Course Title	ENVIRONMENTAL CHEMISTRY					B. Tech. AL & ML (I Sem)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2023102	**BS**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 2Hrs					**End Exam Duration: 3Hrs**			

Course Objectives:

- To provide the fundamental knowledge concerning the chemical-physical characteristics of air, water and soil
- Able to understand the main environmental pollutants present & control measures

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	**Understand** the interconnections between different sectors of the environment like soil, water, atmosphere.
CO 2	**Explain** basic chemical composition of water & factors that influence the quality of water
CO 3	**Describe** waste water treatment processes and the practical approach for testing water quality involved.
CO 4	**Analyze** the different types of pollutions such as Soil & Radioactive pollution which influence the environment
CO 5	**Better realization** about the causes of Industrial pollution &sustainable development by applying Green Chemistry.

Unit-1: Introduction to Environment & Atmosphere Chemistry:

Introduction to environment, Atmosphere, environmental segments, Components of environment, earth's radiation balance, particulates, ions, radicals and their formation. Air pollution: Introduction, Sources-oxides of C, N, S, their effects& control measures. Climatic changes- acid rain, Photo chemical smog formation, Green-house effect, global warming and ozone depletion

Learning Outcomes

- Explain the importance of environment
- List the various effects on environment

Unit-2: Hydrosphere:

Water; Sources of water & its distribution in environment, Chemical composition of water bodies-lakes, streams, rivers, sea, estuaries etc., hydrological cycle. Water pollution-inorganic,

organic pesticides, industrial and radioactive materials, oil spills and oil pollutants, eutrophication, Biomagnification, Water borne diseases.

Learning Outcomes

- Understand different sources of water & chemical composition
- List the causes of water pollution & its effects

Unit-3: Water Quality parameters and its Analysis:

Various water quality parameters- drinking & industrial water. Experimental methods for measuring Hardness of water by EDTA method, DO by Winkler's method, Chlorides, Alkalinity, & TDS. Waste water treatment; domestic waste water-aerobic and anaerobic treatment, and industrial waste water treatment- Open Pond system.

Learning Outcomes:

- List various parameters for water quality analysis
- Explain water analysis methods
- Outline the waste water treatment methods

Unit-4: Soil Pollution

Soil pollution - agricultural pollution - use of chemical fertilizers - Organic chemicals and environment-Agrochemicals-Pesticides, insecticides and herbicides, effects of various pesticides in agriculture on excessive use.

Learning Outcomes:

- Explain the different types of chemicals responsible for soil pollution
- Understand the merits and demerits of agrochemicals

Unit-5: Environmental Pollution and Control

Effects of Air pollution, Water pollution, Soil pollution& Radioactive pollution and their control measures. Solid waste disposal - methods - solid waste from mining and metal production and its disposal - electro-coagulation and flocculation.

Learning Outcomes:

- Explain the effects of air, water and soil pollution
- Outline the solid waste disposal methods

Textbooks:

1. Perspectives in Environmental Studies – Anubha Kaushik, C. P. Kaushik, New Age International Publishers
2. Fundamental Concepts of Environmental Chemistry- Sodhi G S – Oxford University
3. Environmental Chemistry- Anil Kumar De-Willey Publications
4. Environmental Science & Engineering, Glynn Henry J ,Heinke Gary w, Pearson publications

5. Environmental Studies by Benn Joseph, Mc Graw Hill publications

Reference Books:

1. Environmental Science & Engineering, 2nd Edition, P. Yuganath, R. Kumaravelan, Scitech Publication(India), Pvt.Ltd.
2. Air pollution-M.N. Rao, HVN Rao- Mc Graw Hill publications
3. Environment Impact Assessment- Larry W. Canter- Mc Graw Hill publications
4. Environmental Science, A Global Concerns, William P. Cunningham, Mary Ann Cunningham, Mc Graw Hill publications.

Faculty Incharge **HOD/H&S**

Course Title	ENGINEERING CHEMISTRY					B. Tech. ME(I Sem) CE (II Sem)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20EC102 (I Sem) 20EC202 (II Sem)	**BSC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	1	0	3	40	60	100
Mid Exam Duration: 2Hrs						**End Exam Duration: 3Hrs**		

Course Objectives:

- To familiarize engineering chemistry and its applications
- To impart the concept of soft and hard waters, softening methods of hard water
- To train the students on the principles and applications of electrochemistry, polymers, surface chemistry, and cement.

Course Outcomes (CO)

CO	On successful completion of this course, the students will be able to
CO 1	**Evaluate** the amount of hardness and dissolved oxygen present in water sample.
CO 2	**Demonstrate** the corrosion prevention methods and factors affecting corrosion.
CO 3	**Explain** the preparation, properties, and applications of thermoplastics & thermosetting, Elastomers & conducting polymers
CO 4	**Understand** the setting and hardening of cement and concrete phase.
CO 5	**Analyze** the concepts of colloids, micelle and nanomaterials.

