

**SYLLABI AND SCHEME OF
EXAMINATIONS FOR**
(SKILL ENHANCEMENT COURSE FOR UNDER GRADUATE PROGRAM
OFFERED BY THE DEPARTMENT OF CHEMISTRY)

B.Sc. (Life Sciences/Physical Sciences Program)

(Based on Curriculum and Credit Framework for UG Programs under NEP)



**WITH EFFECT FROM
THE
SESSION 2024-25**

**MAHARSHI DAYANAND UNIVERSITY
ROHTAK (HARYANA)**

SCHEME OF EXAMINATIONS FOR SKILL ENHANCEMENT COURSE OFFERED BY THE DEPARTMENT OF CHEMISTRY

B.Sc. (Life Sciences/Physical Sciences Program)

Skill Enhancement Course (SEC)	Nomenclature	Course Code	Credits Distribution			Total Credits	Workload			Total Workload	Marks				Total Marks
			L	T	P		L	T	P		Theory		Practical		
											Internal	External	Internal	External	
Semester I (Session 2024-25)															
SEC 1 @ 3 credits	SECI-Role of Chemistry in Society	24CHE401SE01	2	0	0	03	2	0	0	04	15	35	---	---	75
	SEC Chemistry Practical-I		0	0	1		0	0	2		---	---	05	20	
Semester II (Session 2024-25)															
SEC 2 @ 3 credits	SECII-Fuel Chemistry	24CHE402SE01	2	0	0	03	2	0	0	04	15	35	---	---	75
	SEC Chemistry Practical-II		0	0	1		0	0	2		---	---	05	20	
Semester III (Session 2025-26)															
SEC 3 @ 3 credits	SECIII-Batteries	25CHE403SE01	2	0	0	03	2	0	0	04	15	35	---	---	75
	SEC Practical-III		0	0	1		0	0	2		---	---	05	20	
Semester VII (Session 2027-28)															
SEC 5 @ 4 credits (if offered as an option)	Organic Chemistry Practical-I	27CHE407SE01	0	0	4	04	0	0	8	08	---	---	30	70	100
Semester VIII (Session 2027-28) Option-I															
SEC 6 @ 4 credits (if offered as an option)	Organic Chemistry Practical-II	27CHE408SE03	0	0	4	04	0	0	8	08	---	---	30	70	100
Semester VIII (Session 2027-28) Option-II															
SEC 6 @ 4 credits (if offered as an option)	Inorganic Chemistry Practical-II OR Physical Chemistry Practical-II OR Organic Chemistry Practical-II	27CHE408SE01 OR 27CHE408SE02 OR 27CHE408SE03	0	0	4	04	0	0	8	08	---	---	30	70	100

Syllabi for Skill Enhancement Course Offered by the Department of Chemistry

for B.Sc. (Life Sciences/Physical Sciences Program)

Semester — I (Session: 2024- 25)

Name of Program	B.Sc. (Life Sciences/Physical Sciences)	Program Code	
Paper No.	SEC Paper – I	Nomenclature	Role of Chemistry in Society
Name of the Course	Skill Enhancement Course	Course Code	24CHE401SE01
Credits	02	Maximum Marks	50
Hours per Week	02	External Marks	35
Duration of Examination	02 Hrs.	Internal Marks	15
<p>Syllabus Objectives: This course aims to provide a comprehensive understanding of analytical techniques in chemistry and environmental science. Students will learn soil and water analysis methods, including pH measurement, complexometric titrations and estimation of ions. Additionally, it covers the preparation and uses of various personal care products, introduction to pesticides and the principles behind fuel production and purification processes, emphasizing sustainability and environmental impact.</p>			
<p><i>Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each unit. All questions will carry equal marks.</i></p>			
<p>Course Learning Outcomes (CLO): By the end of the course, the students will be able to:</p> <p>CLO1: Demonstrate proficiency in analysing soil and water samples, including pH measurement and estimation of ions.</p> <p>CLO2: Understand the preparation and applications of personal care products.</p> <p>CLO3: Gain knowledge of pesticides, their synthesis methods, benefits and adverse effects.</p> <p>CLO4: Know the principles behind fuel production processes including fractional distillation and cracking, emphasizing sustainability and clean fuel technologies.</p>			
Unit–I			
Analysis of Soil and Water			
<p>Composition of soil, concept of pH and pH measurement of soil, complexometric titrations, chelation, chelating agents, use of indicators, estimation of calcium and magnesium ions in soil. Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods, determination of dissolved oxygen of a water sample.</p>			
Unit–II			
Chemistry in Cosmetics			
<p>A general study including preparation and uses of the following: Hair dye, soap, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel.</p>			

