

**ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION**

REVISED UG SYLLABUS UNDER CBCS  
(Implemented from Academic Year, 2020-21)  
PROGRAMME: FOUR YEAR B.Sc.(Hons)  
Domain Subject: **CHEMISTRY**

*Skill Enhancement Courses (SECs) for Semester V, from 2022-23 (Syllabus with Learning Outcomes, References, Co-curricular Activities & Model Q.P. Pattern)*

**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	IE Mar-ks	EE Mar-ks	Credits	Prac. Hrs./ Wk	Mar-ks	Credits
	6A	Synthetic Organic Chemistry	3	25	75	3	3	50	2
	7A	Analysis of Organic Compounds	3	25	75	3	3	50	2
OR									
	6B	Analytical Methods in Chemistry-1	3	25	75	3	3	50	2
	7B	Analytical Methods in Chemistry-1	3	25	75	3	3	50	2
OR									
	6C	Industrial Chemistry-1	3	25	75	3	3	50	2
	7C	Industrial Chemistry-2	3	25	75	3	3	50	2
OR									
	6D	Environmental Chemistry	3	25	75	3	3	50	2
	7D	Green Chemistry and Nanotechnology	3	25	75	3	3	50	2
OR									
	6E	Analytical Methods in Chemistry	3	25	75	3	3	50	2
	7E	Cosmetics and Pharmaceutical Chemistry	3	25	75	3	3	50	2

**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.

A.P. State Council of Higher Education  
Semester-wise Revised Syllabus under CBCS, 2020-21  
Four-year B.Sc.(Hons)  
Domain Subject: **CHEMISTRY**  
IV Year B.Sc.(Hons) –Semester–V

Course Code:

Max Marks: 100+50

**Course6-A: Synthetic Organic Chemistry**  
(Skill Enhancement Course (Elective), Credits: 05)

**I. 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.

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

**Unit-1: Per cyclic reactions**

**12 hours**

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

**Unit-2: Organic photochemistry**

**8hours**

1. Jablonski diagram-singlet and triplattates
2. Photochemistryof Carbonylcompounds- $n-\pi$ and $\pi-\pi^*$ transitions,Norrishtype-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, Synthons, 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 using 1, 3-Dithiane.

#### **Unit-5: Reagents in Organic Chemistry**

**10 hours**

Oxidizing agents: PCC, PDC, SeO<sub>2</sub> (Riley oxidation), NBS.

Reducing agents: LiAlH<sub>4</sub> (with mechanism), LTBA, Metal-solvent reduction (Birch reduction), Catalytic reduction.

### **III. References**

1. Peri cyclic reactions by Ian Fleming, Second edition, Oxford University press.
2. Peri cyclic Reactions-A Text book: Reactions, Applications and Theory by 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.

## Course6-A: Synthetic Organic Chemistry-PRACTICAL SYLLABUS

### IV. 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 of amino 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.

### V. 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 orange and methyl blue by column chromatography
5. Separation of food dyes using Column Chromatography
6. Separation of triglycerides using TLC

### VI. 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.

### VII. 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 than 15 hours on the field techniques/skills of detection of N, S and 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 observe the synthetic reactions. 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.*
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.

**VIII. Suggested Question Paper Pattern:**

Max. Marks: 75

Time: 3 hrs

SECTION – A (Total: 15 Marks)

Very Short Answer Questions (10Marks:5x2)

SECTION - B (Total: 4x5=20Marks)

(Answer any four questions. Each answer carries 5 marks

(At least 1 question should be given from each Unit)

1	
2	
3	
4	
5	
6	
7	
8	

SECTION - C (Total: 4x10 =40 Marks)

(Answer any four questions. Each answer carries 10 marks

(At least 1 question should be given from each Unit)

1	
2	
3	
4	
5	
6	
7	
8	

A.P. State Council of Higher Education  
Semester-wise Revised Syllabus under CBCS, 2020-21

Course Code:

Four-year B.Sc. (Hons)  
Domain Subject: **CHEMISTRY**  
IV Year B.Sc.(Hons) –Semester–V

Max Marks: 100+50

**Course7-A: Analysis of Organic Compounds**  
(Skill Enhancement Course (Elective), Credits: 05)

**I. 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 on 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.

**II. 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, But aldehyde, 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.