Unit 1: Water Technology (10 hrs)

Introduction –Soft Water and hardness of water, hardness of water by EDTA Method, Estimation of dissolved oxygen (Winkler's method)-Boiler troubles –Priming, foaming**,** scale and sludge, Caustic embrittlment, Industrial water treatment – specifications for drinking water, Bureau of Indian Standards(BIS) and World health organization(WHO) standards, ion-exchange processes - desalination of brackish water, reverse osmosis (RO) and electro dialysis.

Learning outcomes:

The student will be able to

- List the differences between temporary and permanent hardness of water
- Explain the principles of reverse osmosis and electro dialysis
- Compare quality of drinking water with BIS and WHO standards
- Illustrate problems associated with hard water - scale and sludge
- Explain the working principles of different Industrial water treatment processes

Unit 2: Electrochemistry and Applications: (10 hrs)

Introduction to electrodes – concepts, electrochemical cell, Nernst equation, cell potential calculations.
Primary cells – Zinc-air battery, Secondary cells – Nickel-Cadmium (NiCad),and lithium ion batteries- working of the batteries including cell reactions; Fuel cells, hydrogen-oxygen, methanol fuel cells – working of the cells.
Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry electrochemical corrosion, Pilling Bed worth ratios and uses, Factors affecting the corrosion, Cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).

Learning Outcomes:

At the end of this unit, the students will be able to

- Apply Nernst equation for calculating electrode and cell potentials
- Apply Pilling Bed worth rule for corrosion and corrosion prevention
- Demonstrate the corrosion prevention methods and factors affecting corrosion
- Compare different batteries and their applications

Unit 3: Polymers and Fuel Chemistry: **(8 hrs)**

Introduction to polymers, Polymer dispersion index, functionality of monomers, Mechanism of chain growth, step growth and coordination polymerization.
Thermoplastics and Thermo-setting plastics-: Preparation, properties and applications of poly styrene. PVC and Bakelite
Elastomers – Preparation, properties and applications of Buna S, Buna N, Thiokol
Fuels – Types of fuels, calorific value, numerical problems based on calorific value; Analysis of coal, Liquid Fuels refining of petroleum, fuels for IC engines, knocking and anti-knock agents, Octane and Cetane values, cracking of oils; alternative fuels- propane, methanol and ethanol, bio-fuels.

Learning Outcomes:

At the end of this unit, the students will be able to

- Explain different types of polymers and their applications
- Solve the numerical problems based on Calorific value
- Select suitable fuels for IC engines
- Explain calorific values, octane number, refining of petroleum and cracking of oils

UNIT-4 Advanced Engineering Materials (10 hrs)

Refractories- Classification, Properties, Factors affecting the refractory materials and Applications.
Lubricants- Classification, Functions of lubricants, Mechanism, Properties of lubricating oils – Viscosity, Viscosity Index, Flash point, Fire point, Cloud point.
Building materials- Portland cement, constituents, phases and reactivity of clinker, Setting and Hardening of cement.

Learning Outcomes:

At the end of this unit, the students will be able to

- Identify the factors affecting the refractory material
- Illustrate the functions and properties of lubricants
- Demonstrate the phases and reactivity of concrete formation
- Identify the constituents of Portland cement
- Enumerate the reactions at setting and hardening of the cement

Unit 5: Surface Chemistry and Applications: (10 hrs)

Introduction to surface chemistry, colloids, micelle formation, synthesis of colloids (Dispersion method), chemical and electrochemical method (chemical vapour deposition) of preparation of nano metals and metal oxides, stabilization of colloids and nanomaterials by stabilizing agents, applications of colloids and nanomaterials –medicine.

Learning Outcomes:

At the end of this unit, the students will be able to

- Summarize the concepts of colloids, micelle and nanomaterials
- Explain the synthesis of colloids with examples
- Outline the preparation of nanomaterials and metal oxides
- Identify the application of colloids and nanomaterials in medicine

Text Books:

1. A textbook of Engineering chemistry by Shashi Chawla, Dhanpat Rai & Co publications
2. Text Book of Physical Chemistry, Samuel Glasstone, Mcmillian publications.
3. Textbook of Polymer Science, Third Edition, Fred W. Billi Meyer, TR, A Wiley-Inter Science Publications.
4. An Introduction to Electrochemistry, Glasstone, Arihant Publications.

Reference Books:

1. Textbook of Engineering Chemistry, Jain and Jain, DhanpatRai& Co publications, 2013
2. D.J. Shaw, Introduction to Colloids and Surface Chemistry, Butterworth-Heineman,1992.
3. Water Technology, 2nd Edition, N.F. Gray, Elsevier publications, 2005.
4. H.F.W. Taylor, Cement Chemistry, 2/e, Thomas Telford Publications, 1997.

Faculty In-charge **HOD/ H&S**

Course Title	CHEMISTRY					B. Tech. CSE (I Sem)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2023102	**BSC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	1	0	3	40	60	100
Mid Exam Duration: 2Hrs					**End Exam Duration: 3Hrs**			

Course Objectives:

- To familiarize engineering chemistry and its applications.
- To train the students on the principles and applications of electrochemistry and polymers.
- To introduce instrumental methods, molecular machines and switches.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	**Compare** the materials of construction for battery and electrochemical sensors.
CO 2	**Explain** the preparation, properties, and applications of thermoplastics & thermosetting, elastomers & conducting polymers.
CO 3	**Understand** the principles of spectrometry, slc in separation of solid and liquid mixtures.
CO 4	**Remember** the principle of Band diagrams in application of conductors and semiconductors.
CO 5	**Analyze** the principles and different application of analytical instruments.