Unit-III**Pesticides**

General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, brief introduction of structure activity relationship, synthesis and technical manufacture and uses of representative pesticides in the following classes: organochlorines (gammexene), organophosphates (malathion).

Unit-IV**Experimental Techniques**

Basic principle of pH metric, potentiometric and conductometric titrations, applications of conductivity measurements: determination of degree of dissociation, determination of K_a of acids and base, buffer solution, buffer action, Henderson-Hazel equation, buffer mechanism of buffer action.

Books Recommended/References:

1. Instrumental Methods of Analysis by D. A. Skoog, F. J. Holler and S. R. Crouch.
2. Chemistry In Daily Life by K. Singh.
3. General Chemistry Principles, Patterns, and Applications by B. Averill.
4. Engineering Chemistry by P. C. Jain and M. Jain.
5. Industrial Chemistry by B. K. Sharma.
6. Pesticides by R. J. Cremllyn.
7. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania.

Name of Program	B.Sc. (Life Sciences/Physical Sciences)	Program Code	
Paper No.	SEC Paper – I	Nomenclature	SEC Chemistry Practical – I
Name of the Course	Skill Enhancement Course	Course Code	24CHE401SE01
Credits	01	Maximum Marks	25
Hours per Week	02	External Marks	20
Duration of Examination	02 Hrs.	Internal Marks	05

Syllabus Objectives: This course aims to make the students understand the colloidal solution, their preparation and principle of paper chromatography. It aims to build concepts related to the detection of sulphur in organic compounds as well as purity and purification methods for organic compounds.

Note: Examiner will set two experiments for practical examinations.

(7×2) Marks

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:

- CLO1:** Learn preparation of colloidal solution.
CLO2: Check the purity of compounds.
CLO3: Explore detection of sulphur.
CLO4: Learn about the purification methods of organic compounds.
CLO5: Understand the principle of paper chromatography.

List of Experiments

1. Preparation of colloidal solution of ferric hydroxide $[\text{Fe}(\text{OH})_3]$.
2. Check the purity of organic compounds. (By determination of melting and boiling points).
3. Detection of sulphur in organic compound by Nitroprusside test and Lead acetate test.
4. Purification of the organic compounds by crystallization (from water and alcohol) and distillation methods.

5. Separation of mixture of organic compounds by paper chromatography.	
6. Separation of mixture of inks (blue, red and green) by paper chromatography.	
Viva-Voce	(03 Marks)
Note Book	(03 Marks)
Books Recommended/References:	
1. Laboratory Manual Chemistry of NCERT for class 11 th and 12 th . 2. Basic Concepts: Physical Chemistry Experiments by N. Seedher. 3. Senior Practical Physical Chemistry by B. D. Khosla. 4. Practical Chemistry by O. P. Pandey, D. N. Bajpai and S. Giri. 5. Practical Organic Chemistry – A Primer by V. Peesapati. 6. Practical Organic Chemistry by A. K. Manna.	

