Skill Enhancement Courses (SECs) for Semester -V,

From 2020-21(Syllabus-Curriculum)

Structure of SECs for Semester–V

(To choose One pair from the Five alternate pairs of SECs)

Univ. Code	Course NO. 6&7	Name of Course	Th.Hrs / Week	Credits	Max. Marks Internal Assessment	Max. Marks Sem-End Exam
	6A	Synthetic Organic Chemistry	4	4	25	75
		Synthetic Organic Chemistry Lab	2	1	-	50
	7A	Analysis of Organic Compounds	4	4	25	75
		Analysis of Organic Compounds Lab	2	1	-	50
		OR				
	6B	Analytical Methods in Chemistry-1	4	4	25	75
		Analytical methods in Chemistry-1 Lab	2	1	-	50
	7B	Analytical Methods in Chemistry-1	4	4	25	75
		Analytical Methods in Chemistry-2 Lab	2	1	-	50
		OR				
	6C	Industrial Chemistry-1	4	4	25	75
		Industrial Chemistry - 1 Lab	2	1	-	50
	7C	Industrial Chemistry-2	4	4	25	75
		Industrial Chemistry-2 Lab	2	1	-	50
		OR				
	6D	Environmental Chemistry	4	4	25	75
		Environmental Chemistry Lab	2	1	-	50
	7D	Green Chemistry and Nanotechnology	4	4	25	75
		Green Chemistry and Nanotechnology Lab	2	1	-	50
		OR				
	6E	Analytical Methods in Chemistry	4	4	25	75
		Analytical Methods in Chemistry Lab	2	1	-	50
	7E	Cosmetics and Pharmaceutical Chemistry	4	4	25	75
		Cosmetics and Pharmaceutical Chemistry Lab	2	1	-	50

Note: *Course type code: T: Theory, L: Lab, P: Problem solving
***Note**: FIRST and SECOND PHASES (2 spells) of APPRENTICESHIP between 1st and 2nd year and between 2nd and 3rd year (two summer vacations)
***Note**: THIRD PHASE of APPRENTICESHIP Entire 5th / 6th Semester
Note-1: For Semester–V, for the domain subject Chemistry, any one of the five pairs of SECs shall be chosen as courses 6 and 7, i.e., 6A&7A or 6B&7B or 6C&7C or 6D&7D or 6E&7E. The pair shall not be broken (ABC allotment is random, not on any priority basis).

Note-2: *One of the main objectives of Skill Enhancement Courses (SEC) is to inculcate skills related to the domain subject in students. The syllabus of SEC will be partially skill oriented. Hence, teachers shall also impart practical training to students on the skills embedded in syllabus citing related real field situations.*

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits:4
Course: 6A	Synthetic Organic Chemistry	Hrs/Wk:4

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Identify the importance of reagents used in the synthesis of organic compounds.
2. Acquire knowledge on basic concepts indifferent types of pericyclic reactions.
4. Understand the importance of retro synthesis in organic chemistry.
5. Comprehend the applications of different reactions in synthetic organic chemistry.

Syllabus :*(Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)*

Unit-1: Pericyclic reactions 12 hours

3. A brief introduction to synthetic organic chemistry
4. Features and classification of pericyclic reactions: Phases, nodes and symmetry properties of molecular orbitals in ethylene, 1, 3-butadiene, 1, 3, 5-hexatriene, alkylation and ally radical. Thermal and photochemical reactions.
5. Electro cyclic reactions: Definition and examples, definitions of con and dis rotation, Woodward- Hoffmann selection rules.(Correlation diagrams are not required)
6. Cyclo addition reactions: Definition and examples, definitions of supra facial and antar facial addition, Woodward- Hoffmann selection rules. (Correlation diagrams are not required)

Unit-2: Organic photochemistry 8hours

1. Jablonski diagram-singlet and triplet states
2. Photochemistry of Carbonyl compounds-□−□ and □−□* transitions, Norrish type-1and type-2 reactions
3. Paterno – Buchi reaction.

Unit-3: Retro synthesis 12 hours

1. Important terms in Retro synthesis with examples-Disconnection, Target molecule, FGI, Synthon, Retro synthetic analysis, chemo selectivity, region selectivity
2. Importance of Order of events in organic synthesis
3. Retro synthetic analysis of the compounds: a. cyclohexene, b. 4-Nitro toluene, c. Paracetamol.

Unit-4: Synthetic Reactions 8hours

Shapiro reaction, Stork - enamine reaction (only alkylation), Wittig reaction, Robinson annulation, Bailys-Hillman reaction, Heck reaction, Suzuki coupling. Synthesis of aldehydes and ketones using1, 3-Dithiane.

Unit-5: Reagents in Organic Chemistry 10 hours

Oxidizing agents: PCC, PDC, SeO_2 (Riley oxidation), NBS.

Reducing agents: $LiAlH_4$ (with mechanism), LTBA, Metal-solvent reduction (Birch reduction), Catalytic reduction.

References

1. Pericyclic reactions by Ian Fleming, Second edition, Oxford University press.
2. Pericyclic Reactions-A Text book: Reactions, Applications and Theoryby S. Sankararaman, WILEY-VCH.
3. Reaction Mechanism in Organic Chemistry by S.M. Mukherji and S.P. Singh, Revised edition, Trinity Press.
4. Pericyclic reactions-A Mechanistic study by S.M. Mukherji, Macmillan India.
5. Organic synthesis: The disconnection approach by Stuart Warren, John Wiley & Sons.
6. Organic chemistry by Jonathan Clayden, Nick Greeves and Stuart Warren, Second edition, Oxford university press.
7. Reactions, Reagents and Rearrangements by S.N. Sanyal, Bharati Bhawan Publishers & Distributors.

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits: 1
Course: 6A	Synthetic Organic Chemistry Lab	Hrs/Wk:2

Learning Outcomes:

On successful completion of this practical course, student shall be able to:

1. Perform the organic qualitative analysis for the detection of N, S and halogens using the green procedure.
2. Learn the procedure for the separation of mixture famine acids using paper Chromatography.
3. Prepare the TLC plates for TLC chromatography.
4. Acquire skills in conducting column chromatography for the separation of dyes in the given mixture.

Practical (Laboratory) Syllabus :(**30hrs**) (Max.50 Marks)

1. Green procedure for organic qualitative analysis: Detection of N, S and halogens
2. Separation of given mixture of amino acids (glycine and phenyl alanine) using ascending paper chromatography.
3. Separation of a given dye mixture (methyl orange and methylene blue) using TLC (using alumina as adsorbent).
4. Separation of mixture of methyl range and methyl enable by column chromatography
5. Separation of food dyes using Column Chromatography
6. Separation of triglycerides using TLC

Lab References:

1. Vogel A. I. Practical Organic Chemistry, Longman Group Ltd.
2. Bansal R.K. Laboratory Manual of Organic Chemistry, Wiley-Eastern.
3. Ahluwalia V. K. and Aggarwal R. Comprehensive Practical Organic Chemistry, University press.
4. Mann F. G and Saunders B.C, Practical Organic Chemistry, Pearson Education.

Co-Curricular Activities

a) Mandatory:*(Lab/field training of students by teacher:(lab: 10+field:05*):

1. **For Teacher**: Training of students by the teacher in laboratory and field for not less than15 hours on the field techniques/skills of detection of N, Sand halogens using the green procedure, preparation of TLC plates, detection of organic compounds using R_f values in TLC/ paper chromatography, loading of column, selection of solvent system for column chromatography, separation of amino acids and dye mixture using chromatographic techniques.
2. **For Students**: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the synthetic reactions. Write their observations and submit a hand written fieldwork/project work report notexceeding10 pages in the given format to the teacher.
3. Max marks for Fieldwork/project work Report: 05.
4. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*
4. Unit tests (IE).

b) Suggested Co-Curricular Activities

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and material.
3. Visits of abilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

MODEL QUESTION PAPER (Sem-end. Exam)

B. Sc DEGREE EXAMINATIONS
Semester - III

Course 6A: Synthetic Organic Chemistry

Time: 3Hrs. **Max.Marks:75**

SECTION – A 5 x 5 = 25 M

Answer any **FIVE** questions. Each question carries 5 Marks

1. Draw Molecular orbital diagram of 1,3-butadiene.
2. Differentiate between electrocyclic reactions and cyclo addition reactions.
3. Explain Norrish Type – I reaction.
4. Define Chemoselectivity and Regio selectrivity.
5. Define FGI, Target molecule and synthon. Give examples.
6. Write the mechanism of Stork – enamine reaction.
7. Explain Heck reaction.
8. Explain Birch reduction with mechanism.