**III. References**

1. Organic Spectroscopy by William Kemp, Third Edition, Palgrave USA.
2. Introduction to Spectroscopy by Pavia, Lamp man, Kriza nd 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.Westand 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.

## Course7-A: Analysis of Organic Compounds - PRACTICAL SYLLABUS

### IV. 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 azodye.
3. Acquire skills in the separation of organic compounds in the given mixture using solvent extraction

### V. Practical (Laboratory) Syllabus:(30hrs)

(Max.50 Marks)

1. Identification of various equipment in the laboratory.
2. Acetylation of 1<sup>o</sup> 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.

### VI. 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.

### IV. 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 than 15 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 exceeding 10 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.



**VIII. Suggested Question Paper Pattern:**

Max. Marks: 75

Time: 3 hrs

SECTION - A (Total: 15 Marks)

Very Short Answer Questions (10Marks:5x2)

SECTION - B (Total: 4x5=20Marks)

(Answer any four questions. Each answer carries 5 marks)

(At least 1 question should be given from each Unit)

1	
2	
3	
4	
5	
6	
7	
8	

SECTION - C (Total: 4x10 =40 Marks)

(Answer any four questions. Each answer carries 10 marks)

(At least 1 question should be given from each Unit)

1	
2	
3	
4	
5	
6	
7	
8	

A.P. State Council of Higher Education  
Semester-wise Revised Syllabus under CBCS, 2020-21

Course Code:

Four-year B.Sc. (Hons)  
Domain Subject: **CHEMISTRY**  
IV Year B.Sc.(Hons)–Semester–V

Max Marks: 100+50

**Course6-B: Analytical Methods in Chemistry-1**  
(Skill Enhancement Course (Elective), Credits: 05)

**I. 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.

**II. 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.
2. 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.

**III. 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.

## **Course6-B: Analytical methods in chemistry-1-PRACTICALSYLLABUS**

### **IV. 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

### **V. 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.

### **VI. Lab References:**

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

### **VII. 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 exceeding 10 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.

**VIII. Suggested Question Paper Pattern:**

Max. Marks: 75

Time: 3 hrs

SECTION-A (Total: 15 Marks)

Very Short Answer Questions (10Marks:5x2)

SECTION- B (Total: 4x5=20Marks)

(Answer any four questions. Each answer carries 5 marks

(At least 1 question should be given from each Unit)

1	
2	
3	
4	
5	
6	
7	
8	

SECTION- C (Total: 4x10 =40 Marks)

(Answer any four questions. Each answer carries 10 marks

(At least 1 question should be given from each Unit)

1	
2	
3	
4	
5	
6	
7	
8	

A.P. State Council of Higher Education  
Semester-wise Revised Syllabus under CBCS, 2020-21

Course Code:

Four-year B.Sc. (Hons)  
Domain Subject: **CHEMISTRY**  
IV Year B.Sc.(Hons)–Semester–V

Max Marks: 100+50

**Course7-B: Analytical Methods in Chemistry-2**  
(Skill Enhancement Course (Elective), Credits: 05)

**I. 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.

**II. 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 of  $Fe^{+2}$ ,  $Mn^{+2}$  and  $Pb^{+2}$ .

**UNIT-5: Atomic spectroscopy****8hours**

Types, atomizer, atomic absorption and emission and applications.

**III. 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.

## Course7-B: Analytical Methods in Chemistry-2- PRACTICAL SYLLABUS

### V. 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

### VI. 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.

### VII. Lab References:

1. Text book of Vogel's Quantitative Chemical Analysis, Sixth edition, Pearson.
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.Gand Saunders B.C, Practical Organic Chemistry, Pearson Education.

### VII. Co-Curricular Activities:

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

**11. For Teacher:** Training of students by the teacher in laboratory and field for not less than 15 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.

