



# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

## COURSE CONTENT

ENGINEERING CHEMISTRY LABORATORY								
<b>I Semester: CSE / CSE (CS) / CSE (DS)</b>								
<b>II Semester: AE / ME / CE / ECE / EEE / CSE (AI&amp;ML) / IT</b>								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P		C	CIA	SEE
AHSD05	Foundation	-	-	3	1	40	60	100
<b>Contact Classes: Nil</b>	<b>Tutorial Classes: Nil</b>	<b>Practical Classes: 36</b>			<b>Total Classes: 36</b>			
<b>Prerequisite:</b> Basic Principles of Chemistry								

### I. COURSE OVERVIEW:

The course encourages introducing analytical tools in an Engineering perspective. The course efforts to provide the basic knowledge of analytical methodology, outlines the importance of volumetric analysis, comprehensive instrumental analysis for properties of polymers, colorimetric analysis and spectroscopic analysis. This practical approach gives the essence of analytical chemistry for skill development in determinations of materials properties and its viability in the industry.

### II. COURSES OBJECTIVES:

#### The students will try to learn:

- I. The quantitative analysis to know the strength of unknown solutions by instrumental methods.
- I. The troubles of hard water and its estimation by analytical techniques.
- II. The applications of appropriate lubricant for finely tuned machinery.
- III. The basic knowledge on quantity of light absorbed by the materials.

### III. COURSE OUTCOMES:

#### After successful completion of the course students should be able to:

- CO1 Use conductivity meter and potentiometer for measurement of conductance and electromotive force of solutions
- CO2 Use PH meter for measurement of Strength of Acidic Solutions.
- CO3 Make use of the principles of water analysis for domestic and industrial applications.
- CO4 Predict the Properties of polymeric materials by synthesizing the monomers.
- CO5 Use different types of lubricants to know its properties for the proper lubrication of machinery in industries.
- CO6 Interpret the absorption tendency of solids or liquids by using Colorimetry and spectroscopy techniques.

## IV. COURSE CONTENT:

### 1. GETTING STARTED EXERCISES

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#### 1.1 Introduction to Chemistry Laboratory

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The fundamental concepts and theories required for carrying out qualitative and quantitative analysis.

Detailed explanation on the analytical techniques used for qualitative analysis. Emphasis on instrumental method of analysis and its advantages over conventional methods.

- i. Types of analysis
  - ii. Difference between qualitative and quantitative analysis
  - iii. Common techniques of qualitative and quantitative analysis
  - iv. Introduction to instrumental method of analysis
  - v. Introduction to basic techniques and handling of common apparatus
  - vi. Discussion of Material Safety Data Sheet (MSDS) of chemicals
  - vii. Identification of toxic signs and safety procedures of chemical laboratory
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#### 1.2 Safety Guidelines to Chemistry Laboratory

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The chemistry laboratory must be a safe place in which to work and learn about chemistry.

- i. Wear a chemical-resistant apron.
  - ii. Be familiar with your lab work sheet before you come to lab. Follow all written and verbal instructions carefully. Observe the safety alerts in the laboratory directions. If you do not understand a direction or part of a procedure, ask the teacher before proceeding.
  - iii. When entering the laboratory room, do not touch any equipment, chemicals, or other materials without being instructed to do so. Perform only those experiments authorized by the instructor.
  - iv. If you take more of a chemical substance from a container than you need, you should not return the excess to the container. This might cause contamination of the substance remaining. Dispose of the excess as your instructor directs.
  - v. Never smell anything in the laboratory unless your teacher tells you it is safe. Do not smell a substance by putting your nose directly over the container and inhaling. Instead, waft the vapors toward your nose by gently fanning the vapors toward yourself.
  - vi. Do not directly touch any chemical with your hands. Never taste materials in the laboratory.
  - vii. Work areas should be kept clean and tidy at all times. Always replace lids or caps on bottles and jars.
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#### 1.3 Data recording and reports

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Students must record their experimental values in the provided tables in this laboratory manual and reproduce them in the laboratory worksheets. Worksheets are integral to recording the methodology and results of an experiment. In engineering practice, the laboratory worksheets serve as a valuable reference to the technique used in the laboratory. Note that the data collected will be an accurate and permanent record of the data obtained during the experiment and the analysis of the results.