Unit 1: Structure and Bonding Models: (10 hrs)

Planck's quantum theory, dual nature of matter, Schrodinger equation, significance of Ψ and Ψ^2, applications to hydrogen, molecular orbital theory – bonding in homo- and heteronuclear diatomic molecules – energy level diagrams of O2 , NO and CO, etc., calculation of bond order.

Learning Outcomes:

At the end of this unit, the students will be able to

- **apply** Schrodinger wave equation to hydrogen atom (L3)
- **illustrate** the molecular orbital energy level diagram of different molecular species (L2)
- **explain** the calculation of bond order of O2, NO and CO molecules (L2)
- **discuss** the basic concept of molecular orbital theory (L3)

Unit 2: Modern Engineering materials: **(10 hrs)**

i).Understanding of materials: Crystal field theory – salient features – splitting in octahedral, tetrahedral and square planar geometry. Properties of coordination compounds-Oxidation state, coordination, magnetic properties and colour.

ii). Semiconductor materials, super conductors- basic concept, band diagrams for conductors, semiconductors and insulators, Effect of doping on band structures.

iii). Nanochemistry: Introduction, classification of nano materials, properties and applications of Fullerenes, carbon nano tubes and Graphines nanoparticles.

Learning Outcomes:

At the end of this unit, the students will be able to

- Explain splitting in octahedral and tetrahedral geometry of complexes (L2).
- Discuss the magnetic behavior and colour of coordination compounds (L3).
- Explain the band theory of solids for conductors, semiconductors and insulators (L2)
- Demonstrate the application of Fullerenes, carbon Nano tubes and Graphines nanoparticles (L2).

Unit 3: Electrochemistry and Applications: (10 hrs)

Introduction to Electrodes – concepts, reference electrodes (Calomel electrode, Ag/AgCl electrode and glass electrode); Electrochemical cell, Nernst equation, cell potential calculations and numerical problems, Potentiometry- Potentiometry titrations (redox titrations), concept of conductivity, conductivity cell, conductometric titrations (acid-base titrations), pH metric concepts.

Primary cells – Zinc-air battery, Secondary cells – Nickel-Cadmium (NiCad),and lithium ion batteries- working of the batteries including cell reactions; Fuel cells, hydrogen-oxygen, methanol fuel cells – working of the cells.

Learning Outcomes:

At the end of this unit, the students will be able to

- Apply Nernst equation for calculating electrode and cell potentials (L3)
- Differentiate between ph metry, Potentiometry and conductometric titrations (L2)
- Explain the theory of construction of battery and fuel cells (L2)
- Solve problems based on cell potential (L3)

Unit 4: Polymer Chemistry: (10 hrs)

Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, coordination polymerization, copolymerization (stereo specific polymerization) with specific examples and mechanisms of polymer formation.

Plastics - Thermoplastics and Thermo settings, Preparation, properties and applications of – PVC, Teflon, Bakelite, Nylon-6,6.

Elastomers–Buna-S, Buna-N–preparation, properties and applications.

Conducting polymers – polyacetylenes,– mechanism of conduction and applications.

Learning Outcomes:
At the end of this unit, the students will be able to

- explain the different types of polymers and their applications (L2)
- explain the preparation, properties and applications of Bakelite, Nylon-6,6, (L2)
- describe the mechanism of conduction in conducting polymers (L2)
- discuss Buna-S and Buna-N elastomers and their applications (L2)

Unit 5: Instrumental Methods and Applications (10 hrs)
Electromagnetic spectrum. Absorption of radiation: Beer-Lambert's law. Regions of Electromagnetic radiation. UV-Visible**,** IR Spectroscopes'- (selection rules, principles and applications). Solid-Liquid Chromatography–TLC, retardation factor.

Learning outcomes:
After completion of Unit IV, students will be able to:

- Explain the different types of spectral series in electromagnetic spectrum (L2)
- Understand the principles of different analytical instruments (L2)
- Explain the different applications of analytical instruments (L2)

Text Books:
1. Jain and Jain, Engineering Chemistry, 16/e, DhanpatRai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

Reference Books:

1. G.V.Subba Reddy, K.N.Jayaveera and C. Ramachandraiah, Engineering Chemistry, Mc Graw Hill, 2020.
2. D. Lee, Concise Inorganic Chemistry, 5/e, Oxford University Press, 2008.
3. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.
4. J.M.Lehn, Supra Molecular Chemistry, VCH Publications.