**12. 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.

**13. 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.***

**10. 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.

**VIII. Suggested Question Paper Pattern:**

Max. Marks: 75

Time: 3 hrs

SECTION – A (Total: 15 Marks)

Very Short Answer Questions (10Marks:5x2)

SECTION - B (Total: 4x5=20Marks)

(Answer any four questions. Each answer carries 5 marks

(At least 1 question should be given from each Unit)

1	
2	
3	
4	
5	
6	
7	
8	

SECTION - C (Total: 4x10 =40 Marks)

(Answer any four questions. Each answer carries 10 marks

(At least 1 question should be given from each Unit)

1	
2	
3	
4	
5	
6	
7	
8	

A.P. State Council of Higher Education  
Semester-wise Revised Syllabus under CBCS, 2020-21

Course Code:

Four-year B.Sc. (Hons)  
Domain Subject: **CHEMISTRY**  
IV Year B.Sc.(Hons)–Semester–V

Max. Marks : 100+50

**Course6-C: Industrial Chemistry-1**  
(Skill Enhancement Course (Elective), Credits: 05)

**I. 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.

**II. 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.

### III. 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.

### Course6 C: Industrial Chemistry-1- PRACTICAL SYLLABUS

#### IV. 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.

#### V. Practical(Laboratory)Syllabus:(30hrs)

(Max.50 Marks)

1. Determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of Calcium in Calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.
4. Estimation of sucrose by colorimetry.

#### VI: 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

#### VII. 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.

**VIII. Suggested Question Paper Pattern:**

Max. Marks: 75

Time: 3 hrs

SECTION – A (Total: 15 Marks)

Very Short Answer Questions (10Marks:5x2)

SECTION – B (Total: 4x5=20Marks)

(Answer any four questions. Each answer carries 5 marks)

(At least 1 question should be given from each Unit)

1	
2	
3	
4	
5	
6	
7	
8	

SECTION – C (Total: 4x10 =40 Marks)

(Answer any four questions. Each answer carries 10 marks)

(At least 1 question should be given from each Unit)

1	
2	
3	
4	
5	
6	
7	
8	

A.P. State Council of Higher Education  
Semester-wise Revised Syllabus under CBCS, 2020-21

Course Code:

Four-year B.Sc. (Hons)  
Domain Subject: **CHEMISTRY**  
IV Year B.Sc.(Hons)–Semester–V

Max Marks: 100

**Course7-C: Industrial Chemistry-2**  
(Skill Enhancement Course (Elective), Credits: 05)

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 Inorganic polymers, Thermoplastic and Thermosetting 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: NO<sub>x</sub>, SO<sub>x</sub>, 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.

### III. References:

1. E.Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK
2. J.A.Kent: Riegel's *Handbook 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, 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 & Co Ltd.

### Course 7-C: Industrial Chemistry-2-PRACTICAL SYLLABUS

#### IV. 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.

#### V. Practical (Laboratory) Syllabus:(30hrs)

(Max.50 Marks)

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

#### VI. 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.

#### VII. 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 than 15 hours 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 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.

**VIII. Suggested Question Paper Pattern:**

Max. Marks: 75

Time: 3 hrs

**SECTION – A** (Total: 15Marks)

**Very Short Answer Questions** (10Marks:5x2)

**SECTION - B** (Total: 4x5=20Marks)

(Answer any four questions. Each answer carries 5marks  
(At least 1 question should be given from each Unit)

1	
2	
3	
4	
5	
6	
7	
8	

**SECTION – C** (Total: 4x10 =40 Marks)

(Answer any four questions. Each answer carries 10 marks  
(At least 1 question should be given from each Unit)

1	
2	
3	
4	
5	
6	
7	
8	

A.P. State Council of Higher Education  
Semester-wise Revised Syllabus under CBCS, 2020-21

Course Code:

Four-year B.Sc. (Hons)  
Domain Subject: **CHEMISTRY**  
IV Year B.Sc.(Hons)–Semester –V (from 2022-23)

**Course6-D: Environmental Chemistry**  
(Skill Enhancement Course (Elective), Credits -05      Max Marks: 100+50)

### **I. 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.
1. Engage in simple and advanced analytical tools used to measure the different types of pollution.
4. Explain the energy crisis and different aspects of sustainability.
5. 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.