Semester — II (Session: 2024- 25)

Name of Program	B.Sc. (Life Sciences/Physical Sciences)	Program Code	
Paper No.	SEC Paper – II	Nomenclature	Fuel Chemistry
Name of the Course	Skill Enhancement Course	Course Code	24CHE402SE01
Credits	02	Maximum Marks	50
Hours per Week	02	External Marks	35
Duration of Examination	02 Hrs.	Internal Marks	15
Syllabus Objectives: This course provides an introduction to the chemistry of fuels, focusing on the composition, properties, combustion processes and environmental impacts of various types of fuels. Topics covered include solid fuels (such as coal), liquid fuels (such as crude oil, petroleum etc.), gaseous fuels (coal gas, natural gas and blast furnace gas), nuclear fuels, combustion chemistry, emissions control technologies, and sustainable energy solutions.			
<i>Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each unit. All questions will carry equal marks.</i>			
Course Learning Outcomes (CLO): By the end of the course, the students will be able to:			
CLO1: Gain knowledge of different types of fuels, including fossil fuels (such as petroleum, coal and natural gas), nuclear fuel, hydrogen fuel and alternative fuels (such as synthetic fuels).			
CLO2: Understand the fundamental principles of fuel chemistry, including combustion mechanisms & thermochemistry relevant to fuel reactions.			
CLO3: Understand the processes involved in the production, refining, synthesis of different types of fuels, including extraction, distillation, cracking, hydrogenation and fermentation.			
CLO4: Learn about the chemical composition, physical properties and characteristics of various fuels.			
Unit-I			
Solid Fuels			
Coal - origin, chemical composition, calorific value, classification, characteristics & distribution of Indian coals, storage and spontaneous combustion of coal, coal washing and blending, petrographic constituents of coal, carbonization of coal, manufacture and properties of metallurgical coke, recovery of by-products.			

Unit-II
Liquid Fuels Origin and composition of crude oil, crude oil distillation and its products with special reference to gasoline, kerosene and diesel oil, cracking and reforming, coal tar distillation products, shale oil.
Unit-III
Gaseous Fuels Natural gas, coal gas, coke oven and blast furnace gas, manufacture of water gas and producer gas, carburetted water gas. Synthetic fuels: hydrogenation of coal, Fischer-Tropsch synthesis.
Unit-IV
Nuclear Fuels Introduction, nuclear fuels and nuclear reactors, moderators and structural materials, introduction to renewable energy sources. Combustion: combustion of solids fuels, calculation of volume and weight of air necessary for combustion of fuels, gas analysis.
Books Recommended/References:
1. Fuels and Combustion by S. Sarkar. 2. Elements of Fuels, Furnaces & Refractories by O. P. Gupta. 3. The Elements of Fuel Technology by G. W. Himus and L. Hill. 4. Fuel: Solid, Liquid and Gaseous by J. S. S. Brame and J. G. King.

Name of Program	B.Sc. (Life Sciences/Physical Sciences)	Program Code	
Paper No.	SEC Paper – II	Nomenclature	SEC Chemistry Practical – II
Name of the Course	Skill Enhancement Course	Course Code	24CHE402SE01
Credits	01	Maximum Marks	25
Hours per Week	02	External Marks	20
Duration of Examination	02 Hrs.	Internal Marks	05
Syllabus Objectives: The course introduces the learner to prepare washing and liquid soaps, to check hardness, dissolved oxygen (DO) and chemical oxygen demand (COD) of water. This course also deals with analysis of saturation and unsaturation in organic compounds.			
Note: Examiner will set two experiments for practical examinations.			(7×2) Marks
Course Learning Outcomes (CLO): By the end of the course, the students will be able to: CLO1: Prepare soap by saponification. CLO2: Check hardness of water by EDTA method. CLO3: Detect unsaturation in organic compounds. CLO4: Determine DO and COD values in given water sample.			
List of Experiments			
1. Preparation of washing soap from oils/fats. 2. Preparation of liquid soap from oils/fats. 3. To check hardness of water volumetrically by EDTA method. 4. To check saturation and unsaturation in organic compounds by Br ₂ water and Bayer's reagent. 5. To determine DO and COD values in given water sample.			