SECTION – B 5 x 10 = 50 M

Answer **ALL** questions. Each question carries 10 M

9. a) Explain [2+2] - cycloaddition reaction by any one approach. Derive selection rules.

(OR)

b) Explain Electrocyclic reactions by taking any one example through any one approach.

10. a) Explain Paterno – Buchi reaction and Norrish type – II reaction with an example.

(OR)

b) Draw & Explain Jablonski diagram.

11. a) Write retro synthetic analysis of Cyclohexene and Paracetamol.

(OR)

b) Describe the order of events in retro synthetic analysis. Write retrosynthetic analysis of 4 –nitro toluene.

12. a) Explain the mechanism of Suzuki coupling and Robinson annulation.

(OR)

b) Explain the mechanism of Wittig and Shapiro reactions.

13. a) Write the synthetic applications of PCC and NBS.

(OR)

b) Write the synthetic applications of $LiAlH_4$. Write the mechanism of reduction with $LiAlH_4$.

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits:4
Course: 7A	Analysis of Organic Compounds	Hrs/Wk:4

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Identify the importance of mass spectrometry in the structural elucidation of organic compounds.
2. Acquire the knowledge eon structural elucidation of organic compounds.
3. Understand various chromatography methods in the separation and identification of organic compounds.
4. Demonstrate the knowledge gained in solvent extraction for the separate the organic compounds.

Syllabus :*(Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)*

Unit-1: Mass Spectrometry **10 hours**

A brief introduction to analysis of organic compounds

Basic principles, Instrumentation - Mass spectrometer, electron Ionization (Electron Impact ionization, EI), Molecular ions, metastable ions, Isotope abundance. Basic fragmentation types. Fragmentation patterns in Toluene, 2-Butanol, Butaldehyde, Propionic acid.

Unit-2: Structural elucidation of organic compounds using IR, NMR, mass spectral data- **8hours**

2, 2, 3, 3-Tetra methyl butane, Butane-2, 3-dione, Prop ionic acid and methyl propionate.

Unit-3: Structural elucidation of organic compounds using IR, NMR, Mass spectral data- **8 hours**

Phenyl acetylene, ace to phenomenon amici acid and p-nitro aniline.

Unit-4: Separation techniques-1 **12 hours**

1. Solvent extraction-Principle and theory, Batch extraction technique, application of batch extraction in the separation of organic compounds from mixture- acid & neutral, base &neutral.
2. Chromatography- Principle and theory, classification, types of adsorbents, eluents, $R_f$values and factors affecting $R_f$values.
3. Thin layer chromatography-principle, experimental procedure, advantages and applications.

Unit-5: Separation techniques-2 **12 hours**

1. Paper chromatography- Principle, experimental procedure, ascending, descending, radial and two dimensional, applications.
2. Column chromatography-Principle, classification, experimental procedure, applications.
3. HPLC-Principle, Instrumentation-block diagram and applications.

References

1. Organic Spectroscopy by William Kemp, Third Edition, Palgrave USA.
2. Introduction to Spectroscopy by Pavia, Lamp man, Kriz and Vyvyan, Fifth edition, Cen gage.
3. Organic Spectroscopy: Principles and Applications by Jag Mohan, Second edition, Alpha Science.
4. Spector's copy of Organic Compounds by P.S. Kalsi, Seventh edition, New Age International.
5. Spectroscopic Methods in Organic Chemistry by Ian Fleming and Dudley Williams, Seventh edition, Springer.
6. Fundamentals of Analytical Chemistry by F. James Holler, Stanley R Crouch, Donald M. West and Douglas A. Skoog, Ninth edition, Cen gage.
7. Analytical Chemistry by Gary D.Christian, Purnendu K.Dasgupta and Kevin A.Schug, Seventh edition, Wiley.
8. Quantitative analysis by R.A. Day Jr. and A.L. Underwood, Sixth edition, Pearson.
9. Text book of Vogel's Quantitative Chemical Analysis, Sixth edition, Pearson.

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits: 1
Course: 7A	Analysis of Organic Compounds Lab	Hrs/Wk:2

Learning Outcomes:

On successful completion of this practical course, student shall be able to:

1. Prepare acetanilide using the green synthesis.
2. Demonstrate the preparation of anazodye.
3. Acquire skills in the separation of organic compounds in the given mixture using solvent extraction

Practical (Laboratory) Syllabus :(**30hrs**) (Max.50 Marks)

1. Identification of various equipment in the laboratory.
2. Acetylating of 1^0 amine by green method: Preparation of acetanilide
3. Rearrangement reaction in green conditions: Benzil - Benzilic acid rearrangement
4. Radical coupling reaction: Preparation of 1,1-bis -2-naphthol
5. Green oxidation reaction: Synthesis of adipic acid
6. Preparation and characterization of biodiesel from vegetable oil/ waste cooking oil
7. Photo reduction of Benzophenone to Benzopinacol in the presence of sunlight.
8. Separation of organic compounds in a mixture (acidic compound + neutral compound) using solvent extraction.
9. Separation of organic compounds in a mixture (basic compound +neutral compound) using solvent extraction.

Lab References:

1. Vogel A. I. Practical Organic Chemistry, Longman Group Ltd.
2. Bansal R.K. Laboratory Manual of Organic Chemistry, Wiley-Eastern.
3. Ahluwalia V. K. and Aggarwal R. Comprehensive Practical Organic Chemistry, Universitypress.
4. Mann F.G and Saunders B.C, Practical Organic Chemistry, Pearson Education.

Co-Curricular Activities:

a) **Mandatory:***(Lab/field training of students by teacher:(lab:10+field:05):*

5. **For Teacher**: Training of students by teacher in laboratory and field for not less than15 hours on the field techniques/skills of preparation of acetanilide, preparation of azodye, use of separating funnel for solvent extraction, separation of organic compounds in a mixture.
6. **For Student**: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observe the techniques used for the separation of organic compounds. Write their observations and submit a handwritten fieldwork/project work report not exceeding10 pages in the given format to the teacher.
7. Max marks for Fieldwork/project work Report: 05.

4. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*

5. Unit tests (IE).

b) **Suggested Co-Curricular Activities**

1. Training of students' by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of videos and other material.
3. Visits of facilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

MODEL QUESTION PAPER (Sem-end. Exam)

B. Sc DEGREE EXAMINATIONS
Semester - III

Course 7A: Analysis of Organic Compounds

Time: 3Hrs. **Max.Marks:75**

SECTION – A 5 x 5 = 25 M

Answer any **FIVE** questions. Each question carries 5 Marks

1. Explain Electron impact ionization.
2. Define Molecular ion. Give example.
3. Write IR spectral data for Propionic acid.
4. Write NMR spectral data for acetophenone and P-nitroaniline.
5. Write the principle and theory involved in solvent extraction.
6. Write the applications of TLC.
7. Write the principle and experimental procedure involved in Paper chromatography.
8. Write the experimental procedure involved in Column chromatography.

SECTION – B 5 x 10 = 50 M

Answer **ALL** the questions. Each question carries 10 M

9. a) i. Write significance of Isotopic abundance in Mass Spectrometry.

ii. What are metastable ions. Explain their characteristics.

(OR)

b) Write the Mass Spectral fragmentation patterns of Tolune, 2- Butanol and Propionic acid.

10. a) Predict the IR, NMR and Mass spectral analysis for 2,2,3,3- tetramethyl butane and methyl Propionate.

(OR)

b) Predict the IR, NMR and Mass spectral analysis of Propionic acid butane-2,3-dione.

11. a) Write the IR, NMR, and Mass spectral data for P-nitroaniline and phenyl acetylene.

(OR)

b) Write the IR, NMR and Mass spectral data for acetophenone and cinnamic acid.

12. a) What is Batch extraction. Explain the Solvent extraction technique for separation of mixture of acidic and neutal organic compounds.

(OR)

b) Write the Principle, experimental procedure and advantages of Thin Layer Chromatography.

13. a) Write the principle involved in HPLC. Draw and explain instrument diagram of HPLC.

(OR)

b) Explain ascending, descending, radial and two dimensional paper chromatography. Write its applications.

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits:4
Course: 6B	Analytical Methods in Chemistry-1	Hrs/Wk:4

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Identify the importance of solvent extraction and ion exchange method.
2. Acquire knowledge on the basic principles of volumetric analysis and gravimetric analysis.
3. Demonstrate the usage of common laboratory apparatus used in quantitative analysis.
4. Understand the theories of different types of titrations.
5. Gain knowledge on different types of errors and their minimization methods.

