

**ANDHRAPRADESH 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 Marks | EE Marks | Credits | Prac. Hrs./ Wk | Marks | 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

Course Code:

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

### Course 6-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.
3. 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 test 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 Hydrological 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, McGraw Hill
5. Environmental Chemistry, Anil Kumar De, Wiley Eastern Ltd.
6. Environmental analysis, S.M. Khopkar (IIT Bombay)
7. Environmental Chemistry by B.K. Sharma & H.K. 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.

### Course 6-D: Environmental Chemistry – Practical syllabus

#### IV. Labwork-Skills Outcomes:

On successful completion of this practical course, students 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. 50 Marks).

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, McGraw Hill
3. Environmental Analysis, S.M. 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: 15 hrs)

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. Visit 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 × 2 = 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 5 marks))

(5x5=25 Marks)

(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

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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**

Max Marks: 100+50

IV Year B.Sc. (Hons) Semester  
-V (from 2022-23)

Course 7-D:  
Green Chemistry and  
Nanotechnology  
(Skill Enhancement Course (Elective), Credits-05)

### 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.

**I. Syllabus:** Total Hours: 90, including Teaching, Lab, Field Training, Unit test 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, dry cleaning)

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** 10hrs.

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

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

- 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.
- 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. Labwork-Skills Outcomes:

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

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

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

- Identification of various equipment in the laboratory.
- Acetylation of 1<sup>o</sup> amine by green method: Preparation of acetanilide
- Rearrangement reaction in green conditions: Benzil -Benzilic acid rearrangement
- Radical coupling reaction: Preparation of 1,1-bis-2-naphthol
- Green oxidation reaction: Synthesis of adipic acid
- Preparation and characterization of biodiesel from vegetable oil/waste cooking oil
- Preparation and characterization of Nanoparticles of gold using tea leaves.
- Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.
- Photoreduction of Benzophenone to Benzopinacol in the presence of sunlight.

### V. Reference books:

- Green Chemistry Theory and Practical. P.T. Anatas and J.C. Warner
- Green Chemistry V.K. Ahluwalia Narosa, New Delhi.
- Real world cases in Green Chemistry M.C. Cann and M.E. Connelly
- Green Chemistry: Introductory Text M. Lancaster: Royal Society of Chemistry (London)
- Principles and practice of heterogeneous catalysis, Thomas J.M., Thomas M.J., John Wiley
- Green Chemistry: Environmental friendly alternatives RSSanghli and M.M. Srivastava, Narosa Publications
- Nanotechnology: Health and Environmental Risks, Jo Anne Shatkin, CRC Press (2008).
- Green Processes for Nanotechnology: From Inorganic to Bioinspired Nanomaterials, Vladimir A. Basiuk, Elena V. Basiuk Springer (2015)
- 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) (5x2=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 Cannizzaro reaction.
7. What are the uses of zeolites?
8. Define biocatalysis.
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 5 marks) (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)

1. Explain the basic principles of green chemistry
2. Illustrate the sonication method with any two reactions
3. Describe the preparation and properties of supercritical 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.

