b) solubility product.
Application of E.M.F. measurements: (a) Potentiometric titrations (acid- base and redox), (b) Determination of pH using hydrogen electrode, Quinhydrone electrode and Glass electrode by potentiometric methods.

UNIT IV

Nuclear Chemistry **6 Hrs**

Nuclear Reactions. Difference between nuclear and chemical reactions. Natural radioactivity, characteristics of alpha, beta and gamma rays. Group Displacement Law;

decay constant; Half-life period, Artificial transmutation of elements, Artificial radioactivity, Nuclear fission, Nuclear fusion, Carbon-14 dating. Problems.

The atomic nucleus-elementary particles, quarks, classification of nuclides based on Z and N values, nuclear stability, nuclear potential, binding energy. Nuclear Model: Liquid drop model, Radioactivity, radioactive decay kinetics. Applications of radioactive isotopes. (Numerical problems to be worked out wherever necessary).

Quantum Mechanics **8 Hrs**

Concepts of Operators: Laplacian, Hamiltonian, Linear and Hermitian operators. Algebra of operators, commutator operator. Eigen functions and eigen values. Solutions of Schrödinger wave equation for a particle in a three-dimensional box, particle in a ring. Quantum mechanical degeneracy, tunneling (no derivation).

Schrodinger equation to hydrogen atom in spherical polar coordinates (no derivation). Quantum numbers and their characteristics. Coupling of Angular momenta. Russell-Saunders and JJ-coupling, Term symbols.

References:

1. A Textbook of Inorganic Chemistry, Puri and Sharma 2000, 33rd Ed. (2017), Milestone Publishers.
2. Concise Inorganic Chemistry, J. D. Lee, 5th Ed. (1999), Blackwell Science Ltd.
3. Essentials of nuclear chemistry, 4th edition; H. J. Arniker, NAIL publishers (1995); Chapters 1, 3 and 4.
4. Advanced Inorganic Chemistry, 6th edition; F. A. Cotton and G. Wilkinson.
5. Inorganic Chemistry IV edition; J. E. Huheey, E. A. Keiter and R. L. Keiter, Addison; Wesley (1993).
6. Principles of Physical Chemistry- puri, Sharma and Pathania. Vishal Publishing Company.
7. Essentials of Physical Chemistry, bahl, Bahl and Tuli, S Chand and Company pvt Ltd.
8. Electrochemistry, Principles and applications, Edmund, C. Potter, Cleaver-Hume press London(1961).
9. Principles and applications of Electrochemistry- D. R. Crow 3rd edition Chapmanhall London (1988).

DSC LAB-5: INORGANIC CHEMISTRY PRACTICALS

Course Title: **DSC LAB-5: INORGANIC AND PHYSICAL CHEMISTRY PRACTICALS-III**	
Course Code: **G 502 DC2.5P**	
Total Contact Hours: 4 hrs /week	Course Credits: 2
Formative Assessment Marks: 25	Duration of ESA/Exam: 4 hrs
Summative Assessment Marks: 25	

Inorganic Chemistry Practical

I- Preparation of inorganic complexes:

1. Preparation of tetraamminecopper(II) sulphate
2. Preparation of sodium tri(oxalato)ferrate(III).
3. Preparation of hexamminecobalt(III) chloride.
4. Preparation of pentaamminechlorocobalt(III) chloride.

II. Quantitative Estimation:

1. Estimation of Cu(II) using sodium thiosulphate solution (Iodimetrically).
2. Analysis of gun metal.
3. Analysis of Haematite.
4. Estimation of manganese in pyrolusite by volumetric method.
5. Estimation of nickel using EDTA and standard zinc sulphate.
6. Volumetric estimation of Ca and Mg in Dolomite solution.
7. Volumetric estimation of Ni in Ni and Fe mixture.
8. Determination of iron and Ni in a mixture.

Physical Chemistry Practical

Chemical kinetics:

1. Study the hydrolysis of methyl acetate in presence of two different concentrations of HCl and report the relative strength.
2. Study the hydrolysis of methyl acetate in the presence of HCl at different temperatures and report the energy of activation.
3. Study of variation of viscosity of a liquid with temperature, determine the

constant A and B.