**II 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.

### III. 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.

### Course6-D: Environmental Chemistry – Practical syllabus

#### IV. 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 Chemistry lab.
2. Learn the procedures of preparation of standard solutions.
3. Demonstrate skills in operating instruments.
4. Acquire skills in handling spectrophotometer.
5. Analyse water and soil samples.

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

1. Identification of various equipment in the laboratory.
2. Determination of carbonate and bicarbonate in water samples by double titration method.
3. Determination of hardness of water using EDTA
  - a) Permanent hardness
  - b) Temporary hardness
4. Determination of Chlorides in water samples by Mohr's method.
5. Determination of pH, turbidity and total solids in water sample.
6. Determination of  $\text{Ca}^{+2}$  and  $\text{Mg}^{+2}$  in soil sample by flame photometry.
7. Determination of PH in soil samples using pH metry.

## VI. List of Reference books:

1. A Text Book of Quantitative Inorganic Analysis (3<sup>rd</sup> Edition)–A.I.Vogel
2. Water pollution, Lalude, MC Graw Hill
3. Environmental analysis, SM Khopkar ( IIT Bombay )
4. Web related references suggested by teacher.

## VII. 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 than 15 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.

## VIII. Suggested Question Paper Pattern and Model (Theory):

Max.Marks:75

Time:3 hrs

### SECTION - A

Very Short Answer Questions

(Answer any five of the following questions.

Each answer carries 2 marks) (5 x2=10 Marks)

1. Explain the terms with examples  
a) Pollutant b)Contaminant
2. Write the reaction of atmospheric oxygen
3. Explain Greenhouse effect.
4. Brief note on Bhopal gas disaster.
5. Discuss what is Eutrophication and the effects of Eutrophication
6. Write the toxic effect of Lead and Mercury.
7. What are the biochemical effects of pesticides?
8. Explain food chain.
9. Define BOD & COD.
10. Write about the functions of Ecosystem.

**SECTION - B**

(Answer any five of the following questions.  
Each answer carries 5marks) (5x5=25Marks  
(At least 1 question should be given from each Unit)

1. Explain the scope and importance of environment in now-a-days.
2. Write about Hydrological cycle.
3. What are Acid rains?
4. Write a brief note on Global warming.
5. Explain the reasons for the Hardness of water.
6. Brief about Solid waste management.
7. Describe Biodiversity at regional level.
8. Discuss briefly about Carbon cycle.

**SECTION - C**

(Answer any four of the following questions.  
Each answer carries 10 marks) (4x10 = 40 Marks)  
(At least 1 question should be given from each Unit)

1. Explain the formation and depletion of the Ozone layer.
  2. Discuss about the renewable energy resources.
  3. What are the toxic effects of cyanide on the environment?
  4. Describe the methods to convert permanent hard water to soft water.
  5. Outline the functions and types of ecosystem.
  6. Give a detailed account on biodiversity
-

Four-year B.Sc. (Hons)  
Domain Subject: **CHEMISTRY**  
IV Year B. Sc.(Hons) Semester –V (from 2022-23)

Course7- D: Green Chemistry and Nanotechnology  
(Skill Enhancement Course (Elective), Credits – 05)

Max Marks: 100+50

### 1. 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.

**VI. 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, Hunsdiecker 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 CO<sub>2</sub>:** 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. Aldolcondensation –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.

### **III. 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.

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

1. Identification of various equipment in the laboratory.
2. Acetylation of 1<sup>o</sup> 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. 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.

### **V. 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.

## VI. 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.

## VII. Suggested Question Paper Pattern/ Model (Theory):

Max. Marks: 75

Time: 3 hrs

SECTION -A (Total: 10 Marks)

Very Short Answer Questions

(Answer any five of the following questions.