Viva-Voce	(03 Marks)
Note Book	(03 Marks)
Books Recommended/References:	
<ol style="list-style-type: none"> 1. Soap-Making Manual-A practical handbook on the raw materials, their manipulation, analysis and control in the modern soap plant by E. G. Thomssen. 2. Practical Chemistry by O. P. Pandey, D. N. Bajpai and S. Giri. 3. Practical Organic Chemistry by A. K. Manna. 4. Water Pollution Causes, Effects and Control by P. K. Goyal. 	

Semester — III (Session: 2025- 26)

Name of Program	B.Sc. (Life Sciences/Physical Sciences)	Program Code	
Paper No.	SEC Paper – III	Nomenclature	Batteries
Name of the Course	Skill Enhancement Course	Course Code	25CHE403SE01
Credits	02	Maximum Marks	50
Hours per Week	02	External Marks	35
Duration of Examination	02 Hrs.	Internal Marks	15

Syllabus objectives: The aim of this paper is to make the students learn the basic principle, design, working of batteries and their applications in daily life. It includes comprehensive overview of general characteristics and applications of some primary and secondary batteries.

Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing seven short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each unit. All questions will carry equal marks.

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:

CLO1: Understand battery fundamentals.

CLO2: Analyse battery types.

CLO3: Examine battery chemistry.

CLO4: Evaluate battery performance.

CLO5: Study battery materials.

Unit-I

Basic Concepts

Components of cells and batteries, classification of cells and batteries, operation of a cell, theoretical cell voltage, capacity, energy, specific energy and energy density of practical batteries.

Unit-II

Battery Design and Factors Affecting Battery Performance

General introduction, designing to eliminate potential safety problems, battery safeguards when using discrete batteries, battery construction, design of rechargeable batteries, factors affecting battery performance.

Unit-III

Primary Batteries

General characteristics and applications of primary batteries, types and characteristics of primary batteries, comparison of the performance characteristics of primary battery systems, recharging primary batteries.

A) Zinc-Carbon Batteries (Leclanche' and Zinc Chloride Cell Systems): General characteristics, cell chemistry, types of cells and batteries, construction, cell components.
B) Magnesium and Aluminum Batteries: General characteristics, cell chemistry, construction of Mg/MnO ₂ batteries, performance characteristics of Mg/MnO ₂ batteries, sizes and types of Mg/MnO ₂ batteries, other types of magnesium primary batteries.
Unit-IV
Secondary Batteries General characteristics and applications of secondary batteries, types and characteristics of secondary batteries, comparison of performance characteristics for secondary battery systems and introduction, chemistry, construction, performance characteristics, charging characteristics of following batteries: Lead batteries, Lithium ion batteries, Iron electrode batteries, Nickel-Cadmium, Nickel-Metal hydride, Nickel-Zinc batteries.
Books Recommended/References:
1. Understanding Batteries by R. M. Dell and D. A. J. 2. The TAB Battery Book: An In-Depth Guide to Construction, Design and Use by M. Root. 3. Fuel Cell- principles and applications by M. A. Scibioh and B. Vishwanathan. 4. Energy Storage Systems – Batteries and Their Chemistry by M. Cultu.

Name of Program	B.Sc. (Life Sciences/Physical Sciences)	Program Code	
Paper No.	SEC Paper – III	Nomenclature	SEC Chemistry Practical – III
Name of the Course	Skill Enhancement Course	Course Code	25CHE403SE01
Credits	01	Maximum Marks	25
Hours per Week	02	External Marks	20
Duration of Examination	02 Hrs.	Internal Marks	05

Syllabus Objectives: This course aims to provide knowledge of total dissolved solid (TDS) of water, retention factor (R_f value) of oil, estimation of iron from alloy and to detect aldehyde group. It also aims to enable student to identify the adulteration in given food materials.