4. Catalytic decomposition of H_2O_2

Conductometric titrations

1. Acid mixture *versus* NaOH.
2. Weak acid (CH_3COOH) with salt ($CuSO_4$) versus NaOH.
3. Strong acid (HCl) with salt (NH_4Cl) versus NaOH.

Course Title: **DSC-6: ORGANIC CHEMISTRY AND SPECTROSCOPY -I**	
Course Code: **G 502 DC3.5**	
Total Contact Hours: 56	Course Credits: 4
Formative Assessment Marks: 40	Duration of ESA/Exam: 2.5 hrs
Summative Assessment Marks: 60	

Course Outcomes:

At the end of the course the student should be able to,

CO 1: Predict mechanism of electrophilic substitution reactions in heterocyclic compounds.

CO2: Compare the basicity of heterocyclic compound containing nitrogen.

CO3: Learn conformations and configurations of carbohydrates

CO4: To understand the structure and reactivity of amino acids.

CO 5: To gain knowledge of molecular-vibrational, rotational and Raman spectroscopy.

CO 6: To study the theory and applications of NMR and UV spectroscopy.

UNIT I

Heterocyclic Compounds **14 Hrs**

Introduction: Types and nomenclature, aromatic character of pyrrole, furan, thiophene. Comparison of aromaticity of these compounds. Methods of synthesis of pyrrole (Paal-Knorr, from acetylene), furan (Paal-Knorr, Feist-Benary), thiophene (Paal-Knorr, from Furan) and pyridine (Hantzsch, from acetylene). Electrophilic substitution reactions (nitration, sulfonation, halogenations, Friedel Craft's reaction). Comparison of basicity of pyridine, piperidine and pyrrole. Introduction to condensed five and six- numbered heterocycles. Preparation of indole (Fischer Indole synthesis) and quinoline (Skraup synthesis), electrophilic substitution reactions of indole and quinoline (nitration, sulfonation, halogenation, Friedel-Crafts reaction). Introduction to heterocycles containing two hetero atoms: synthesis of pyrazole (from 1,3 dicarbonyl compounds), imidazole (from α-haloketone and amidine), oxazole (Robinson Gabriel synthesis),

thiazole (Gabriel synthesis), electrophilic substitution reactions of pyrazole, imidazole, oxazole, thiazole.

UNIT II

Carbohydrates **8 Hrs**

Classification. Monosaccharides: interconversions of glucose and fructose, chain lengthening of aldoses (Kiliani-Fischer method), Chain shortening (Ruff degradation); Conversion of glucose and mannose – epimerisation; Reduction, reaction with hydroxylamine, and semicarbazide; osazone formation – Mechanism; Amadori rearrangement; Formation of glycosides, ethers (methyl), esters (acetates). Configuration of glucose; Lobry de Bruyn-van Ekenstein rearrangement. Determination of ring size of monosaccharides (methylation and periodic acid method). Mechanism of mutarotation**.**

Amino acids and Peptides **6 Hrs**

Amino acids: Classification, structure and stereochemistry of amino acids, Acid–base behaviour, isoelectric point and electrophoresis – explanation. Preparation of α-amino acids from α-halogenated acids, from ethyl malonate; Strecker synthesis, Koops synthesis and Gabriel synthesis. Reactions due to -COOH groups – with bases, esterification and reduction. Reactions due to NH_2 groups – with acid, acylation, nitrous acid, DNFB. Action of heat.

Classification and nomenclature of peptides. Edman methods of sequencing. Cleavage of peptide bond by chemical and enzymatic methods. Protection of amino group and carboxyl group as alkyl and aryl esters. Coupling of protected amino acids.

UNIT III

Molecular Spectroscopy – I **2 Hrs**

Interaction of electromagnetic radiation with molecules and various types of spectra; Born - Oppenheimer approximation (Physical meaning only. No mathematical derivation).

Rotation spectroscopy **4 Hrs**

Rigid rotor and non-rigid rotor; expression for moment of inertia of diatomic molecule (No derivation), Selection rules, Frequency and wavenumber of lines in the rotational spectra. Intensity of rotational spectral lines (explanation by taking population of energy level and degeneracy only elementary account). Isotopic effect - explanation by taking ^{12}CO and ^{13}CO, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy **5 Hrs**

Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, Hooke's law, Energy levels of a simple harmonic oscillator, selection rules, anharmonicity, Morse potential, dissociation energies. Fundamental frequencies, overtones, hot bands, Applications of IR - calculation of moment of inertia, bond length, force constant, and dissociation energy, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies.

