



**RAJAGIRI SCHOOL OF ENGINEERING & TECHNOLOGY  
(AUTONOMOUS)**

**B.TECH. DEGREE PROGRAMME**

**FIRST SEMESTER  
(2020 ADMISSIONS)**

<b>100908/CH900B</b>	<b>ENGINEERING CHEMISTRY</b>
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**SYLLABUS**

Rajagiri Valley, Kakkanad,  
Kochi 682 039, Kerala, INDIA  
[www.rajagiritech.ac.in](http://www.rajagiritech.ac.in)

<b>COURSE CODE</b>	<b>COURSE NAME</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>CREDIT</b>	<b>YEAR OF INTRODUCTION</b>
<b>100908/CH900B</b>	<b>ENGINEERING CHEMISTRY</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>	<b>2020</b>

- 1. Preamble:** To enable the students to acquire knowledge in the concepts of chemistry for engineering applications and to familiarize the students with different application-oriented topics like spectroscopy, electrochemistry, instrumental methods etc. Also familiarize the students with topics like mechanism of corrosion, corrosion prevention methods, SEM, stereochemistry, polymers, desalination etc., which enable them to develop abilities and skills that are relevant to the study and practice of chemistry.
- 2. Prerequisite:** Concepts of chemistry introduced at the plus two levels in schools

### 3. Syllabus

#### Module 1

Introduction - Differences between electrolytic and electrochemical cells - Daniel cell - redox reactions - cell representation. Different types of electrodes (brief) - Reference electrodes - SHE - Calomel electrode - Glass Electrode - Construction and Working. Single electrode potential - definition - Helmholtz electrical double layer -Determination of  $E^0$  using calomel electrode.Determination of pH using glass electrode.Electrochemical series and its applications. Free energy and EMF - Nernst Equation - Derivation - single electrode and cell (Numericals) -Application - Variation of emf with temperature. Potentiometric titration - Introduction -Redox titration only.Lithiumion cell - construction and working.Conductivity- Measurement of conductivity of a solution (Numericals).Corrosion-Electrochemicalcorrosion – mechanism. Galvanic series- cathodic protection - electroless plating –Copper and Nickel plating.

#### Module 2

Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numericals). UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications.IR-Spectroscopy – Principle - Number of vibrational modes - Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications.  $^1\text{H}$  NMR spectroscopy – Principle - Relation between

field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief).

### **Module 3**

Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$  and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ . Chromatographic methods - Basic principles and applications of column and TLC- Retention factor. GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications. Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nanomaterials - Surface characterisation -SEM – Principle and instrumentation (block diagram).

### **Module 4**

Isomerism-Structural, chain, position, functional, tautomerism and matamerism - Definition with examples - Representation of 3D structures-Newman, Sawhorse, Wedge and Fischer projection of substituted methane and ethane. Stereoisomerism - Geometrical isomerism in double bonds and cycloalkanes (cis-trans and E-Z notations). R-S Notation – Rules and examples - Optical isomerism, Chirality, Enantiomers and Diastereoisomers-Definition with examples.Conformational analysis of ethane, butane, cyclohexane, mono and di methyl substituted cyclohexane. Copolymers - Definition - Types - Random, Alternating, Block and Graft copolymers - ABS - preparation, properties and applications.Kevlar-preparation, properties and applications.Conducting polymers - Doping -Polyaniline and Polypyrrole - preparation properties and applications. OLED - Principle, construction and advantages.

### **Module 5**

Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages. Municipal water treatment (brief) - Disinfection methods - chlorination, ozone andUV irradiation.Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD- definition, estimation (only brief procedure) and significance (Numericals). Sewage water treatment- Primary,

Secondary and Tertiary - Flow diagram -Trickling filter and UASB process.

#### 4. Text Books

1. B. L. Tembe, Kamaluddin, M. S. Krishnan, “Engineering Chemistry (NPTEL Web-book)”, 2018.
2. P. W. Atkins, “Physical Chemistry”, Oxford University Press, 10<sup>th</sup> edn., 2014.

#### 5. Reference Books

1. C. N. Banwell, “Fundamentals of Molecular Spectroscopy”, McGraw-Hill, 4<sup>th</sup>edn., 1995.
2. Donald L. Pavia, “Introduction to Spectroscopy”, Cengage Learning India Pvt. Ltd., 2015.
3. B. R. Puri, L. R. Sharma, M. S. Pathania, “Principles of Physical Chemistry”, Vishal Publishing Co., 47<sup>th</sup> Edition, 2017.
4. H. H. Willard, L. L. Merritt, “Instrumental Methods of Analysis”, CBS Publishers, 7<sup>th</sup> Edition, 2005
5. Ernest L. Eliel, Samuel H. Wilen, “Stereo-chemistry of Organic Compounds”, WILEY, 2008.
6. Raymond B. Seymour, Charles E. Carraher, “Polymer Chemistry: An Introduction”, Marcel Dekker Inc; 4th Revised Edition, 1996.
7. MuhammedArif, Annette Fernandez, Kavitha P. Nair “Engineering Chemistry”, Owl Books, 2019.
8. Ahad J., “Engineering Chemistry”, Jai Publication, 2019.
9. Roy K. Varghese, “Engineering Chemistry”, Crownplus Publishers, 2019.
10. Soney C. George, RinoLaly Jose, “Text Book of Engineering Chemistry”, S. Chand & Company Pvt Ltd, 2019.

#### 6. Course Outcomes: After the completion of the course the student will be able to

**CO1:** Apply the basic concepts of electrochemistry and corrosion to explore its possible applications in various engineering fields and an ability to design and construct electrochemical energy storage devices like cells, batteries etc

**CO2 :** Understand various spectroscopic techniques like UV-Visible, IR, NMR and its applications and to analyze and deduce the structure of chemical compounds

**CO3:** Apply the knowledge of analytical method for characterizing a chemical mixture or compound. Understand the basic concept of SEM for surface characterisation of nanomaterials

**CO4:** Learn about the basics of stereochemistry and its application. Apply the knowledge of conducting polymers and advanced polymers in engineering

**CO5:** To develop skills for treating water by understanding various water treatment methods

### 7. Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1									
CO2	1	1		1	2							
CO3	1	1		1	2							
CO4	2	1										
CO5	1			1			3					

### Assessment Pattern (marginal changes can be made according to question paper pattern):

Learning Objectives	Continuous Internal Evaluation (CIE)		End Semester Examination (ESE out of 100)
	Internal Examination 1 (25)	Internal Examination 2 (25)	
Remember	4	4	20
Understand	4	4	25
Apply	7	7	25
Analyse	5	5	20
Evaluate	5	5	10

## 8. Mark Distribution

Total	CIE				ESE
	Attendance	Internal Examination	Assignment/Quiz/Course Project	Total	
150	10	25 (Average of two scores)	15	50	100

## 9. End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question will have 2 sub-divisions (7 marks each) and carry 14 marks.