Syllabus:

(Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)

Unit-1: Quantitative analysis-1 **8 hours**

1. A brief introduction to analytical methods in chemistry
2. Principles of volumetric analysis, concentration terms- Molarity, Molality, Normality, v/v, w/v, ppm and ppb, preparing solutions- Standard solution, primary standards and secondary standards.
3. Description and use of common laboratory apparatus- volumetric flask, burette, pipette, beakers, measuring cylinders.

Unit-2: Quantitative analysis-2 **12hours**

1. Principles of volumetric analysis: Theories of acid-base (including study of acid-base titration curves), redox, complex metric, iodometric and precipitation titrations-choice of indicators for the saturations.
2. Principles of gravimetric analysis: precipitation, coagulation, peptization, co precipitation, post precipitation, digestion, filtration, and washing of precipitate, drying and ignition.

Unit-3: Treatment of analytical data **8hours**

Types of errors- Relative and absolute, significant figures and its importance, accuracy - methods of expressing accuracy, errors- Determinate and indeterminate and minimization of errors, precision-methods of expressing precision, standard deviation and confidence interval.

Unit-4: separation techniques **12 hours**

1. Solvent Extraction: Introduction, principle, techniques, factors affecting solvent extraction, Batch extraction, continuous extraction and counter current extraction. Synergism. Application-Determination of Iron (III).
2. Ion Exchange method: Introduction, action of ion exchange resins, applications.

UNIT-5: Analysis of water **10hours**

Determination of dissolved solids, total hardness of water, turbidity, alkalinity, Dissolved oxygen, COD, determination of chloride using Mohr's method.

References

1. Fundamentals of Analytical Chemistry by F.James Holler, Stanley R Crouch, Donald M.Westand Douglas A.Skoog, Ninth edition, Cengage.
2. Analytical Chemistry by Gary D.Christian, Purnendu K.Dasgupta and KevinA.Schug,Seventh edition, Wiley.
3. Quantitative analysis by R.A.DayJr. And A.L.Underwood, Sixth edition, Pearson.
4. Text book of Vogel's Quantitative Chemical Analysis, Sixth edition, Pearson.
5. Text book of Environmental Chemistry and Pollution Control by S.S.Dara and D.D.Mishra, Revised edition, S Chand & CoLtd.

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits: 1
Course: 6B	Analytical methods in Chemistry-1 Lab	Hrs/Wk:2

Learning Outcomes:

On successful completion of this practical course, student shall be able to:

1. Estimate Iron(II) using standard Potassium dichromate solution
2. Learn the procedure for the estimation of total hardness of water
3. Demonstrate the determination of chloride using Mohr's method
4. Acquire skills in the operation and calibration of pH meter
5. Perform the strong acid vs strong base titration using pH meter

c) **Practical (Laboratory)Syllabus**:(**30hrs**) (Max.50 Marks)

1. Estimation of Iron(II) using standard Potassium dichromate solution (using DPA indicator)
2. Estimation of total hardness of water using EDTA
3. Determination of chloride ion by Mohr's method
4. Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.
5. Preparation of buffer solutions of different pH (i) Sodium acetate-acetic acid, (ii) Ammonium chloride-ammonium hydroxide.
6. pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.
7. Determination of dissociation constant of a weak acid.

d) Lab References:

1. Text book of Vogel's Quantitative Chemical Analysis, Sixth edition, Pearson.

e) Co-Curricular Activities:

a) **Mandatory:***(Lab/field training of students by teacher:(lab:10+field:05):*

8. For Teacher: Training of students by the teacher in laboratory and field for not less than 15 hours on the field techniques/skills of calibration of pH meter, Strong acid vs strong base titration using pH meter, determination of chloride ion, estimation of water quality parameters and estimation of Iron(II).
9. For Student: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observe various methods used for the analysis of water. Write their observations and submit a hand written fieldwork/project work report not exceeding10 pages in the given format to the teacher.
10. Max marks for Fieldwork/project work Report: 05.
4. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*
5. Unit tests (IE).

b) **Suggested Co-Curricular Activities**

1. Training of students' by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics).
3. Visits to facilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

MODEL QUESTION PAPER (Sem-end. Exam)

B. Sc DEGREE EXAMINATIONS
Semester - III

Course 6B: Analytical methods in Chemistry-1

Time: 3Hrs. **Max.Marks:75**

SECTION – A 5 x 5 = 25 M

Answer any **FIVE** questions. Each question carries 5 Marks

1. Define Molarity and normality.
2. Write note on choice of indicators in titrations.
3. Explain Coagulation and peptization.
4. Define relative and absolute errors.
5. Explain the methods of expressing accuracy.
6. Explain the factors affecting Solvent extraction.
7. Write any two applications of solvent extraction.
8. How will you determine total hardness of water.

SECTION – B 5 x 10 = 50 M

Answer **ALL** the questions. Each question carries 10 M

9. a) What is Primary and Secondary standards. How will you prepare standard solution. Give an example.

(OR)

b) Explain Common laboratory apparatus used in quantitative analysis. Define Molality, ppm and ppb.

10. a) Explain redox, complexometric and iodometric titrations.

(OR)

b) What is Gravimetric analysis. Write principle & Explain the terms involved in it.

11. a) What are Significant figures. Explain its calculation and importance.

(OR)

b) What are determinate and indeterminate errors. Write the techniques for minimization of errors.

12. a) Explain Batch extraction, continuous extraction and counter current extraction.

(OR)

b) Write an essay on Ion exchange method and its applications.

13. a) How will you determine chloride using Mohr's method.

(OR)

b) Explain the determination of dissolved salts, Dissolved oxygen and COD.

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits:4
Course: 7B	Analytical Methods in Chemistry-2	Hrs/Wk:4

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Identify the importance of chromatography in the separation and identification of compounds in a mixture
2. Acquire a critical knowledge on various chromatographic techniques.
3. Demonstrate skills related to analysis of water using different techniques.
4. Understand the principles of spectro chemistry in the determination of metal ions.
5. Comprehend the applications of atomic spectroscopy.

Syllabus :*(Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)*

Unit-1: Chromatography-Introduction and classification 10 hours

Principle, Classification of chromatographic methods, Nature of adsorbents, eluents, $R_f$values, factors affecting $R_f$values.

Unit-2: TLC and paper chromatography 12 hours

1. Thin layer chromatography: Principle, Experimental procedure, preparation of plates, adsorbents and solvents, development of chromatogram, detection of spots, applications and advantages.
2. Paper Chromatography: Principle, Experimental procedure, choice of paper and solvents, various modes of development- ascending, descending, radial and two dimensional, applications.

Unit -3: Column chromatography 12 hours

1. Column chromatography: Principle, classification, Experimental procedure, stationary and mobile phases, development of the Chromatogram, applications.
2. HPLC: Basic principles, instrumentation –block diagram and applications.

Unit -4: Spectrophotometry 8hours

Principle, Instrumentation: Single beam and double beam spectrometer, Beer-Lambert's law- Derivation and deviations from Beer-Lambert's law, applications of Beer-Lambert's law-Quantitative determination ofFe^{+2}, $Mn^{+2}$and Pb^{+2}.

Unit -5: Atomic spectroscopy 8hours

Types, atomizer, atomic absorption and emission and applications.

References

1. Fundamental so Analytical Chemistry by F.James Holler, Stanley R Crouch, Donald M.Westand Douglas A.Skoog, Ninth edition, Cengage.
2. Analytical Chemistry by Gary D.Christian, Purnendu K.Dasgupta and Kevin A.Schug, Seventh edition, Wiley.
3. Quantitative analysis by R.A.Day Jr. and A.L.Underwood, Sixth edition, Pearson.
4. Text book of Vogel's Quantitative Chemical Analysis, Sixth edition/ Pearson.

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits: 1
Course: 7B	Analytical Methods in Chemistry-2 Lab	Hrs/Wk:2

Learning Outcomes:

On successful completion of this practical course, student shall be able to:

1. Perform the separation of a given dye mixture using TLC
2. Learn the preparation of TLC plates
3. Demonstrate the separation of mixture of amino acids using paper chromatography
4. Acquire skills in using column chromatography for the separation of dye mixture

Practical (Laboratory) Syllabus: (**30hrs**) (Max.50Marks)

1. Separation of a given dye mixture (methyl orange and methylene blue) using TLC (using alumina as adsorbent).
2. Separation of mixture of methyl orange and methylene blue by column chromatography.
3. Separation of given mixture of amino acids (glycine and phenyl alanine) using ascending paper chromatography.
4. Separation of food dyes using Column Chromatography
5. Separation of triglycerides using TLC
6. Verification of Beer lambert's law. (Using potassium permanganate solution) using colorimeter /spectrophotometer.