Raman Spectroscopy **3 Hrs**

Qualitative treatment of Rotational Raman effect; effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference.

UNIT – IV

Nuclear Magnetic Resonance (NMR) Spectroscopy **8 Hrs**

Introduction, origin of spectra, instrumentation of PMR spectrometer, TMS as internal standard, solvents used, number of signals for simple organic molecule, area of signals. Chemical shift and factors affecting chemical shift (Inductive, anisotropic, hydrogen bonding). Nuclear shielding and deshielding, Spin-spin splitting, coupling constants. Interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane and ethyl acetate.

UV Spectroscopy **6 Hrs**

Types of electronic transitions, λ_{max}, chromophores and auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λ_{max} for the following systems: α,β-unsaturated aldehydes, ketones,

carboxylic acids and esters; conjugated dienes: alicyclic, homoannular and heteroannular; extended conjugated systems (aldehydes, ketones and dienes).

References:

1. Organic Chemistry, S. M. Mukherji, S. P. Singh, R. K. Kapoor, R. Dass (2017), New Age Publications.
2. Organic Chemistry, Paula Y. Bruice, 8th Ed. (2016), Pearson Education Publishers.
3. Advanced Organic Chemistry, Arun Bahl, B. S. Bahl, 5th Ed (2012), S. Chand
4. Organic Chemistry, R. T. Morrison, R. N. Boyd and S. K. Bhattacharjee, 7th Ed. (2010), Pearson Education India.
5. Advanced Organic Chemistry - Reactions, Mechanism and Structure, Jerry March, John Wiley (2008).
6. A Guidebook to Mechanism in Organic Chemistry, Peter Sykes, Longman, (2000).
7. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed.Tata McGraw-Hill:New Delhi (2006).
8. Brian Smith: Infrared Spectral Interpretations: A Systematic Approach.
9. Kemp, W. Organic Spectroscopy, Palgrave.

DSC LAB-6: ORGANIC CHEMISTRY PRACTICALS

Course Title: **DSC LAB -6: ORGANIC CHEMISTRY PRACTICALS**	
Course Code: **G 502 DC4.5P**	
Total Contact Hours: 4 hours/week	Course Credits: 2
Formative Assessment Marks: 25	Duration of ESA/Exam: 4 hrs
Summative Assessment Marks: 25	

I-Preparation (one stage)

1. Synthesis of *p*-iodonitrobenzene from *p*-nitro aniline
2. Synthesis of benzoic acid from benzaldehyde
3. Synthesis of 7-hydroxy 4-methyl coumarin
4. Oxidation of cyclohexanol (to adipic acid)

5. Preparation of *S*- Benzylisothiuronium chloride
6. Preparation of *p*-nitroacetanilide from acetanilide
7. Synthesis of *p*-nitroaniline from *p*-nitroacetanilide
8. Preparation of 2,4,6-tribromoaniline.
9. Synthesis of N-phenyl-2,4-dintroaniline

Quantitative Analysis

1. Estimation of amino acids
2. Saponification value of oil
3. Estimation of sugars
4. Estimation of Phenols
5. Iodine value of oil (chloramine-T method)

SIXTH SEMESTER

Course Title: **DSC -7: INORGANIC AND PHYSICAL CHEMISTRY-IV**	
Course Code: **G502 DC1.6**	
Total Contact Hours: 56	Course Credits: 4
Formative Assessment Marks: 40	Duration of ESA/Exam: 2.5 hrs
Summative Assessment Marks: 60	

Course Outcomes:

At the end of the course the student should be able to,

CO1: Be aware of the kinetics, stability, electronic spectra and types of bonding in complex compounds.

CO2: Know the importance of essential elements in the biological system.

CO3: Explain the basic definitions and terms in a phase diagram.

CO4: Learn the applications of radioisotopes.

CO5: Understand the applications of thermo-analytical methods.

CO6: Study the mechanisms of thermal and photochemical reactions.

UNIT I

Metal-Ligand equilibria in solution **10 Hrs**

Kinetic and thermodynamic stability of metal complexes, stepwise and overall formation constant and their relationship, factors affecting the stability of metal complexes with reference to the nature of the metal ion and ligand, chelate effect, macrocyclic effect and their thermodynamic origin. Spectrophotometric determination of stability constant. Substitution reaction in square planar complexes, trans effect. macrocyclic effect and their thermodynamic origin.