Each answer carries 2 marks) (5 x2=10 Marks)

1. What are the goals of Green chemistry
2. Explain green synthesis.
3. Discuss epoxidation.
4. Write a brief note on decaffeination
5. Describe the advantages of MAOS.
6. Explain Cannizaro reaction.
7. What are the uses of zeolites?
8. Define bio catalysis.
9. Discuss in brief aerosol method.
10. What is chemical vapour synthesis?

SECTION - B (Total: 25 Marks)

(Answer any five of the following questions.

Each answer carries 5marks) (5x5=25 Marks)

(At least 1 question should be given from each Unit

1. What is the need of green chemistry?
2. Discuss atom economy reactions.
3. Write short notes on Heck reaction.
4. Explain solid supported synthesis.
5. Describe the green synthetic procedure for the Diels-alder reaction
6. Brief about Bio catalysis.
7. How do you perform Strecker's synthesis by green synthesis method?
8. Discuss about Ultrasound assisted reactions.

SECTION – C (Total: 40 Marks)

(Answer any four of the following questions.

Each answer carries 10 marks) (4x10 = 40 Marks)

(At least 1 question should be given from each Unit)

1. Explain the basic principles of green chemistry
2. Illustrate the sonication method with any two reactions
3. Describe the preparation and properties of super critical carbon dioxide.
4. Explain the synthesis of fused anthro quinines by microwave assisted organic synthesis
5. How are adipic acid and catechol prepared by Green synthesis?
6. Discuss the classification and applications of Nanomaterials.

A.P. State Council of Higher Education  
Semester-wise Revised Syllabus under CBCS, 2020-21

Course Code:

Four-year B.Sc. (Hons)  
Domain Subject - **CHEMISTRY**  
IV Year B. Sc.(Hons)–Semester –V (from 2022-23)  
Course6-E: Analytical Methods in Chemistry  
(Skill Enhancement Course (Elective), Credits: 05)

Max Marks: 100+50

**I. 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.

**II. 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.

### **III. 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.
5. Perform some separation techniques of Organic compounds.

### **IV. 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  $\text{KMnO}_4$  Redox titration.
4. Determination of Saponification value of oil and Iodine value of oil.
5. Paper chromatographic separation of  $\text{Fe}^{3+}$ ,  $\text{Al}^{3+}$ , and  $\text{Cr}^{3+}$ .
6. Separation and identification of the monosaccharaides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the  $R_f$  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.

### **V. 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<sup>th</sup> edition
7. Chemistry experiments for instrumental methods, Donald T Sawyer William
8. Instrumental methods of analysis, Willard, Merit, Dean, 6<sup>th</sup> edition.
9. Web related references suggested by teacher.

### **VI. 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.

**VII. Suggested Question Paper Pattern and model :**

Max.Marks:75

Time:3 hrs

**SECTION- A** (Total: 10 Marks)

**Very Short Answer Questions** (5x2=10 Marks)

(Answer any five of the following questions.

Each answer carries 2 marks)

1. Define Precipitation and Coagulation.
2. Explain Iodometric titration with a suitable example.
3. What is Correlation coefficient?
4. What are the methods of expressing Accuracy?
5. Outline the principle involved in Solvent extraction.
6. Write a brief note on Synergism.
7. How can you classify the Chromatographic methods?
8. Explain two dimensional chromatography.
9. Discuss the basic principle involved in HPLC
10. What are stationary and mobile phases?

**SECTION - B**(Total: 25Marks)

(Answer any five of the following questions.

Each answer carries 5 marks)5x5=25Marks

(At least1 question should be given from each Unit)

1. Define the complex ometrictit rations with examples.
2. Discuss the choice of indictors for the titrations with suitable examples.
3. Write a short note on standard deviation.
4. What are the methods of expressing precision?
5. Describe the development of chromatogram in paper chromatography.
6. Explain the factors affecting Rfvalues.
7. What type of adsorbents and solvents used in thin layer chromatography?
8. Outline the applications of high performance liquid chromatography

**SECTION - C** (Total: 40 Marks)

(Answer any four of the following questions.