Faculty In-charge **HOD/ H&S**

K.S.RM. COLLEGE OF ENGINEERING: KADAPA R-18

(AUTONOMOUS INSTITUTION)

SYLLABUS FOR ENGINEERING CHEMISTRY
(Common to CE, ME, EEE- I SEM)
(Common to ECE & CSE - II SEM)

L	T	P	C
3	1	0	4

Course Objectives:

- Knowledge in Chemistry serves as basic nutrient for the understanding and thereby design of materials of importance in life. Thus the advancement in Engineering depend on the outcome of basic sciences.
- The Engineering Chemistry course for undergraduate students is framed to strengthen the fundamentals of chemistry and then build an interface of theoretical concepts with their industrial! Engineering applications.
- The course main aim is to impart in-depth knowledge of the subject and highlight the role of chemistry principles (or) applications in the field of engineering.
- An attempt has been made to logically correlate the topic with its application.
- After the completion of the course, the student would understand about the concepts of chemistry .

•Course Outcomes

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications.
Quantum theory is more than 100 years old and to understand phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels.

•The course will enable the student to:

•1.Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces. Properties of metals, water and thermodynamic considerations.

2. Rationalize periodic properties such as ionization potential, electro negativity and oxidation states .

3. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.

4. Remember the major chemical reactions that are used in the synthesis and streochemistry of molecules.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**1**	**3**	**-**	**-**	**2**	**-**	**-**	**3**	**-**	**2**	**-**
CO2	**3**	**1**	**-**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**-**	**-**	**3**	**-**	**-**	**1**	**-**	**3**	**-**	**-**	**-**
C04	**-**	**2**	**-**	**-**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**

*3 –maximum ; 2-minimum ; 1-low

Module-1 : Atomic and molecular structure

Schrodinger wave equation. Particle in a box (one dimensional) and their applications .Molecular orbital's of diatomic molecules and plots of the multicenter orbital's. Equations for atomic and molecular orbital's. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Learning Outcomes: At the end of this unit, the student will be able to

*****apply Schrodinger wave equation to particle in a box.

*****illustrate the molecular orbital energy diagrams of diatomic molecules.

*****get knowledge on properties of conductors, semiconductors and insulators and role of doping.

*****discuss the magnetic behavior of transition metal complexes.

Module-2: Periodic properties

Effective nuclear charge, penetration of orbital's, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electro negativity, polarizability, oxidation states, coordination numbers and geometries, hard, soft acids and bases.

Learning Outcomes: At the end of this unit, the student will be able to

*describe the arrangement of the elements in the periodic table.

*explains the discovery of electron ,proton and neutron and their characteristics.

*explains the rules of electron filling in atoms and writes the electronic configuration.

* Explains the energies of s ,p, d, f orbitals & identifies the periodic properties and can explain how they vary in group and period.

*illustrate the geometries of complex structures andexplains the acid- base nature

Module-3:

Intermolecular forces

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena.

Use of free energy in chemical equilibria

Thermodynamic functions: Introduction, define energy, entropy , Free energy. Free energy and emf. Cell potentials ,Nernst equation and applications .Water chemistry-types of water and Boiler troubles. Corrosion-types of corrosion and factors influencing corrosion.

Learning Outcomes: At the end of this unit, the student will be able to

*****explains the formation of ionic bond and dipolar interactions**.**

*explains the behavior of real gases and describe the conditions required for liquification and gases and critical phenomenon.

*illustrate the definitions of energy and entropy and apply Nernst equation for calculating cell potentials.

*list the differences between temporary and permanent hardness and illustrate problems associated with use of hard water in boilers

*demonstrate corrosion types and factors influencing corrosion.

Module-4: Spectroscopic techniques and applications

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomicmolecules.

Learning Outcomes: At the end of this unit, the student will be able to

*****explains principles of spectroscopy and explains different types of spectral series in electromagnetic spectrum.

*****Illustrate the principle of fluorescence and its application in medicine

*derive equation for rotational and vibrational spectra and its application for diatomic molecules.

Module-5:

Stereochemistry

Representations of 3 dimensional structures, structural isomers and stereo isomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis of Cyclohexane.

Simple Organic Reactions

Introduction to reactions involving Substitution(SN^1 &SN^2), Addition Reactions involving C=C(Markonikoffreaction)&C=O(Grignardreagent),Elimination(E_1&E_2)Oxidation(Baeyer villiger reaction),Reduction(Clemmensen reduction).

Learning Outcomes: At the end of this unit, the student will be able to

*represent the organic molecule in 3-dimensional structure.

*explains different types of isomers with examples.

*illustrate the mechanisms of substitution ,addition and elimination reaction.

*explains oxidation and reduction reactions.

Suggested Text Books

1. Engineering Chemistry, Satyaprakash, Khanna Book Publishing, Delhi
2. A Text Book of Engg. Chemistry, Shashi Chawla, Dhanpat Rai & Co. (P) Ltd.
3. . Essentials of Physical Chemistry, Bahl&Tuli, S.Chand Publishing
4. Applied Chemistry, Sunita Rattan, Kataria
5. Engineering Chemistry, Baskar, Wiley
6. . Engineering Chemistry – I, D. GrourKrishana, Vikas Publishing
7. . Laboratory Manual Engg. Chemistry, Anupma Rajput, Dhanpat Rai & Co.