Note: Examiner will set two experiments for practical examinations. (7×2) Marks

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:

- CLO1:** Determine the TDS of given water sample.
CLO2: Determine retention factor (R_f value) of oil.
CLO3: Estimation of iron from alloy.
CLO4: Detect aldehyde group present in given organic compound.
CLO5: Identify the adulteration in given food materials.

List of Experiments

1. Determination of TDS in a given water sample.
2. Determine retention factor (R_f value) of oil.
3. Estimation of iron from alloy.
4. Detection of aldehyde group by Silver Mirror test and Felhing's solution.
5. Checking the adulteration in given food materials (Milk, edible oil, sugar, turmeric and chilli powder).

Viva-Voce	(03 Marks)
Note Book	(03 Marks)
Books Recommended/References:	
1. Water Treatment, How To Make Water Safe To Drink by D. Holman. 2. Organic Chemistry by S. N. Dhawan. 3. B.Sc. Chemistry Practical by S. Goyal. 4. Food Processing and Preservation by G. Subbulakshmi.	

Semester — VII (Session: 2027- 28)

Name of Program	B.Sc. (Life Sciences/Physical Sciences)	Program Code	
Paper No.	SEC Paper – V	Nomenclature	Organic Chemistry Practical – I
Name of the Course	Skill Enhancement Course	Course Code	27CHE407SE01
Credits	04	Maximum Marks	100
Hours per Week	08	External Marks	70
Duration of Examination	08 Hrs.	Internal Marks	30
Syllabus Objectives: This course in organic chemistry focuses on qualitative analysis and simple organic preparations thereby providing the students with practical skills of separation, purification and identification of organic compounds. Through these objectives, students will acquire a well-rounded skill set that prepares them for further studies in organic chemistry and applications in various scientific and industrial contexts.			
<i>Note: Examiner will set two experiments for practical examinations.</i>			
Course Learning Outcomes (CLO): By the end of the course, the students will be able to: CLO1: Handle organic chemicals in a safe and competent manner. CLO2: Understand the separation of organic compounds from binary mixtures. CLO3: Perform the standard techniques used in practical organic chemistry. CLO4: Recognize different procedures for separation, identification and purification of organic compounds. CLO5: Apply the basic chemical concepts to understand the mechanism of chemical reactions.			
List of Experiments			
1. Qualitative Analysis Separation, purification and identification of organic compounds in binary mixtures by chemical tests and preparation of their derivatives.			(50 Marks)
Viva-Voce			(10 Marks)
Note Book			(10 Marks)
Books Recommended/References:			
1. Experiments and Techniques in Organic chemistry by D. J. Pasto, C. R. Johnson and M. J. Miller. 2. Macroscale and Microscale Organic Experiments by K. L. Williamson and D. C. Heath. 3. Systematic Qualitative Organic Analysis by H. Middleton. 4. A Handbook of Organic Analysis-Qualitative and Quantitative by H. Clark. 5. Vogel's Textbook of Practical Organic chemistry by A. I. Vogel, A. R. Tatchell, B. S. Furnis, A. J. Hanaford and P. W. G. Smith.			

Semester — VIII (Session: 2027- 28)

(Option –I)

Name of Program	B.Sc. (Life Sciences/Physical Sciences)	Program Code	
Paper No.	SEC Paper – VI	Nomenclature	Organic Chemistry Practical – II
Name of the Course	Skill Enhancement Course	Course Code	27CHE408SE03
Credits	04	Maximum Marks	100
Hours per Week	08	External Marks	70
Duration of Examination	08 Hrs.	Internal Marks	30

Syllabus Objectives: The organic synthesis and purity analysis course aims to provide students with a complete understanding of organic synthesis techniques and the methods for assessing the purity of synthesized compounds. The course aims to prepare students for advanced work in organic chemistry, research or industrial applications by combining theoretical knowledge with practical skills in organic synthesis and analytical techniques.

Note: Examiner will set two experiments for practical examinations.