Lab References:

1. Text book of Vogel's Quantitative Chemical Analysis, Sixth edition, Pearson.
2. Vogel A. I. Practical Organic Chemistry, Longman Group Ltd.
3. Bansal R.K. Laboratory Manual of Organic Chemistry, Wiley- Eastern.
4. Ahluwalia V. K. and Aggarwal R. Comprehensive Practical Organic Chemistry, University press.
5. Mann F.G and Saunders B.C, Practical Organic Chemistry, Pearson Education.

Co-Curricular Activities:

a) **Mandatory:***(Lab/field training of students by teacher (lab:10+field:05):*

1. **For Teacher**: Training of students by the teacher in laboratory and field for not lessthan15 hours on the field techniques/skills of determination of hardness of water, using the calorimeter and or Spectrophotometer, preparation of TLC plate, identification of spots in TLC and Paper chromatographic techniques, loading of column, selection of solvent system, separation of amino acids and dyes mixture using chromatographic techniques.
2. **For Student**: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observe the chromatographic techniques used for the separation of compounds. Write their observations and submit a hand written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.
3. Max marks for Fieldwork/project work Report: 05.
4. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*
5. Unit tests (IE).

b) **Suggested Co-Curricular Activities**

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics).
3. Visits to facilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

MODEL QUESTION PAPER (Sem-end. Exam)

B. Sc DEGREE EXAMINATIONS
Semester - III

Course 7B: Analytical Methods in Chemistry-2

Time: 3Hrs. **Max.Marks:75**

SECTION – A 5 x 5 = 25 M

Answer any **FIVE** questions. Each question carries 5 Marks

1. What is Chromatography. Define Rf. Write its formula.
2. Explain development of chromatogram in TLC.
3. Explain experimental procedure of Paper Chromatography.
4. Write the Basic principle involved in HPLC.
5. Write the applications of column chromatography.
6. Define Beer – Lambert's law. Write applications of it.
7. Write the derivation and deviations of Beer Lambert's law.
8. What are the types of atomic spectroscopy.

SECTION – B 5 x 10 = 50 M

Answer **ALL** the questions. Each question carries 10 M

9. a) Write note on nature of adsorbents, eluents used in chromatography. Explain factors affecting Rf values.

(OR)

b) Write the principle involved in Chromatography. Write general applications of chromatography.

10. a) Explain various modes of development of Paper chromatogram- ascending, descending, radial and two dimensional chromatography.

(OR)

b) Explain the principle and experimental procedure of TLC.

11. a) Write the Principle, classification and experimental procedure of column chromatography.

(OR)

b) Draw the block diagram of instrument of HPLC. Explain the parts in it. Write its applications.

12. a) Explain the instrumentation of single and double beam spectrometers.

(OR)

b) Explain the quantitative determination of Fe^{2+} and Mn^{2+}

13. a) Write the principle and instrumentation of atomic emission spectroscopy.

(OR)

b) Write about different burners, fuel and oxidants in atomic absorption spectroscopy. Write its applications.

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits:4
Course: 6C	Industrial Chemistry-1	Hrs/Wk:4

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Identify the importance of different surface coatings.
2. Acquire a critical knowledge on manufacture of ceramics and cement.
3. Understand various steps in the manufacture of cane sugar.
4. Explain the manufacture of pulp and paper.

Syllabus :*(Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)*

Unit-1: Fertilizers **10 hours**

A brief introduction to industrial chemistry

Different types of fertilizers. Manufacture of the following fertilizers: Urea, Ammonium nitrate, Calcium ammonium nitrate, Ammonium phosphates; Polyphosphate, Superphosphate, Compound and mixed fertilizers.

Unit-2: Silicates **10hours**

1. **Ceramics:** Important clays and Felds par. Ceramics-types, uses and manufacture. High technology ceramics and their applications.
2. **Cements:** Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

Unit-3: Surface Coatings **12 hours**

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, modified oils, Pigments, toners and lake pigments, fillers, thinners, enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Water and Oil paints.

Unit-4: Sugar Chemistry **08hours**

Introduction–Manufacture and recovery of cane sugar from molasses, manufacture of sucrose from beat root, testing and estimation of sucrose.

Unit-5: Paper Industry **10hours**

Pulp and Paper-Introduction, Manufacture of pulp, sulphate or Kraft pulp, soda pulp, sulphite pulp, rag pulp, beating, refining, filling, sizing and colouring of pulp, manufacture of paper.

References:

1. E.Stocchi: *Industrial Chemistry*, Vol-I, Ellis HorwoodLtd.UK
2. J.A.Kent: Riegel's *Hand book of Industrial Chemistry*, CBS Publishers, New Delhi.
3. P.C.Jain, M.Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
4. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, NewDelhi.
5. B.K.Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut
6. O. P. Vermani, A. K. Narula: *Industrial Chemistry*, Galgotia Publications Pvt. Ltd., New Delhi.

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits: 1
Course: 6C	Industrial Chemistry - 1 Lab	Hrs/Wk:2

Lab work-Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Determine free acidity in ammonium sulphate fertilizer.
2. Learn the procedure for the Estimation of Calcium in Calcium ammonium nitrate fertilizer.
3. Demonstrate skills on Estimation of phosphoric acid in superphosphate fertilizer.
4. Acquire skills in using colorimetry for the estimation of sucrose.

Practical(Laboratory)Syllabus:(**30hrs**) (Max.50 Marks)

5. Determination of free acidity in ammonium sulphate fertilizer.
6. Estimation of Calcium in Calcium ammonium nitrate fertilizer.
7. Estimation of phosphoric acid in superphosphate fertilizer.
8. Estimation of sucrose by colorimetry.

Lab References

1. Text book of Vogel's Quantitative Chemical Analysis, Sixth edition, Pearson.
2. Text book on Experiments and Calculations in Engineering Chemistry, S.S.Dara, S.Chand.
3. R.Gopalan, D.Venkappayya, S.Nagarajan: Engineering Chemistry, Vikas Publications.
4. B.K.Sharma: Engineering Chemistry, Goel Publishing House, Meerut

Co-Curricular Activities:

a) **Mandatory:***(Lab/field training of students by teacher:(lab:10+field:05):*

1. **For Teacher**: Training of students by the teacher in laboratory and field for not less than15 hours on field related skills in determination of free acidity, estimation of calcium and phosphoric acid in a fertilizer, use of colorimeter to estimate sucrose.

2. **For Student**: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observe the surface coatings of surfaces used to prevent the corrosion. Write their observations and submit a hand written fieldwork/project work report not exceeding10 pages in the given format to the teacher.

3. Max marks for Fieldwork/project work Report: 05.

4. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*

5. Unit tests (IE).

b) **Suggested Co - Curricular Activities**

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics).
3. Visits to facilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

MODEL QUESTION PAPER (Sem-end. Exam)

B. Sc DEGREE EXAMINATIONS
Semester - III

Course 6C: Industrial Chemistry

Time: 3Hrs. **Max.Marks:75**

SECTION – A **5 x 5 = 25 M**

Answer any **FIVE** questions. Each question carries 5 Marks

1. What are different types of fertilizers.
2. What are mixed fertilizers. Give examples.
3. What are high technology ceramics.
4. Write the classification of cements and write constituents in it.
5. Write note on different types of paints.
6. What are water and oil paints.
7. How will you estimate sucrose.
8. Explain the manufacture of pulp.

SECTION – B **5 x 10 = 50 M**

Answer **ALL** the questions. Each question carries 10 M

9. a) How will you manufacture urea, calcium ammonium nitrate.

(OR)

b) How will you manufacture Ammonium phosphate and superphosphate.

10. a) What are ceramics. Write their types and manufacture process of Ceramics.

(OR)

b) How will you manufacture cement and explain setting process.

11. a) What are Heat retardant, eco friendly, fire retardant and plastic paints. Give examples and significance.

(OR)

b) What are objectives of coating surfaces. Explain preliminary treatment of surface and write classification of surface coatings.

12. a) Write in brief the manufacturing process of sugar.

(OR)

b) Explain the manufacturing process of sucrose from beet root.