Each answer carries10 marks) 4x10 = 40 Marks

(At least 1 question should be given from each Unit)

1. Describe the acid-base titrations in detailed.
2. Discuss various types of errors with suitable examples.
3. Explain any two methods for solvent extraction.
4. Write the principle involved and applications of thin layer chromatography. Discuss the preparation of thin layer chromatography plates.
5. Discuss about column chromatography and the important applications.
6. Give the experimental procedure of paper chromatography. Write any two of its applications.

A.P. State Council of Higher Education  
Semester-wise Revised Syllabus under CBCS, 2020-21

Course Code:

Four-year B.Sc. (Hons)  
Domain Subject: Chemistry  
IV Year B. Sc.(Hons)– Semester – V (from 2022-23)

MaxMarks: 100+50

Course7- E: Cosmetics and Pharmaceutical Chemistry  
(Skill Enhancement Course (Elective), Credits- 05)

### I. 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.

**II. 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 tritrate), 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<sub>2</sub>, Vitamin B<sub>12</sub> and Vitamin C.

### III. 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.

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

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

#### **V. Reference Books:**

1. A handbook of Industrial 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 Highton 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.

#### **VI. 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 for not less than 15 hours on field 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.

### **Suggested Question Paper Pattern and Model:**

Max.Marks:75

Time:3hrs

#### SECTION –A (Total: 10 Marks)

##### Very Short Answer Questions

(Answer any five of the following questions.  
Each answer carries 2 marks)(5x2=10 Marks)

1. What are the ingredients in the preparation of talcum powder?
2. Discuss the properties of good hair remover.
3. What are volatile oils? Give any two examples.
4. Describe the importance of Eucalyptus and Rose oils.
5. Explain analgesics with suitable examples.
6. How can a drug be targeted to an organ?
7. What are Antibacterial? Give an example.
8. Give the structure of Phenobarbital. Describe it's use as drug
9. What are Antibiotics? Give any two examples.
10. Explain the discovery of Penicillin.

#### SECTION - B(Total: 25Marks)

(Answer any five of the following questions.  
Each answer carries 5 marks)5x5=25Marks

(At least 1 question should be given from each Unit)

1. Give a detailed outline of the method of preparation of Lipsticks.
2. Differentiate between vanishing and cold creams. Discuss their preparation.
3. Differentiate between Deodorants and Antiperspirants with suitable examples.
4. Outline the synthesis of Aspirin.
5. How do you understand by screening in drug development and what is it's significance?
6. Explain the fermentation process for the synthesis of Lysine.
7. Discuss the synthesis of Glycerol nitrate and give it's medicinal importance.
8. Outline the production of Ethyl alcohol.

#### SECTION - C (Total: 40 Marks)

(Answer any four of the following questions.

Each answer carries 10 marks) 4x10 = 40 Marks  
(At least 1 question should be given from each Unit)

1. What do you mean by cosmetics? Explain with the help of suitable examples its various types.  
Differentiate between the following with suitable examples:
  - a) Antiperspirant and Deodorant.
  - b) Perfumes/Cologne and Aftershaves.
    1. c) Perspiration/sweating and pheromone.
    - d) Middle notes and base notes in perfumery.
  2. (a) Explain what is fermentation?  
(b) Explain Aerobic fermentation.  
(c) Discuss how fermentation can be used for the industrial production of Vitamin B<sub>12</sub> & Vitamin C
  3. (a) Discuss the retro synthetic approach in drug development.  
(b) Outline the synthesis of Ibuprofen.
  4. Discuss the production of Cephalosporin in detailed.

5. Outline the synthesis of Chloramphenicol and Sulphonamide.

Draft syllabus prepared by:

1. Dr. M. Mahaboob Pacha,  
Associate Professor (Retd).Govt. Degree College,  
Ramachandrapuram.
2. Dr. C.A. Jyothirmayee  
Associate Professor in Chemistry  
Ch SD St Theresa's college for women (A), ELURU
3. Mr. P. Kiran Kumar,AssistantProfessor,  
S.G.A.Govt.DegreeCollege,  
Yellamanchili
4. Prof C. Suresh Reddy,  
ProfessorofChemistry, S.V.University, Tirupati.

=====