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:

CLO1: Handle organic chemicals in a safe and competent manner.

CLO2: Perform the standard techniques used in practical organic chemistry.

CLO3: Carry out multistep synthesis of organic compounds following a prescribed procedure.

CLO4: Apply the basic chemical concepts to understand the mechanism of chemical reactions.

CLO5: Characterize and purify the synthesized compounds.

List of Experiments**1. Simple organic preparations and checking the purity of samples prepared: (20 Marks)**

- (i) Chalcone from benzaldehyde and acetophenone.
- (ii) Phenyl-azo- β -naphthol dye from aniline.
- (iii) Adipic acid from cyclohexene.
- (iv) 2-Butoxynaphthalene from 2-naphthol and 1-iodobutane.
- (v) 3,4-Dihydropyrimidin-2(1H)-ones from aldehyde, β -ketoester and urea (Biginelli reaction).
- (vi) Benzilic acid from benzil.

2. Two-step organic synthesis and checking purity of samples prepared: (30 Marks)

- (i) Acetanilide from acetophenone *via* acetophenone oxime.
- (ii) *p*-Nitroaniline from acetanilide *via* *p*-nitroacetanilide.
- (iii) Methyl orange from sulphanilic acid *via* diazotized sulphanilic acid.
- (iv) 2,4-Dinitrophenylhydrazine from chlorobenzene *via* 1-chloro-2,4-dinitrobenzene.
- (v) Anthranilic acid from phthalic anhydride *via* phthalimide.
- (vi) *m*-Nitroaniline from nitrobenzene *via* *m*-dinitrobenzene

Viva-Voce (10 Marks)**Note Book (10 Marks)****Books Recommended/References:**

1. Experiments and Techniques in Organic Chemistry by D. J. Pasto, C. R. Johnson and M. J. Miller.
2. Macroscale and Microscale Organic Experiments by K. L. Williamson and D. C. Heath.
3. Systematic Qualitative Organic Analysis by H. Middleton.
4. A Handbook of Organic Analysis-Qualitative and Quantitative by H. Clark.
5. Vogel's Textbook of Practical Organic Chemistry by A. I. Vogel, A. R. Tatchell, B. S. Furnis, A. J. Hanaford and P. W. G. Smith.

Semester — VIII (Session: 2027- 28)

(Option –II)

Name of Program	B.Sc. (Life Sciences/Physical Sciences)	Program Code	
Paper No.	SEC Paper – VI	Nomenclature	Inorganic Chemistry Practical – II
Name of the Course	Skill Enhancement Course	Course Code	27CHE408SE01
Credits	04	Maximum Marks	100
Hours per Week	08	External Marks	70
Duration of Examination	08 Hrs.	Internal Marks	30

Syllabus Objectives: The course on quantitative inorganic analysis is designed to equip students with comprehensive knowledge and practical skills in separating and determining metal ions through various analytical methods. Additionally, students will delve into the principles and applications of cerimetry for determining Ferrous, Oxalate, and Nitrite ions. The course emphasizes hands-on experience in laboratory settings, ensuring proficiency in analytical techniques. Overall, the course aims to foster a deep understanding of inorganic analytical methods, enhance problem-solving skills, and promote awareness of sustainable practices in chemical analysis.

Note: *Examiner will set two experiments for practical examinations.*

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:

CLO1: Separate and determine binary mixtures of metal ions using gravimetric and volumetric methods.

CLO2: Determine strengths of ferrous and oxalate using cerimetry.

CLO3: Determine the strengths of nitrite ions using cerimetry (also by indirect method).

CLO4: Synthesize some metal acetyl acetonato complexes employing green methods.