13. a) Write in detail different steps in manufacturing of paper.

(OR)

b) Explain manufacture of soda pulp, sulphite pulp. Explain the refining and colouring of pulp.

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits: 4
Course: 7C	Industrial Chemistry-2	Hrs/Wk:4

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Identify the importance of industrial waste management.
2. Acquire a critical knowledge on the preparation and applications of organic polymers.
3. Demonstrate the analysis of water quality parameters.
4. Explain the sources of air pollution.

II. **Syllabus :***(Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)*

Unit-1: Organic Polymers-1 **10 hours**

Basic definitions, degree of polymerization, classification of polymers- Natural and Synthetic polymers, Organic and In organic polymers, Thermoplastic and Thermo setting polymers, Plastics, Elastomers, Fibers and Resins, Linear, Branched and Cross-Linked polymers.

Unit-2: Organic Polymers-2 **10 hours**

Addition polymers and Condensation polymers, mechanism of polymerization- Free radical, ionic and Zeigler-Natta polymerization. Industrial manufacturing and applications of following polymers, Polystyrene, Poly acrylonitrile, Poly methacrylate, Poly methyl-methacrylate.

Unit-3: Air Pollution **8 hours**

Sources of air pollution, acid rain, photochemical smog, Greenhouse effect, Formation and depletion of ozone, sources and effects of various gaseous pollutants: NOx, SOx, SPM, CO, hydrocarbons, controlling methods of air pollution.

Unit-4: Analysis of water **10hours**

Determination of total hardness of water, Dissolved oxygen, BOD, COD, total dissolved solids, turbidity, alkalinity, determination of chloride using Mohr's method.

Unit-5: Industrial Waste Management **12hours**

Waste water treatment - primary, secondary & tertiary treatment. (All treatment methods in detail). Characteristics of solid wastes, methods of solid waste treatment and disposal, microbiology involved in solid waste disposal, methods of solid waste disposal-composting, sanitary landfilling- economic, aesthetic and environmental problems.

References:

1. E.Stocchi: *IndustrialChemistry*,Vol-I,EllisHorwoodLtd.UK
2. J.A.Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
3. P.C.Jain, M.Jain: *Engineering Chemistry*, DhanpatRai & Sons, Delhi.
4. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
5. B.K.Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut
6. O. P. Vermani, A. K. Narula: *Industrial Chemistry*, Galgotia Publications Pvt. Ltd., New Delhi.
7. A.K.De, *Environmental Chemistry*: New Age International Pvt, Ltd, New Delhi.
8. C.k.Varshney: *Water Pollution and Management*, Wiley Eastern Limited, Chennai.
9. S.S. Dara and D.D. Mishra: *Textbook of Environmental Chemistry and Pollution Control*, Revised edition, S.C.Hand &CoLtd.

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits: 1
Course: 7C	Industrial Chemistry-2 Lab	Hrs/Wk:2

Lab work-Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Learn the procedures for the determination of BOD and COD.
2. Demonstrate skills in the determination of chloride in the given water sample.
3. Acquire skills in determining the hardness of water.

Practical (Laboratory) Syllabus:(**30hrs**)

Determination of Hardness of water by EDTA titration.

1. Determination of Chemical Oxygen Demand (COD)
2. Determination of Biological Oxygen Demand (BOD)
3. Determination of chloride using Mohr's method.
4. Determination of pH, turbidity and total solids in water sample.
5. Determination of Ca^{+2} and Mg^{+2} in soil sample by flame photometry.
6. Determination of Ph in soil samples using pH-metry.

Lab References:

1. Textbook of Vogel's Quantitative Chemical Analysis, Sixth edition, Pearson.
2. Textbook on Experiments and Calculations in Engineering Chemistry, S.S.Dara, S.Chand.

Co-Curricular Activities

a) **Mandatory:***(Student training by teacher in field related skills: inlab:15, infield: 05 hours):*

1. **For Teacher**: Training of students by the teacher in laboratory and field for not less than15hours on the field related skills in determination of hardness of water, estimation of COD and BOD in water sample, determination chloride ion in water sample.
2. **For Student**: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observe the measurement of water quality parameters. Write their observations and submit a hand written fieldwork/project work report not exceeding10 pages in the given format to the teacher.
3. Max marks for Fieldwork/project work Report: 05.
4. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*
5. Unit tests (IE).

b) **Suggested Co-Curricular Activities**

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics).
3. Visits to facilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

MODEL QUESTION PAPER (Sem-end. Exam)

B. Sc DEGREE EXAMINATIONS
Semester - III

Course 7C Industrial Chemistry-2

Time: 3Hrs. **Max.Marks:75**

SECTION – A **5 x 5 = 25 M**

Answer any **FIVE** questions. Each question carries 5 Marks

1. What are thermoplastic and thermosetting polymers.
2. Write applications of polystyrene, polyacrylonitrile.
3. Write industrial manufacturing of polymethacrylate.
4. Explain controlling methods of air pollution.
5. Explain green house effect.
6. Explain formation & depletion of ozone.
7. How will you determine Dissolved oxygen.
8. Write microbiology involved in solid waste disposal.

SECTION – B **5 x 10 = 50 M**

Answer **ALL** the questions. Each question carries 10 M

9. a) Classify polymers into Natural and Synthetic Polymers and Organic and Inorganic Polymers. Give examples.

(OR)

b) What are fibres, Resins, Linear, Branched and Cross linked polymers. Give examples.

10. a) Write the mechanism of ionic and Zeigler-Natta Polymerisation.

(OR)

b) Explain the industrial manufacturing of Polystyrene and polyacrylonitrile.

11. a) i. What are sources of air pollution. ii. Write about Acid rain and Photochemical smog.

(OR)

b) Write the sources and effects of NOx, SOx, CO.

12. a) How will you determine total hardness of water, BOD and COD.

(OR)

b) Define turbidity and alkalinity. Determine Chloride using Mohr's method.

13. a) Write in detail Primary, Secondary and Tertiary waste water treatment methods.

(OR)

b) What are characteristics of solid wastes. Write methods of solid waste treatment and disposal.

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits: 4
Course: 6D	Environmental Chemistry	Hrs/Wk:4

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Understand the environment functions and how it is affected by human activities.
2. Acquire chemical knowledge to ensure sustainable use of the world's resources and ecosystems services.
4. Engage in simple and advanced analytical tools used to measure the different types of pollution.
5. Explain the energy crisis and different aspects of sustainability.
6. Analyze key ethical challenges concerning biodiversity and understand the moral principles, goals and virtues important for guiding decisions that affect Earth's plant and animal life.

Syllabus :*(Total Hours: 90, including Teaching, Lab, Field Skills Training, Unit tests etc.)*

Unit-I Introduction **10h**

Environment Definition – Concept of Environmental chemistry- Scope and importance of environment in nowadays – Nomenclature of environmental chemistry – Segments of environment– Effects of human activities on environment – Natural resources–Renewable Resources–Solar and biomass energy and Nonrenewable resources – Thermal power and atomic energy – Reactions of atmospheric oxygen and Hydro logical cycle.

Unit -II

Air Pollution **10h**

Definition – Sources of air pollution – Classification of air pollution – Ambient air quality standards- Climate change – Global warming – Pollution from combustion systems- Acid rain – Photochemical smog – Greenhouse effect – Formation and depletion of ozone – Bhopal gas disaster–Instrumental techniques to monitor pollution – Controlling methods of air pollution.

Unit -III

Water pollution **10h**

Unique physical and chemical properties of water – Water quality standards and parameters – Turbidity- pH Dissolved oxygen – BOD, COD, Suspended solids, total dissolved solids, alkalinity– Hardness of water–Methods to convert temporary hard water in to soft water – Methods to convert permanent hard water into soft water – eutrophication and its effects –Industrial waste water treatment.

Unit -IV

Chemical Toxicology **10h**

Toxic chemicals in the environment – effects of toxic chemicals – cyanide and its toxic effects – pesticides and its biochemical effects – toxicity of lead, mercury, arsenic and cadmium- Solid waste management.

Unit -V

Ecosystem and biodiversity **10h**

Ecosystem

Concepts–structure–Functions and types of ecosystem–Abiotic and biotic components – Energy flow and Energy dynamics of ecosystem– Food chains – Food web– Tropic levels–Biogeochemical cycles (carbon, nitrogen and phosphorus)

Biodiversity

Definition – level and types of biodiversity – concept- significance – magnitude and distribution of biodiversity–trends-bio geographical classification of India–biodiversity at national, global and regional level.