Engineering Chemistry Laboratory R18

L	T	P	C
0	0	3	1.5

Choice of experiments from the following:

1.Estimation of Hardness of Water present in given water sample by EDTA method.

2. Determination of surface tension and viscosity.

3. Determination of chloride content of water.

4.Colligative properties using freezing point depression.

5.Estimation of Dissolved Oxygen present in given water sample by Winkler's method.

6.Potentiometry - determination of Redox potentials and emfs.

7.Synthesis of a polymer/drug.

8.Saponification/acid value of an oil.

9. Determination of cell constant and conductance of solutions..

10.Chemical oscillations- Iodine clock reaction.

11.Determination of the partition coefficient of a substance between two immiscibleliquids.

12. Adsorption of acetic acid by charcoal.

Laboratory Outcomes

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering.

The students will learn to:

*Estimate rate constants of reactions from concentration of reactants/products as afunction of time.

*Measure molecular/system properties such as surface tension, viscosity,conductance of solutions, redox potentials, chloride content of water, etc.

*Synthesize a small drug molecule and analyse a salt sample.

K.S.RM. COLLEGE OF ENGINEERING: KADAPA R-18

(AUTONOMOUS INSTITUTION)

SYLLABUS FOR ENGINEERING CHEMISTRY
(Common to CE, ME, EEE- I SEM)
(Common to ECE & CSE - II SEM)

L	T	P	C
3	1	0	4

Course Objectives:

- Knowledge in Chemistry serves as basic nutrient for the understanding and thereby design of materials of importance in life. Thus the advancement in Engineering depend on the outcome of basic sciences.
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Quantum theory is more than 100 years old and to understand phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels.

•The course will enable the student to:

•1.Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces. Properties of metals, water and thermodynamic considerations.

2. Rationalize periodic properties such as ionization potential, electro negativity and oxidation states .

3. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.

4. Remember the major chemical reactions that are used in the synthesis and streochemistry of molecules.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**1**	**3**	**-**	**-**	**2**	**-**	**-**	**3**	**-**	**2**	**-**
CO2	**3**	**1**	**-**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**-**	**-**	**3**	**-**	**-**	**1**	**-**	**3**	**-**	**-**	**-**
C04	**-**	**2**	**-**	**-**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**

*3 –maximum ; 2-minimum ; 1-low

Module-1 : Atomic and molecular structure

Schrodinger wave equation. Particle in a box (one dimensional) and their applications .Molecular orbital's of diatomic molecules and plots of the multicenter orbital's. Equations for atomic and molecular orbital's. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Learning Outcomes: At the end of this unit, the student will be able to

*****apply Schrodinger wave equation to particle in a box.

*****illustrate the molecular orbital energy diagrams of diatomic molecules.

*****get knowledge on properties of conductors, semiconductors and insulators and role of doping.

*****discuss the magnetic behavior of transition metal complexes.

Module-2: Periodic properties

Effective nuclear charge, penetration of orbital's, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electro negativity, polarizability, oxidation states, coordination numbers and geometries, hard, soft acids and bases.

Learning Outcomes: At the end of this unit, the student will be able to

*describe the arrangement of the elements in the periodic table.

*explains the discovery of electron ,proton and neutron and their characteristics.

*explains the rules of electron filling in atoms and writes the electronic configuration.

* Explains the energies of s ,p, d, f orbitals & identifies the periodic properties and can explain how they vary in group and period.

*illustrate the geometries of complex structures andexplains the acid- base nature

Module-3:

Intermolecular forces

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena.

Use of free energy in chemical equilibria

Thermodynamic functions: Introduction, define energy, entropy , Free energy. Free energy and emf. Cell potentials ,Nernst equation and applications .Water chemistry-types of water and Boiler troubles. Corrosion-types of corrosion and factors influencing corrosion.

Learning Outcomes: At the end of this unit, the student will be able to

*****explains the formation of ionic bond and dipolar interactions**.**

*explains the behavior of real gases and describe the conditions required for liquification and gases and critical phenomenon.

*illustrate the definitions of energy and entropy and apply Nernst equation for calculating cell potentials.

*list the differences between temporary and permanent hardness and illustrate problems associated with use of hard water in boilers

*demonstrate corrosion types and factors influencing corrosion.

Module-4: Spectroscopic techniques and applications

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomicmolecules.

Learning Outcomes: At the end of this unit, the student will be able to

*****explains principles of spectroscopy and explains different types of spectral series in electromagnetic spectrum.

*****Illustrate the principle of fluorescence and its application in medicine

*derive equation for rotational and vibrational spectra and its application for diatomic molecules.

Module-5:

Stereochemistry

Representations of 3 dimensional structures, structural isomers and stereo isomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis of Cyclohexane.

Simple Organic Reactions

Introduction to reactions involving Substitution(SN^1 &SN^2), Addition Reactions involving C=C(Markonikoffreaction)&C=O(Grignardreagent),Elimination(E_1&E_2)Oxidation(Baeyer villiger reaction),Reduction(Clemmensen reduction).

Learning Outcomes: At the end of this unit, the student will be able to

*represent the organic molecule in 3-dimensional structure.