List of Experiments

1. Quantitative Inorganic Analysis (25 Marks)

a) Separation and determination of two metal ions *via* volumetric and gravimetric methods

- (i) Silver-Copper
- (ii) Copper-Nickel
- (iii) Copper-Zinc
- (iv) Nickel-Zinc
- (v) Copper-Iron

2. (a) Determination by Cerimetry (25 Marks)

- (i) Ferrous
- (ii) Oxalate
- (iii) Nitrite

(b) Green methods of preparation of the following

- (i) Bis(acetylacetonato) zinc (II)
- (i) Bis(acetylacetonato) chromium (II)

Viva-Voce (10 Marks)

Note Book (10 Marks)

Books Recommended/References:

1. A Text Book of Quantitative Inorganic Analysis by A.I. Vogel.
2. Applied Analytical Chemistry by O. P. Vermani.
3. Vogel's Quantitative Chemical Analysis by J. Mendham.
4. Vogel's Qualitative Inorganic Analysis by G. Svehla.
5. Practical Inorganic Chemistry by Marr and Rockett.
6. Principles of Instrumental Analysis by D. A. Skoog, F. J. Holler and S. R. Crouch.
7. Quantitative Chemical Analysis by D. C. Harris.

Name of Program	B.Sc. (Life Sciences/Physical Sciences)	Program Code	
Paper No.	SEC Paper – VI		Physical Chemistry Practical – II
Name of the Course	Skill Enhancement Course	Course Code	27CHE408SE02
Credits	04	Maximum Marks	100
Hours per Week	08	External Marks	70
Duration of Examination	08 Hrs.	Internal Marks	30

Syllabus Objectives: The course on experimental techniques in physical chemistry aims to provide students with a thorough understanding of various experimental methods used in the study of physical chemistry principles. The objectives include developing hands-on experimental skills in physical chemistry techniques and enhancing the understanding of fundamental principles governing physical and chemical processes. This course aims to prepare students for advanced studies or careers in physical chemistry, research and industrial applications by combining theoretical knowledge with practical skills in experimental techniques.

Note: *Examiner will set two experiments for practical examinations.*

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:

CLO1: Know the concept of viscosity and determine the viscosity of various liquids.

CLO2: Study the conductometric and pH metric titration for determination of normality and strength of acids.

CLO3: Study the potentiometric titration and determine strength and thermodynamic properties of given acids.

CLO4: Determine the partition coefficient of a solute between two immiscible solvents using distribution law.

CLO5: Study the kinetics of hydrolysis of ethyl or methyl acetate and calculation of thermodynamic parameters.

CLO6: Develop the ability to compile interpreted information in the form of lab record.

List of Experiments**1. Viscosity****(25 Marks)**

- (i) Study the variation of viscosity with concentration for a glycerol/amyI alcohol solution using Ostwald viscometer and thereafter determine the concentration of unknown solution of glycerol and amyI alcohol.
- (ii) Determination of molar mass of a polymer by using viscometer.
- (iii) Determine the temperature coefficient of given liquid.

2. Conductometry

- (i) Study the equivalent conductance versus square root of concentration relationship of a strong electrolyte (KCl or NaCl) and weak electrolyte (acetic acid).
- (ii) Determine the strength of NaOH and NH₄OH in a given mixture by titrating it against HCl.
- (iii) Estimate conductometrically the quantities of HCl and NH₄Cl in their mixture.

3. pH-metry

(i) Titration of a mixture of (HCl + CH ₃ COOH) against NaOH pH-metrically and comment on the shape of the curve.	
4. Potentiometry	(25 Marks)
(i) Determine the strength of acetic acid by titrating it against NaOH potentiometrically. Also calculate dissociation constant of acid using quinhydrone electrode.	
(ii) Study the effect of ionic strength on mean activity coefficient of HCl in a given solution.	
(iii) Determine the standard free energy change and equilibrium constant for the reaction. $\text{Cu} + 2\text{Ag}^+ \rightarrow \text{Cu}^{2+} + 2\text{Ag}$	
5. Distribution Law	
(i) Study the complex formation of cuprammonium ion or study the complex formation between copper sulphate and ammonia solution.	
(ii) Determination of equilibrium constant for $\text{I}_2 + \text{I}^- = \text{I}_3^-$	
6. Chemical Kinetics	
(i) Determination of the rate constant and activation energy for hydrolysis of ethyl or methyl acetate.	
(ii) Determination of the temperature coefficient for hydrolysis of ethyl or methyl acetate and calculation of thermodynamic parameters.	
Viva-Voce	(10 Marks)
Note Book	(10 Marks)
Books Recommended/References:	
1. Practical Physical Chemistry by A. M. James and F. E. Prichard.	
2. Findley's Practical Physical Chemistry by B. P. Lavitt.	
3. Practical Physical Chemistry by S. R. Palit and S. K. De.	
4. Experimental Physical Chemistry by R. C. Das and B. Behera.	