List of Reference books:

1. Fundamentals of ecology by M.C.Dash
2. A Text book of Environmental chemistry by W. Moore and F.A. Moore
3. Environmental Chemistry by Samir k.Banerji
4. Water pollution, Lalude, MC Graw Hill
5. Environmental Chemistry, Anil Kumar De, Wiley Eastern ltd.
6. Environmental analysis, SM Khopkar (IIT Bombay)
7. Environmental Chemistry by BK Sharma & H Kaur, Goel publishing house.
8. Fundamentals of Environmental Chemistry, Manahan, Stanley. E
9. Applications of Environmental Chemistry, Eugene R. Wiener
10. Web related references suggested by teacher.

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits: 1
Course: 6D	Environmental Chemistry Lab	Hrs/Wk:2

Lab work-Skills Outcomes:

On successful completion of this practical course, student shall be able to:

11. List out, identify and handle various equipment in Chemistry lab.
12. Learn the procedures of preparation of standard solutions.
13. Demonstrate skills in operating instruments.
14. Acquire skills in handling spectrophotometer.
15. Analyse water and soil samples.

Practical (Laboratory) Syllabus: (**30hrs**) (Max.50 Marks).

16. Identification of various equipment in the laboratory.
17. Determination of carbonate and bicarbonate in water samples by double titration method.
18. Determination of hardness of water using EDTA
    a) Permanent hardness b) Temporary hardness
19. Determination of Chlorides in water samples by Mohr's method.
20. Determination of pH, turbidity and total solids in water sample.
21. Determination of Ca^{+2} and Mg^{+2} in soil sample by flame photometry.
22. Determination of PH in soil samples using pH metry.

List of Reference books:

23. A Text Book of Quantitative Inorganic Analysis (3rd Edition)–A.I.Vogel
24. Water pollution, Lalude, MC Graw Hill
25. Environmental analysis, SM Khopkar (IIT Bombay)
26. Web related references suggested by teacher.

Co-Curricular Activities:

a) Mandatory: (Training of students by teacher on field related skills: 15hrs)

1. For Teacher: Skills training of students by the teacher in classroom, lab and field for not less than15 hours on field related quantitative techniques for the water quality parameters, soil pollution and air pollution.

2. For Student: Individual visit to any one of the local field agencies/research laboratories in universities/research organizations/private sector culminating writing and submission of a hand-written fieldwork/project work Report not exceeding 10 pages in the given format.

3. Max marks for Fieldwork/project work Report: 05.

4. Suggested Format for Fieldwork/project work: *Title page, student details, index page, details of places visited, observations, findings and acknowledgements.*

5. Unit tests (IE).

b) Suggested Co-Curricular Activities:

1. Training of students by related industrial experts.
2. Visits to research organizations and laboratories.
3. Invited lectures and presentations on related topics by field / industrial experts.
4. Assignments.
5. Seminars, Group discussions, Quiz, Debates etc. (on related topics).
6. Preparation of videos on tools, techniques and applications of spectrophotometry.

MODEL QUESTION PAPER (Sem-end. Exam)

B. Sc DEGREE EXAMINATIONS
Semester - III

Course 6D: Environmental Chemistry

Time: 3Hrs. **Max.Marks:75**

SECTION – A **5 x 5 = 25 M**

Answer any **FIVE** questions. Each question carries 5 Marks

1. Explain the scope and importance of environment in now a days.
2. Write about atomic energy.
3. What are acid rains.
4. Write a brief note on global warming
5. Explain the reasons for hardness of water.
6. Write note about solid waste management.
7. Write about functions and types of ecosystem.
8. Explain biodiversity at global level.

SECTION – B **5 x 10 = 50 M**

Answer **ALL** the questions. Each question carries 10 M

9. a) Write an essay on Renewable resources and non-renewable resources.

(OR)

b) Explain the reactions of atomospheric oxygen and Hydrological cycle.

10. a) Explain the formation and depletion of ozone. Write controlling methods of air pollution.

(OR)

b) Explain the instrumental techniques to monitor pollution.

11. a) Describe the methods used to convert permanent hard water to soft water.

(OR)

b) What are water quality standards and parameters. Define DO, BOD, COD.

12. a) What are toxic effects of cyanide on the environment.

(OR)

b) What are toxic effects of Pesticides, lead and mercury.

13. a) Outline the functions and types of ecosystem.

(OR)

b) Give a detailed account on biodeiversity.

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits: 4
Course: 7D	Green Chemistry and Nanotechnology	Hrs/Wk:4

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Understand the importance of Green chemistry and Green synthesis.
2. Engage in Microwave assisted organic synthesis.
3. Demonstrate skills using the alternative green solvents in synthesis.
4. Demonstrate and explain enzymatic catalysis.
5. Analyse alternative sources of energy and carry out green synthesis.
6. Carry out the chemical method of nanomaterial synthesis.

Syllabus: *Total Hours: 90, including Teaching, Lab, Field Training, Unit tests etc.)*

Unit-I Green Chemistry: Part- I **10 hrs**

Introduction-Definition of green Chemistry, Need for green chemistry, Goals of Green chemistry Basic principles of green chemistry. Green synthesis- Evaluation of the type of the reaction

i) Rearrangements (100% atom economic), ii) Addition reaction (100% atom economic). Organic reactions by Sonication method: apparatus required and examples of sonochemical reactions (Heck, Hunds dicker and Wittig reactions).

Unit- II Green Chemistry: Part- II **10 hrs**

A) Selection of solvent:

i) Aqueous phase reactions

ii) Reactions in ionic liquids, Heck reaction, Suzuki reactions, epoxidation.

Iii) Solid supported synthesis

B) Supercritical CO2: Preparation, properties and applications, (decaffeination, drycleaning)

C) Green energy and sustainability.

Unit-III Microwave and Ultrasound assisted green synthesis: **10 hrs**

Apparatus required, examples of MAOS (synthesis of fused anthroquinones, Leukart reductive amination of ketones) - Advantages and disadvantages of MAOS. Aldol condensation –Cannizzaro reaction- Diels-Alder reactions-Strecker's synthesis

Unit-IV Green catalysis and Green synthesis **10 hrs**.

Heterogeneous catalysis, use of zeolites, silica, alumina, supported catalysis - bio catalysis: Enzymes, microbes Phase transfer catalysis (micellar /surfactant)

1. Green synthesis of the following compounds: adipic acid, catechol, disodium menudo acetate (alternative Strecker's synthesis)

2. Microwave assisted reaction in water –Hoffmann elimination – methyl benzoate to benzoic acid – oxidation of toluene and alcohols–microwave assisted reactions in organic solvents. Diels-Alder reactions and decarboxylation reaction.

3. Ultrasound assisted reactions–sonochemical Simmons–Smith reaction (ultrasonic alternative to iodine)

Unit – V Nanotechnology in Green chemistry **10 hrs**

Basic concepts of Nano science and Nanotechnology – Bottom-up approach and Top-down approaches with examples – Synthesis of Nano materials – Classification of Nanomaterial – Properties and Application of Nanomaterial. Chemical and Physical properties of Nanoparticles – Physical synthesis of nanoparticles – Inert gas condensation - aerosol method - Chemical Synthesis of nanoparticles – precipitation and co-precipitation method, sol-gel method.

Lab work - Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. List out, identify and handle various equipment in the laboratory.
2. Learn the procedures of green synthesis.
3. Demonstrate skills in the preparation of Nanomaterials.
4. Acquire skills in Microwave assisted organic synthesis.
5. Perform some applications of Nanomaterials.

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits: 1
Course: 7D	Green Chemistry and Nanotechnology Lab	Hrs/Wk:2

Practical (Laboratory) Syllabus: (30 hrs.) (Max.50 Marks).

1. Identification of various equipment in the laboratory.
2. Acetylation of 1^0 amine by green method: Preparation of acetanilide
3. Rearrangement reaction in green conditions: Benzil - Benzilic acid rearrangement
4. Radical coupling reaction: Preparation of 1,1-bis -2-naphthol
5. Green oxidation reaction: Synthesis of adipicacid
6. Preparation and characterization of biodiesel from vegetable oil/ waste cooking oil
7. Preparation and characterization of Nanoparticles of gold using tea leaves.
8. Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.
9. Photo reduction of Benzophenone to Benzopinacol in the presence of sunlight.