*explains different types of isomers with examples.

*illustrate the mechanisms of substitution ,addition and elimination reaction.

*explains oxidation and reduction reactions.

Suggested Text Books

1. Engineering Chemistry, Satyaprakash, Khanna Book Publishing, Delhi
2. A Text Book of Engg. Chemistry, Shashi Chawla, Dhanpat Rai & Co. (P) Ltd.
3. . Essentials of Physical Chemistry, Bahl&Tuli, S.Chand Publishing
4. Applied Chemistry, Sunita Rattan, Kataria
5. Engineering Chemistry, Baskar, Wiley
6. . Engineering Chemistry – I, D. GrourKrishana, Vikas Publishing
7. . Laboratory Manual Engg. Chemistry, Anupma Rajput, Dhanpat Rai & Co.

Engineering Chemistry Laboratory R18

L	T	P	C
0	0	3	1.5

Choice of experiments from the following:

1.Estimation of Hardness of Water present in given water sample by EDTA method.

2. Determination of surface tension and viscosity.

3. Determination of chloride content of water.

4.Colligative properties using freezing point depression.

5.Estimation of Dissolved Oxygen present in given water sample by Winkler's method.

6.Potentiometry - determination of Redox potentials and emfs.

7.Synthesis of a polymer/drug.

8.Saponification/acid value of an oil.

9. Determination of cell constant and conductance of solutions..

10.Chemical oscillations- Iodine clock reaction.

11.Determination of the partition coefficient of a substance between two immiscibleliquids.

12. Adsorption of acetic acid by charcoal.

Laboratory Outcomes

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering.

The students will learn to:

*Estimate rate constants of reactions from concentration of reactants/products as afunction of time.

*Measure molecular/system properties such as surface tension, viscosity,conductance of solutions, redox potentials, chloride content of water, etc.

*Synthesize a small drug molecule and analyse a salt sample.

SYLLABUS FOR ENGINEERING CHEMISTRY
(CE, ME – I Sem)
(EEE, ECE, CSE- II Sem)

Objectives:

- Knowledge in Chemistry serves as basic nutrient for the understanding and thereby design of materials of importance in life. Thus the advancement in Engineering depend on the outcome of basic sciences.
- The Engineering Chemistry course for undergraduate students is framed to strengthen the fundamentals of chemistry and then build an interface of theoretical concepts with their industrial! Engineering applications.
- The course main aim is to impart in-depth knowledge of the subject and highlight the role of chemistry principles (or) applications in the field of engineering.
- An attempt has been made to logically correlate the topic with its application.
- After the completion of the course, the student would understand about the concepts of chemistry in respect of water, Polymers with their applications, Energy sources, material chemistry and advanced chemistry.

Course Outcomes

CO 1: Recall differences between hard and soft water, disadvantages of using hard water domestically and industrially.

CO 2: Understand the electrochemical sources of energy and corrosion.

CO 3: Apply suitable methods for treatment of water, fuel analysis, lubricants and principles of green techniques.

CO 4: Analyze the industrial based polymers, various engineering materials.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	3	-	1	-	-	-
CO2	-	-	3	-	-	-	1	-	2	-	-	-
CO3	-	-	3	-	3	-	2	-	-	-	-	-
C04	1	3	-	-	-	2	-	-	-	-	-	-

*3 –maximum; 2-minimum; 1-low.

UNIT-I:

Water: Sources of water, types of impurities in water. Hardness of water: Causes, expression of hardness - units - Types of hardness-Temporary & permanent hardness of water. Disadvantages of hard water, Methods of treatment of water for domestic purpose Analysis of water : Hardness of water by EDTA method, Estimation of Dissolved oxygen by Winkler's method Numerical problems. **Boiler troubles** - Scale & Sludge formation, caustic embrittlement, Boiler corrosion, priming & foaming. Softening of water -Internal Treatment: phosphate,colloidal,calgon,carbonate and sodium aluminate treatment, External treatment : Zeolite, Ion exchange process. Reverse osmosis, electro dialysis.

UNIT -II:

Polymers: Introduction, Types of Polymerization, Mechanism (chain growth & Step growth). Plastics: Thermoplastic resins & Thermo set resins. Compounding of plastics, Preparation, properties, engineering applications of polyethylene, Bakelite, Nylon, Teflon. Elastomers-Natural rubber, vulcanization, Compounding of rubber,
Synthetic Rubbers :Buna-S, Butyl rubber and Thiokol Rubbers.
Inorganic Polymers : Basic introduction, Preparation, properties and engineering applications of Silicones, Polyphospazins(-(R)2-P=N-)

UNIT-III:

Electrochemistry: Basic concepts for construction of Electrochemical cells, Types of cells: Concentration cells, Galvanic cells. Electrochemical Series. Batteries- Primary (Laclanche cell) and Secondary Batteries (Lead acid cell) .Fuel cells-H_2-0_2fuel cell and methanol- oxygen fuel cells. Corrosion- Introduction, Types and Mechanism of Corrosion(Wet and Dry corrosion), factors influence corrosion, Control of Corrosion- Cathodic Protection(Sacrificial anodic protection & impressed current cathodic protection). Basic principles of Electroplating, Electroless plating.