Bioinorganic Chemistry **4 Hrs**

Essential and trace elements in the biological processes. Metalloporphyrins with reference to haemoglobin and Myoglobin, skeletal structure and functions. Explanation for cooperativity effect and Bohr effect. Biological role of some important metals- Ca^{+2},

Mg^{+2}, Na^{+}, K^{+}, Fe^{+2}, Cu^{+}, Zn^{+2}. Mechanism of $Na+/K^{+}$ pump. Effect of excess intake of metals.

UNIT II

Electronic spectra of transition metal complexes **12 Hrs**

Introduction, microstates and microstate table for p^2 and d^2, types of electronic transitions, Spectroscopic ground states, selection rules, term symbols for d^n ions, Racah parameter, Orgel, Tanabe-Sugano diagrams of d^1 d^2 and d^6 system, spectra of 3d metal-aqua complexes of trivalent V, Cr, Co and Ni, calculation of Dq, B and ß parameters, CT spectra.

Magnetic Properties of coordination compounds **2 Hrs**

Classification of magnetic materials, magnetic susceptibility, and its determination by Gouy method.

UNIT III

Binary Mixtures **3 Hrs**

Ideal liquid mixtures - Raoult's law, Vapour pressure *vs* composition (mole-fraction) curves. Azeotropes - HCl-H_2O and Ethanol-Water system; Fractional distillation, partially miscible liquids - phenol-water, triethanol-water and nicotine-water systems. Lower and upper consolute temperature; Effect of impurity on consolute temperature. Immiscible liquids – steam distillation.

Phase Equilibrium **6 Hrs**

Phase rule - statement (mathematical expression) and meaning of the terms. Explanation for the terms phase, component and degrees of freedom with suitable examples for each. Derivation of phase rule from thermodynamic consideration. Explanation of phase equilibria of one component system (water and sulphur system) using phase diagram. Two component system - classification with examples, simple eutectic system (lead-silver system) - phase diagram and explanation, desilverisation of lead (Pattinson's process). Compound formation with incongruent melting point (NaCl + water system) - phase diagram and explanation. Solid solutions - compound formation with congruent melting point (Mg-Zn system) phase diagram and explanation. Freezing mixtures (acetone-dry ice). Solid solution formation.

Thermo-analytical methods **5 Hrs**

TGA - Principle, instrumentation, types of thermo balances; Deflection and null type; Factors affecting TGA curves – rate of heating and furnace atmosphere; Determination of composition of a compound with example of $CaC_2O_4.H_2O$; Quantitative applications – evaluation of suitable standard, testing of sample purity, study of organic compound, drying and ignition temperature. Qualitative application – determination of curie point. DTG – Advantages over TGA; Significance of DTG curves. DTA - Principle, Factors affecting DTA curves – rate of heating and furnace atmosphere (N_2 and O_2) with example of $CaC_2O_4.H_2O$; Simultaneous TGA and DTA curves; interpretation of DTA curve; applications. DSC – Principle, types – power compensated and heat flux; Advantages of DSC over TGA; applications.

UNIT IV

Radiation Chemistry **6 Hrs**

Introduction. Radiation sources and units. Radiation dosimetry, dosimeter. Radiolysis of water (using gamma rays), radiolysis of gases and liquids. Application of radioisotopes in the study of organic reaction mechanism. Industrial applications.

Chemical Dynamics II **8 Hrs**

Concept of Steady state kinetics, Chain reactions - chain length and chain inhibition, comparison of photochemical and thermal reactions, mechanisms of thermal and photochemical reactions between hydrogen-bromine and hydrogen-chlorine. comparative study of thermal and photochemical hydrogen- halogen reactions. pyrolysis of acetaldehyde, decomposition of ethane.

Kinetics of Fast reactions: Introduction, study of reactions by relaxation methods (temperature and pressure jump) Flow method (Plug flow method and stopped flow method), Flash Photolysis and Shock tube method.