Reference books:

1. Green Chemistry Theory and Practical. P.T.Anatas and J.C. Warner
2. Green Chemistry V.K. Ahluwalia Narosa, New Delhi.
3. Real world cases in Green Chemistry M.C. Cann and M.E. Connelly
4. Green Chemistry: Introductory Text M.Lancaster: Royal Society of Chemistry (London)
5. Principles and practice of heterogeneous catalysis, Thomas J.M.,Thomas M.J., John Wiley
6. Green Chemistry: Environmental friendly alternatives R S Sanghli and M.M Srivastava, Narosa Publications
7. Nanotechnology: Health and Environmental Risks, Jo Anne Shatkin, CRC Press (2008).
8. Green Processes for Nanotechnology: From Inorganic to Bioinspired Nanomaterials, Vladimir A. Basiuk, Elena V. Basiuk Springer (2015)
9. Web related references suggested by teacher.

Co-Curricular Activities:

a) Mandatory: (*Training of students by teacher on field related skills: 15 hours*)

1. **For Teacher:** Training of students by the teacher in the classroom or in the laboratory for not less than 15 hours on field related quantitative techniques for Enzymatic catalysis, Microwave assisted organic synthesis, Biodiesel preparation etc.

2. **For Student:** Individual visit to any one of the local field agencies, research laboratories in universities/research organizations/private sector culminating writing and submission of a hand-written fieldwork/project work Report not exceeding 10 pages in the given format.

3. Max marks for fieldwork/project work Report: 05.

4. Suggested Format for fieldwork/project work: *Title page, student details, index page, details of places visited, observations, findings and acknowledgements.*

5. Unit tests (IE).

b) Suggested Co-Curricular Activities:

1. Training of students by related industrial experts.
2. Visits to research organizations and laboratories.
3. Invited lectures and presentations on related topics by field / industrial experts.
4. Assignments.
5. Seminars, Group discussions, Quiz, Debates etc. (on related topics).
6. Preparation of videos on tools, techniques and applications of Green chemistry and Nano synthesis.

MODEL QUESTION PAPER (Sem-end. Exam)

B. Sc DEGREE EXAMINATIONS
Semester - III

Course 7D: Green Chemistry and Nanotechnology

Time: 3Hrs. **Max.Marks:75**

SECTION – A **5 x 5 = 25 M**

Answer any **FIVE** questions. Each question carries 5 Marks

1. What is Green Chemistry. Write its goals.
2. Write note on green energy and sustainability.
3. Write Heck reaction using sonochemical method.
4. Explain Diel's Alder reaction.
5. Write note on phase transfer catalysis.
6. Write Simmons – smith reaction using ultrasound method.
7. Write a note on nanotechnology.
8. Write applications of nanomaterials.

SECTION – B **5 x 10 = 50 M**

Answer **ALL** the questions. Each question carries 10 M

9. a) Write the basic Principles of green chemistry.

(OR)

b) What are atom economy reactions. Explain wittig reaction using sonication method.

10. a) Write Suzuki reaction and epoxidation.

(OR)

b) Explain about Green energy and sustainability.

11. a) What are MAOS. Write its advantages and disadvantages.

(OR)

c) Explain Aldol Condensation and Cannizaro reaction.

12. a) Write Green Synthesis of Aidpic acid, Catechol and disodium monoiodo acetate.

(OR)

b) Explain microwave assisted Diel's - Alder reaction and decarboxylation reactions.

13. a) Explain Bottom up and Top Down approachs of synthesis of nanomaterials with examples.

(OR)

b) Write the classification, properties of nanoparticles. Explain Sol- gel method.

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits:4
Course: 6E	Analytical Methods in Chemistry	Hrs/Wk:4

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Understand the various methods involved in Quantitative analysis.
2. Acquire a critical knowledge on separation techniques.
3. Demonstrate skills related to Chromatographic techniques through hands on experience.
4. Able to engage in safe and accurate laboratory practices by handling laboratory glassware, Equipment and chemical reagents appropriately.
5. Comprehend the applications of Chromatographic techniques in different fields.

Syllabus: *Total Hours: 90, including Teaching, Lab, Field Skills Training, Unit tests etc.)*

Unit-1: Quantitative analysis (10hrs)

Importance in various fields of science, steps involved in chemical analysis**.** Principles of volumetric analysis: Theories of acid-base, redox, complex metric, iodometric and precipitation titrations Detection of end point in redox titration, choice of indicators for the saturations. Principles of gravimetric analysis: precipitation, coagulation, peptization, co-precipitation, post-precipitation, digestion, filtration and washing of precipitate, drying and ignition.

Unit-2: Treatment of analytical data: (10hrs)

Types of errors, significant figures and its importance, accuracy-methods of expressing accuracy, absolute and relative errors, error analysis and minimization of errors.

Precision - methods of expressing precision, standard deviation and confidence limit. The correlation coefficient.

Unit-3: Separation techniques in Chemical analysis: (10hrs)

Solvent Extraction: Introduction, principle, techniques, factors affecting solvent extraction, Batch extraction, continuous extraction and counter current extraction. Synergism. Application-Determination of Iron (III).

Ion Exchange: Introduction, action of ionex change resins, separation of inorganic mixtures, applications.

Unit– 4: Chromatography: Part - I (10hrs)

Classification of chromatography methods, principles of differential migration adsorption phenomenon, Nature of adsorbents, solvent systems, R_f values, factors effecting R_f values.

Paper Chromatography: Principles, R_f values, experimental procedures, choice of paper and solvent systems, developments of chromatogram-ascending, descending and radial. Two dimensional chromatography, applications.

Unit– 5: Chromatography: Part - II (10hrs)

Thin layer Chromatography (TLC): Advantages. Principles, factors effecting R_f values. Experimental procedures. Adsorbents and solvents. Preparation of plates. Development of the chromatogram. Detection of the spots. Applications.

Column Chromatography: Principles, experimental procedures, Stationary and mobile Phases, Separation techniques, Applications. HPLC: Basic principles and applications.

Lab work-Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. List out, identify and handle various equipment in Analytical Chemistry lab.
2. Learn the procedures of preparation of primary and secondary standard solutions.
3. Demonstrate skills in the preparation of Paper, Thin layer and column Chromatography.
4. Acquire skills in observing the Chromatogram.

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits: 1
Course: 6E	Analytical Methods in Chemistry Lab	Hrs/Wk:2

5. Perform some separation techniques of Organic compounds.

Practical (Laboratory) Syllabus :(30hrs) (Max.50Marks).

1. Identification and handling of various laboratory equipment.
2. Determination of Zn(II)/ Mg(II) using EDTA
3. Determination of Fe (II) present in an Iron tablet using $KMnO_4$ -Redox titration.
4. Determination of Saponification value of oil and Iodine value of oil.
5. Paper chromatographic separation of $Fe3^+$, Al^{3+}, and Cr^{3+}.
6. Separation and identification of the monosaccharaides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values.
7. Chromatographic separation of the active ingredients of plants, flowers and juices by TLC.
8. Separation by Column Chromatography – Mixture of Ortho and Para Nitro anilines.

List of Reference Books

1. Analytical Chemistry by Skoog and Miller
2. A text book of qualitative in organic analysis by A.I.Vogel
3. Nano chemistry by Geoffrey Ozin and Andre Arsenault
4. Stereo chemistry by D.Nasipuri
5. Organic Chemistry by Clayden
6. Analytical Chemistry by Gary D. Christian, 6^{th} edition
7. Chemistry experiments for instrumental methods, Donald T Sawyer William
8. Instrumental methods of analysis, Willard, Merit, Dean, 6^{th} edition.
9. Web related references suggested by teacher.

Co-Curricular Activities:

a) Mandatory: (training of students by teacher on field related skills: 15 hrs.**)**

1. For Teacher: Training of students by the teacher in laboratory and field for not less than 15 hours on field related Quantitative techniques like Separation techniques, preparation by Column, preparation of TLC and determination of the purity of the sample.

2. For Student: Individual visit to any one of the Field agency, research laboratories in universities/research organizations/private sector culminating writing and submission of a hand-written fieldwork/project work Report not exceeding 10 pages in the given format.

3. Max marks for Fieldwork/project work Report: 05.

4. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of places visited, observations, findings and acknowledgements.*

5. Unit tests (IE).

b) Suggested Co-Curricular Activities:

1. Training of students by related industrial experts.
2. Visitor research organizations and laboratories.
3. Invited lectures and presentations on related topics by field / industrial experts.
4. Assignments.
5. Seminars, Group discussions, Quiz, Debates etc. (on related topics).
6. Preparation of videos on tools, techniques and applications of chromatography.