UNIT-IV:

Fuel technology:
Fuels: Classification, Characteristics of good fuel. Solid fuels: Manufacture of Metallurgical coke by Otto Hoffmann's by product oven process. Liquid fuels – petroleum crude - refining of petroleum. Synthetic petrol: Bergius and Fischer Tropsech's process, Calorific value of fuels: HCV, LCV, determination of Calorific value of solid fuels(Bomb calorimetry).
Lubricants: Functions of lubricant, mechanism of lubrication(thick film, thin film& extreme pressure lubrication). Properties of lubricants: Viscosity, Flash & fire point,Cloud and pour point, Aniline point.

UNIT- V:

Advanced Chemistry:

Green Chemistry: Introduction , Significance of green chemistry, 12 principles of Green chemistry.
.
Photo Chemistry: Introduction, Fluorescence, Phosphorescence, Luminiscent compounds, Solar cells
Catalysis: Introduction, Types of Catalysis(Homogenous& Heterogenous catalysis) Action of catalyst (Catalytic promoters,Catalytic inhibitor and catalytic poisons) and applications of catalyst.

TEXTBOOKS

1 Text Book of Engineering Chemistry, Jain and Jain, DhanapathRai Publishing Company, New Delhi, 15th Edition, 2010.
2 Engineering Chemistry by Jayaveera, G.V. Subba Reddy, Tata McGraHill Publications, Edition 2013.
3 Text Book of Engineering Chemistry, Shashichawla, DhanapathRai Publications, New Delhi, 4th Edition, 2011.
4 Text Book of Engineering Chemistry by S.S. Dara&Mukkati S. Chand & Co Publishers, New Delhi, 2006.

REFERENCES

1. Text Book of Engineering Chemistry - C. Parameswara Murthy, C.V. Agarwal and Andra Naidu, BS Publications, Hyderabad, 3rd Edition, 2008.
2. Engineering Chemistry by K.B. Chandra Sekhar, UN. Das and Sujatha Mishra, SClTECH, Publications India Pvt. Limited, Chennai, 2nd Edition, 2012.
3. Chemistry of Engineering Materials by C.V. Agarwal, A. Naidu, BS publications.

ENGINEERING CHEMISTRY

(Common to all branches)

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	CR
14231004	BS	Engineering Chemistry	2	0	0	30	70	3

Objectives:

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- An attempt has been made to logically correlate the topic with its application.
- After the completion of the course, the student would understand about the concepts of chemistry in respect of water, Polymers with their applications, Energy sources, material chemistry and advanced chemistry.

UNIT I

Water: Introduction, Hardness: Causes, expression of hardness – units – Types of hardness, estimation of temporary & permanent hardness of water, analysis of water, numerical problems. Boiler troubles – Scale & Sludge formation, caustic embrittlement, corrosion, priming & foaming, Softening of water (Internal & External treatment – Lime soda, Zeolite, Ion exchange process) Reverse osmosis, electro dialysis.

UNIT II

Polymers: Types of Polymerization, Mechanism (chain growth & Step growth). Plastics: Thermoplastic resins & Thermo set resins. Compounding of plastics, preparation, properties, engineering applications of polyethylene, PVC, Bakelite, Nylon. Conducting polymers: Poly acetylene, Polyaniline, conduction, doping, Applications. Rubber – Natural rubber, vulcanization. Elastomers – Buna-s, Butyl rubber, Thiokol Rubbers, Fibres – Polyester fiber, Inorganic polymers – Silicones.

UNIT III

Energy sources: Batteries, fuels, classification – conventional fuels (solid, liquid, gaseous) Solid fuels – coal and their significance, Liquid fuels – primary – petroleum – refining of petroleum – cracking, knocking, synthetic petrol – Bergius and Fischer Tropsech's process; Gaseous fuels – natural gas, analysis of flue gas by Orsat's method, combustion – problems, Calorific value of fuel – HCV, LCV, determination of calorific value by Junker's gas calorie meter. Nuclear energy, Solar cells.

UNIT IV

Material Chemistry: Cement: composition of Portland cement, manufacture of port land Cement, setting & hardening of cement (reactions). Refractories: Classification, Characteristics of a good refractory. Lubricants: Criteria of a good lubricant, mechanism, properties of lubricants: Cloud, point, pour point, flash & fire point, Viscocity. Rocket Propellants – Classification and Characteristics of good propellants.

UNIT – V

Advance Chemistry: Green Chemistry: Introduction, Goals and Significance of green chemistry, basic components of green chemistry, industrial applications – products from natural materials, Green solvents, Green fuels and e-green propellents, Bio- catalysis.

PhotoChemistry:Introduction,Fluorescence,,Phosphorescence,Luminescent compounds, Photo and light responsive compounds.

Catalysis: Introduction, action of catalyst (Catalytic promoters and catalytic poisons) Types of Catalysis.

Instrumental Techniques: Chromatography, UV-visible spectroscopy, IR Spectrophotometry, AA.