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## 2. CONDUCTOMETRY

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- 2.1 Determine the neutralization point between strong acid against strong base
- i. The basic principle of conductometric titrations
  - ii. Titration of unknown solution of acid with base
  - iii. Graphical plots on volume of titrant vs. conductance
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## 3. POTENTIOMETRY

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### 3.1 Estimate the amount of Iron by using potentiometry

- i. The basic principle of potentiometric titrations
  - ii. Titration of Mohr's salt with potassium dichromate
  - iii. Graphical plots on volume of titrant vs. potential
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## 4. pH METRY

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### 4.1 Determine the pH of the unknown solution by pH metry

- i. The basic principle of pH metry
  - ii. Titration of unknown solution with standard acid
  - iii. Graphical plots on volume of titrant vs. pH to obtain equivalence point
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## 5. ARGENTOMETRIC TITRATIONS

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### 5.1 Determination of chloride content of water by argentometry

- i. Principle of Argentometric titration.
  - ii. Titration of water samples by using EDTA to find the total hardness in water.
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## 6. MEASUREMENT OF TOTAL DISSOLVED SOLIDS IN WATER

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### 6.1 Measurement of total dissolved solids (TDS) in different water samples

- i. Specifications of potable water
  - ii. Measure the total dissolved solids in different water samples by TDS meter
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## 7. COMPLEXOMETRY METHOD

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### 7.1 Estimate the total hardness of water by EDTA

- i. Principle of complexometric titration
- ii. Titration of water samples by using EDTA to find the total hardness in water.

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## 8. PREPARATION OF POLYMERS

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### 8.1 Synthesize Thiokol rubber using sodium polysulphide with 1, 2-Dichloroethane.

- i. Preparation of elastomers from chemicals.
- ii. Applications of Thiokol rubber.

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## 9. VISCOSITY OF LUBRICANT

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### 9.1 Determine the viscosity of the lubricants using Red Wood viscometer / Ostwald's viscometer

- i. **The principle of viscosity of lubricant**
- ii. Significance of viscosity index of lubricant
- iii. Viscosity of given lubricant at various temperature by using Red wood viscometer

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## 10. FLASH AND FIRE POINTS OF LUBRICANT

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### 10.1 Determine the flash and fire points of lubricants

- i. **Significance of flash and fire point of lubricant in industries**
- ii. Flash and Fire points of a given lubricant by using Pensky Martens flash point apparatus

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## 11. CLOUD AND POUR POINTS OF LUBRICANT

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### 11.1 Determine cloud and pour points of lubricants

- i. **Significance of cloud and pour point of lubricants in industries**
- ii. Cloud and Pour points of a given lubricant by using cloud and pour point apparatus

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## 12. COLORIMETRY

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### 12.1 Estimate the metal ion concentration using colorimeter

- i. Complexation of metal ion with ligands
- ii. Detection of absorbance of the colored metal -ligand complex solution
- iii. Graphical determination of concentration of the metal ions in the solution

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## 13. SPECTROSCOPY

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### 13.1 Characterization of nanomaterials by UV-visible spectrophotometer

- i. Synthesis of silver oxide nanomaterials
- ii. Dispersion of nanoparticles in suitable solvent
- iii. Determination of absorption edge of the nanoparticles using spectroscopic technique

## V. TEXTBOOKS:

1. K. Mukkanti et al. *Practical Engineering Chemistry*, B.S. Publications, Hyderabad.
2. Vogel's, *Quantitative chemical analysis*, prentice Hall, 6<sup>th</sup> Edition, 2009.

## VI. REFERENCE BOOKS:

1. Solanki, M. K. *Engineering Chemistry Laboratory Manual*. (Edu creation Publishing, 2019).
2. Jeffery, G. H. in *TEXTBOOK OF QUANTITATIVE CHEMICAL ANALYSIS* (ed John Wiley and Sons) (1989).

3. Gary-D-Christian, P. K. S. D., Kevin A. Schug. Analytical-Chemistry-by-Gary-D-Christian. 7 edn, Vol. 7 826 (Wiley, 2014).
4. Budinski, Kenneth G., Engineering materials: properties and selection, 5th edition, Prentice-Hall, 1996, pg.423.
5. Engineering chemistry by Jain & Jain, 17<sup>th</sup> Edition, ISBN:978-93-5216-641-1
6. Nitin K Puri, "Nanomaterials synthesis properties and applications" I K international publishing house Pvt Ltd, 1st Edition 2021.
7. B. Ramadevi and P. Aparna, S Chand publications, *lab manual for engineering chemistry*, S Chand publications, NewDelhi,1<sup>st</sup> Edition 2022.

#### **VII. ELECTRONICS RESOURCES:**

1. <https://nptel.ac.in/translation>
2. <https://nptel.ac.in/courses/115105120>
3. <https://archive.nptel.ac.in/courses/122/101/122101001/#>

#### **VIII. MATERIALS ONLINE**

1. Course Template
2. Laboratory Manual