References:

1. Textbook of Physical Chemistry, P. L. Soni, O. P. Dharmarha and U. N. Dash, 2016, Sultan Chand & Sons.
2. Atkin's Physical Chemistry, Peter Atkins & Julio de Paula, Indian Edition 2006, Oxford Publication.
3. Chemical Kinetics- K. J. Laidler, McGraw Hill. Inc. New York (1988).
4. Concise Inorganic Chemistry, J. D. Lee, 5th Ed. (1999), Blackwell Science Ltd.
5. Physical Chemistry- P. Atkins and J. D. Paula, 9th Edn., Oxford University Press (2010).
6. Nuclear and Radioactive chemistry; Friedlander, Kennedy and Miller; Chapters 8 and 9.

DSC LAB-7: INORGANIC AND PHYSICAL CHEMISTRY PRACTICALS

Course Title: **DSC LAB-7: INORGANIC AND PHYSICAL CHEMISTRY PRACTICALS-IV**	
Course Code: **G502 DC2.6P**	
Total Contact Hours: 4 hrs/week	Course Credits: 2
Formative Assessment Marks: 25	Duration of ESA/Exam: 4 hrs
Summative Assessment Marks: 25	

Inorganic Chemistry Practicals:

Semi micro qualitative analysis of mixtures containing two anions, two common cations and one less familiar element: W, Mo, Ce, Th, Zr, V, U and Li (any 5 combinations)

Physical Chemistry Practicals

1. The percentage of NaCl present in water - phenol system.
2. Determination of composition of a binary liquid mixture (alcohol & toluene) by Refractometry.
3. The molecular weight of a non - volatile solute by Walker - Lumsden method.
4. Determination of degree of dissociation of an electrolyte by ebullioscopic method.

Conductometric Experiments

1. Precipitation titration: conductometric titration of lithium sulphate versus $BaCl_2$.
2. Conductometric titration of weak acid versus weak base.

Potentiometric titration

1. $K_2Cr_2O_7$ versus FAS.
2. Weak acid versus NaOH
3. Determination of single electrode potential of M^{2+}/M and estimate the given unknown concentration (Zn^{+2}/Zn, Cu^{+2}/Cu)
4. Titration of weak acid against a strong base using quinhydrone electrode and calculation of pKa and Ka of the weak acid.

Course Title: **DSC -8: ORGANIC CHEMISTRY AND SPECTROSCOPY-II**	
Course Code: **G502 DC3.6**	
Total Contact Hours: 56	Course Credits: 4
Formative Assessment Marks: 40	Duration of ESA/Exam: 2.5 hrs
Summative Assessment Marks: 60	

Course Outcomes:

At the end of the course the student should be able to,

CO1: Understand the mechanism of nucleophilic substitution reactions and addition reactions with suitable examples.

CO2: Know the importance and synthesis of vitamins.

CO3: Study mechanism of rearrangement reactions.

CO4: Learn the basics of symmetry and group theory.

CO5: Learn different photochemical processes.

CO6: Learn principles and applications of atomic absorption spectroscopy.

UNIT I

Aromatic Substitution Reactions **7 Hrs**

Electrophilic Substitution Reactions: sulfonylation reactions; Diazonium coupling, Vilsmeier-Haack reaction, Gatterman reaction.

Nucleophilic substitution reaction: Goldberg reaction, Bucherer reaction, Schiemann reaction.

Vitamins **7 Hrs**

Definition, classification with example and their importance. Synthesis of Vitamins A, Vitamin B1 (thiamine), Vitamin B6 (pyridoxine), folic acid, pantothenic acid, riboflavin, Vitamin C, Vitamin E (α-tocopherol), Vitamin H (biotin), Vitamins K1 and K2.

UNIT II

Addition Reactions **4 hrs**

Addition to carbon-heteroatom multiple bonds: Addition of Grignard reagents and organolithium reagents to carbonyl compounds and unsaturated carbonyl compounds.

Wittig, Mannich and Stobbe reactions.

Rearrangement reactions: 5 Hrs

Wagner-Meerwein, Fries, Wolff, Hofmann, Lossen, Schmidt, Benzil-benzilic acid, Favorskii and Baker-Venkatraman rearrangement.

Synthetic Polymers: 5 Hrs

Introduction, addition polymerisation – mechanism of free radical, cationic and anionic, Ziegler-Natta Catalyst. Condensation polymerisation-manufacture and applications of polyesters (Dacron), polyamides (nylon6, nylon 6,6) phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubbers (neoprene, SBR, BUNA N), Vulcanisation.