Name of Program	B.Sc. (Life Sciences/Physical Sciences)	Program Code	
Paper No.	SEC Paper – VI	Nomenclature	Organic Chemistry Practical – II
Name of the Course	Skill Enhancement Course	Course Code	27CHE408SE03
Credits	04	Maximum Marks	100
Hours per Week	08	External Marks	70
Duration of Examination	08 Hrs.	Internal Marks	30

Syllabus Objectives: The organic synthesis and purity analysis course aims to provide students with a complete understanding of organic synthesis techniques and the methods for assessing the purity of synthesized compounds. The course aims to prepare students for advanced work in organic chemistry, research or industrial applications by combining theoretical knowledge with practical skills in organic synthesis and analytical techniques.

Note: Examiner will set two experiments for practical examinations.

Course Learning Outcomes (CLO): By the end of the course, the students will be able to:

CLO1: Handle organic chemicals in a safe and competent manner.

CLO2: Perform the standard techniques used in practical organic chemistry.

CLO3: Carry out multistep synthesis of organic compounds following a prescribed procedure.

CLO4: Apply the basic chemical concepts to understand the mechanism of chemical reactions.

CLO5: Characterize and purify the synthesized compounds.

List of Experiments	
1. Simple organic preparations and checking the purity of samples prepared:	(20 Marks)
(i) Chalcone from benzaldehyde and acetophenone. (ii) Phenyl-azo- β -naphthol dye from aniline. (iii) Adipic acid from cyclohexene. (iv) 2-Butoxynaphthalene from 2-naphthol and 1-iodobutane. (v) 3,4-Dihydropyrimidin-2(1H)-ones from aldehyde, β -ketoester and urea (Biginelli reaction). (vi) Benzilic acid from benzil.	
2. Two-step organic synthesis and checking purity of samples prepared:	(30 Marks)
(i) Acetanilide from acetophenone <i>via</i> acetophenone oxime. (ii) <i>p</i> -Nitroaniline from acetanilide <i>via</i> <i>p</i> -nitroacetanilide. (iii) Methyl orange from sulphanilic acid <i>via</i> diazotized sulphanilic acid. (iv) 2,4-Dinitrophenylhydrazine from chlorobenzene <i>via</i> 1-chloro-2,4-dinitrobenzene. (v) Anthranilic acid from phthalic anhydride <i>via</i> phthalimide. (vi) <i>m</i> -Nitroaniline from nitrobenzene <i>via</i> <i>m</i> -dinitrobenzene	
Viva-Voce	(10 Marks)
Note Book	(10 Marks)
Books Recommended/References:	
1. Experiments and Techniques in Organic Chemistry by D. J. Pasto, C. R. Johnson and M. J. Miller. 2. Macroscale and Microscale Organic Experiments by K. L. Williamson and D. C. Heath. 3. Systematic Qualitative Organic Analysis by H. Middleton. 4. A Handbook of Organic Analysis-Qualitative and Quantitative by H. Clark. 5. Vogel's Textbook of Practical Organic Chemistry by A. I. Vogel, A. R. Tatchell, B. S. Furnis, A. J. Hanaford and P. W. G. Smith.	