MODEL QUESTION PAPER (Sem-end. Exam)

B. Sc DEGREE EXAMINATIONS

Semester - III

Course 6E: Analytical Methods in Chemistry

Time: 3Hrs. **Max.Marks:75**

SECTION – A **5 x 5 = 25 M**

Answer any **FIVE** questions. Each question carries 5 Marks

1. Write note on Complexometric titrations. Give example.
2. What are precipitation titrations. Give examples.
3. Write a note on types of errors.
4. What is solvent extraction. Explain with an example.
5. Write applications of ion exchange separations.
6. What is Chromatography. Write principle involved in it.
7. What is two dimensional chromatography.
8. Write the applications of HPLC.

SECTION – B **5 x 10 = 50 M**

Answer **ALL** the questions. Each question carries 10 M

9. a) What are acid base titrations. Explain in detail.

(OR)

b) Write a detailed note on Gravimetric analysis.

10. a) Discuss various types of errors with suitable examples.

(OR)

b) What is accuracy & precision. Write methods of expressing precession.

11. a) Explain batch extraction, continuous extraction and counter current extraction.

(OR)

b) What is Ion exchange chromatography. Write action of ion exchange resins. How will you separate inorganic mixtures using Ion exchangers.

12. a) Write the principle and experimental procedure involved in paper chromatography.

(OR)

b) Define Rf. Write the factors influencing Rf Values. Write about nature of adsorbents, solvents used in Chromatography.

13. a) Write the principle and applications of thin layer chromatography. Discuss the preparation of TLC plates.

(OR)

b) Discuss about column chromatography and write its applications.

ADIKAVI NANNAYA UNIVERISITY:: RAJAHMENDRAVARAM

B.Sc Chemistry Syllabus (w.e.f: 2020-21 A.Y)

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits:4
Course: 7E	Cosmetics and Pharmaceutical Chemistry	Hrs/Wk:4

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Explain the principles of formulation and application of Cosmetics & perfumes.
2. Acquire a critical knowledge on synthetic techniques of drugs.
3. Demonstrate the skills in various aspects of the fermentation technology and apply for production.
4. Comprehend the applications offer mentation.

Syllabus: *Total Hours: 90, including Teaching, Lab, Field Skills Training, Unit tests etc.)*

Unit- I Chemistry of Cosmetics (8hrs)

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours.

Unit- II Chemistry of Perfumes (8hrs)

Essential oils and their importance in cosmetic industries with reference to Eugenol, Geranial, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmine, Civet one, Mascon.

Unit–III Drugs & Pharmaceuticals – I (10hrs)

Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti- inflammatory agents (Aspirin, paracetamol, ibuprofen)

Unit–IV Drugs & Pharmaceuticals - II (12hrs)

Synthesis of the representative drugs of the following classes: Antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glycerol triturate), antilaprosy (Daps one), HIV-AIDS related drugs (AZT-Zidovudine).

Unit – V Fermentation (12hrs)

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B_2, Vitamin B_{12} and Vitamin C.

Lab work-Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. The ability to develop comprehensive product development programs to meet new product criteria and timing.
2. Acquire skills in the preparation of Cosmeceuticals.
3. Demonstrate proficiency in the experimental techniques for fermentation and microbial production of enzymes.
4. Carry out perfume testing with the knowledge of perfumes.
5. Learn the procedure of synthesis of drugs.
6. Critically develop, apply, report, interpret and reflect on strategies for collecting data in the lab and field.

B. Sc	Semester – V (Skill Enhancement Course- Elective)	Credits: 1
Course: 7E	Cosmetics and Pharmaceutical Chemistry Lab	Hrs/Wk:2

Practical (Laboratory) Syllabus :(**30hrs**)

Identification of various equipment in the laboratory

1. Preparation of talcum powder.
2. Preparation of shampoo.
3. Preparation of hair remover.
4. Preparation of face cream.
5. Preparation of nail polish and nail polish remover.
6. Preparation of Aspirin and it's analysis.
7. Preparation of Magnesium bisilicate (Antacid).
8. Fermentation process.

Reference Books:

1. A handbook of lndustrial Organic Chemistry by Samuel P Sadtler, JB Lippincott company.
2. Handbook Industrial Chemistry by Mohammad Farhat Ali Khan, First edition
3. Related online methods available.
4. Industrial Chemistry, E. Stocchi: Vol -I, Ellis Horwood Ltd. UK.
5. Engineering Chemistry P.C. Jain, M. Jain:,Dhanpat Rai & Sons, Delhi.
6. Industrial Chemistry, Sharma, B.K. & Gaur, , Goel Publishing House, Meerut(1996)
7. Introduction to Medicinal Chemistry, G.L. Patrick: Oxford University Press, UK.
8. Medicinal and Pharmaceutical Chemistry, Hakishan, V.K. Kapoor:, Vallabh Prakashan, Pitampura, New Delhi.
9. Principles of Medicinal Chemistry, William O. Foye, Thomas L., Lemke, David A. William: B.I. Waverly Pvt. Ltd. New Delhi.
10. Industrial Microbiology, 3rd Edition, JR Casida L.E. (2015New Age International (P) Limited Publishers, New Delhi, India.
11. Industrial Microbiology: An Introduction. 1st Edition, Waites M.J., Morgan N.L., Rockey J.S. and Higton G. (2001) Blackwell Science, London, UK.
12. Microbiology. 5th Edition, Pelczar M.J., Chan E.C.S. and Krieg N.R. (2003) Tata McGraw-Hill Publishing Company Limited, New Delhi.

Co-Curricular Activities:

a) **Mandatory :***(Training of students by teacher on field related skills: 15hrs)*

1. For Teacher: Training of students by the teacher in laboratory and field fornotlessthan15hoursonfield skills/techniques like purification of the crude, Separation techniques, synthesis of simple drugs etc.

2. For Student: Individual visit to any one of the related local agencies, cosmetic industry, pharmaceutical laboratories in universities / research organizations / private sector culminating writing and submission of a hand-written fieldwork/project work Report not exceeding 10 pages in the given format.

3. Max marks for Fieldwork/project work Report: 05.

4. Suggested Format for Fieldwork/project work**:** *Title page, student details, index page, details of places visited, observations, findings and acknowledgements.*

5. Unit tests (IE).

b) **Suggested Co-Curricular Activities**

1. Training of students by related industrial experts.
2. Assignments(including technical assignments like identifying tools in plant biotechnology and their handling, operational techniques with safety and security, IPR)
3. Seminars, Group discussions, Quiz, Debates etc. (on related topics).
4. Preparation of videos on tools and techniques in plant biotechnology.
5. Collection of material/figures/photos related to products of plant tissue culture, writing and organizing them in a systematic way in a file.
6. Visits to plant tissue culture/biotechnology facilities, firms, research organizations etc.
7. Invited lectures and presentations on related topics by field/industrial experts.

MODEL QUESTION PAPER (Sem-end. Exam)

B. Sc DEGREE EXAMINATIONS
Semester - III

Course 7E: Cosmetics and Pharmaceutical Chemistry

Time: 3Hrs. **Max.Marks:75**

Answer any **FIVE** questions. Each question carries 5 Marks

1. Give a detailed outline of the method of preparation of lipstick.
2. Differentiate between Vanishing and cold creams. Write their preparation.
3. What are essential oils. Write their importance.
4. Write a note on drug discovery and drug design.
5. Write synthesis of chloramphenicol.
6. What are CNS agents. Give examples.
7. Write about aerobic fermentation.
8. Write the production of ethyl alcohol and citric acid.

SECTION – B 5 x 10 = 50 M

Answer **ALL** the questions. Each question carries 10 M

9. a) Write the preparation and uses of Hair dye, hair spray and nail enamels

(OR)

b) Write the preparation and uses of Shampoo and face powder.

10. a) What do you mean by cosmetics. Explain with the help of suitable examples its various types.

(OR)

b) Write the importance of sandalwood oil, eucalyptus oil and rose oil in cosmetic industries.

11. a) Discuss the retrosynthetic approach in drug development by taking an example.

(OR)

b) Write the synthesis of aspirin and paracetamol.

12. a) Write the synthesis of any one antibiotic and antifungal agent.

(OR)

b) Write the synthesis of any one antilaprosy and HIV-AIDS related drugs.

13. a) Discuss the production of Cephalosporin in detailed.

(OR)

b) What is fermentation. Discuss how fermentation can be used for the industrial production of vitamin B^{12} and vitamin C.