UNIT III

Symmetry and Group Theory in Chemistry 6 Hrs

Definition of groups, subgroups, simple theorems in group theory. Symmetry elements and symmetry operations, point groups, Schöenflies notations, representations of groups by matrices, reducible and irreducible representations, character tables, Great Orthogonality Theorem (without proof) and its applications.

Photochemistry 8 Hrs

Interaction of radiation matter; Differences between thermal and photochemical reactions. Laws of photochemistry: Grothus-Draper law, Stark - Einstein law, primary and secondary reactions, Quantum yield - reasons for low and high quantum yield, Examples for high quantum yield with explanation (decomposition of HI, combination H_2 and Cl_2 reaction), Examples for low quantum yield with explanation (combination of H_2 and Br_2). Photosensitized reactions with examples - Photosynthesis in plants, dissociation of H_2, Isomerization of 2-butene and butadiene. Photo-physical processes - Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing). Types of fluorescence-sensitized and resonance fluorescence (examples), explanation of phosphorescence with examples. Chemiluminescence. Norrish type I and type II reaction.

UNIT IV

Photoelectron Spectroscopy **3 Hrs**

Principle, valence and core binding energies, shifts in energies due to chemical forces, photoelectron spectra of simple molecules.

Electron Paramagnetic Resonance Spectroscopy **8 Hrs**

Electron Paramagnetic Resonance (EPR) Spectroscopy: Basic principles, selection rules, intensity, width, position of spectral line, multiplet structure of EPR spectra, hyperfine interaction, spin-orbit coupling, zero field splitting and Kramer's degeneracy, rules for interpreting spectra, factors affecting the magnitude of values. Instrumentation. Applications to the study of free radicals, coordination compounds.

Atomic Absorption Spectroscopy **3 Hrs**

Atomic absorption, atomic emission, and atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences).

References:

1. Elementary Organic Spectroscopy, Y. R. Sharma, 5th Ed. (2013), S. Chand Publication.
2. Fundamentals of Molecular Spectroscopy, C. N. Banwell, E. McCash, 4th Ed. (1994), Tata McGraw-Hill.
3. Spectrometric Identification of Organic Compounds, R. M. Silverstein, F. X. Webster, D. J. Kiemle, 8th Ed (2014), John Wiley & Sons.
4. New Trends in Green Chemistry, V.K. Ahluwalia, M. Kidwai (2004), Springer Science.
5. Organic Chemistry of Natural Products (Vol - I and II), Gurudeep R. Chatwal, M. Arora, (2009), Himalaya Publishing House.
6. Biopolymers, R.M. Johnson, L.Y. Mwaikambo and N. Tucker (2010).

7. Handbook of Bioplastics & Biocomposites for Engineering Applications, Srikanth Pilla (2011), John Pillai & Sons.
8. Fundamentals of Photochemistry, K. K. Rohatgi-Mukherjee., 3rd Ed. (2017), New Age Publishers.
9. Group Theory and Symmetry in Chemistry, Gurudeep Raj, A. Bhagi, V. Jain (2017), Krishna Prakashan Media Ltd.
10. Chemical Applications of Group Theory, F. A. Cotton, 3rd Ed (2008), Wiley.

DSC LAB-8: ORGANIC CHEMISTRY PRACTICALS

Course Title: **DSC LAB -8: ORGANIC CHEMISTRY PRACTICALS**	
Course Code: **G502 DC 4.6P**	
Total Contact Hours: 4 hrs/ week	Course Credits: 2
Formative Assessment Marks: 25	Duration of ESA/Exam: 4 hrs
Summative Assessment Marks: 25	

Organic Chemistry Practicals

I Preparation of Organic Compounds (Two and three step) and characterization by IR spectroscopy.

1. 2,4-Dinitrophenylhydrazine from chloronitrobenzene.
2. Anthranilic acid from phthalic acid.
3. Benzanilide from benzophenone.
4. Benzilic acid from benzoin.
5. Synthesis of acridone.

II Qualitative analysis

Systematic analysis and identification of organic compounds:

1. *p*-nitrobenzoic acid 2. *p*-nitrophenol 3. anthranilic acid
4. *o*-chloroaniline 5. *p*-nitroaniline 6. *p*-nitrobenzaldehyde

****