Textbooks:

1.A Text Book of Engineering Chemistry, Jain and Jain, DhanapathRai PublishingCompany, New Delhi, 15th Edition, 2010.

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References Books:

1. Text Book of Engineering Chemistry – C. Parameswara Murthy, C.V. Agarwal and Andra Naidu, BS Publications, Hyderabad, 3rd Edition, 2008.
2. Engineering Chemistry by K.B. Chandra Sekhar, UN. Das and Sujatha Mishra, SCITECH, Publications India Pvt. Limited, Chennai, 2nd Edition, 2012.
3. Text Book of Engineering Chemistry by S.S. Dara&Mukkati S. Chand & Co Publishers, New Delhi, 2006.
4. Chemistry of Engineering Materials by C.V. Agarwal, C.P. Murthy, A. Naidu, BS Publications.

K.S.RM. COLLEGE OF ENGINEERING: KADAPA (R14)

(AN AUTONOMOUS INSTITUTION)

SYLLABUS FOR ENGINEERING CHEMISTRY
(Common to all Branches)

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UNIT-I:

Water: Introduction, Hardness: Causes, expression of hardness - units - Types of hardness, estimation of temporary & permanent hardness of water, analysis of water : Hardness of water, DO, TDS, Estimation of Chlorides, Fluorides and available Chlorine in water. Numerical problems.
Boiler troubles - Scale & Sludge formation, caustic embrittlement, Boiler corrosion, priming & foaming. Softening of water (Internal & External treatment - Zeolite, Ion exchange process) Reverse osmosis, electro dialysis.

UNIT -II:

Polymers: Introduction, Types of Polymerization, Mechanism (chain growth & Step growth). Plastics: Thermoplastic resins & Thermo set resins. Compounding of plastics, preparation, properties, engineering applications of polyethylene, PVC, Bakelite, Nylon. Conducting polymers: Poly acetylene, Polyaniline properties and applications. Elastomers: Natural rubber, vulcanization, Buna-S, Butyl rubber and Thiokol Rubbers.

UNIT-III:
Energy systems:

Electrochemistry: Introduction, types of cells: concentration cells, galvanic cells, Electro chemical Series, Batteries- Primary (Laclanche cell) and Secondary Batteries (Lead acid cell) , fuel cells-H_2-0_2fuel cell, methanol- oxygen fuel cells and PCM fuel cells.
Corrosion- Introduction, mechanism, types of Corrosion, factors influence corrosion, control of corrosion- cathodic protection, Anodic protection, Electro plating, Electroless plating.

UNIT-IV:

Material Chemistry and applications:
Fuels: classification, conventional fuels (solid, liquid, gaseous), Solid fuels: Manufacture of Metallurgical coke, Liquid fuels – petroleum crude - refining of petroleum - cracking, knocking, Octane number, Cetane number. Synthetic petrol: Bergius and Fischer Tropsech's process, Calorific value of fuels: HCV, LCV, determination of solid and gaseous fuels. Combustion- Problems.
Refractories: Classification, Characteristics of a good refractory.
Lubricants: Criteria of a good lubricant, mechanism, properties of lubricants: Viscosity, flash & fire point Cloud and pour point, Aniline point.

UNIT- V:

Advanced Chemistry:
Green Chemistry: Introduction, Goals and Significance of green chemistry, basic components of green chemistry, industrial applications - products from natural materials, Green solvents, Green fuels and e-green propellents, Bio-catalysis.
Photo Chemistry: Introduction, Fluorescence, Phosphorescence, Luminiscent compounds, Photo and light responsive compounds. Solar cells
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4. Chemistry of Engineering Materials by C.V. Agarwal, C.P. Murthy, A. Naidu, BS Publications.

ENGINEERING CHEMISTRY LAB

OBJECTIVES

- This course on Chemistry Lab is designed with 12 experiments in an academic year. 1t is common to all branches of Engineering in B.Tech 1st Year.
- The objective of the course is that the student will have exposure to various experimental skills which is very essential for an Engineering student.
- The experiments are selected from various areas of Chemistry like Conductometry, Polymers, Energy sources and water.
- Also the student is exposed to various tools like Analytical Balance, pH meter, Viscometer, conductometer, Bomb calorimeter, etc.

LIST EXPERIMENTS

I. Introduction to Lab - Analytical Balance, Molarity, Normality, Calculations, Glass ware.

II. W ATER ANALYSIS:

1. Determination of total hardness of water by EDTA method.
2. Estimation of Dissolved Oxygen present in given water sample by Winkler's method
3. Determination of Acidity of water
4. Estimation of chloride ions using Potassium Chromite Indicator.

III. CONDUCTOMETRY

1. Conductometric titrations of strong acid Vs strong base (Neutralization titration)
2. Conductometric titrations of Barium Chloride Vs Sodium Sulphate (Precipitation titration)

IV. PHYSICAL PROPERTIES

1. Determination of viscosity of oils by Redwood viscometer I & II.
2. Determination of calorific value of fuel sample using Bomb Calorimetry.

V. TITRIMETRY

1. Estimation of Iron by Diphenyl amine indicator.
2. Determination of Copper by EDT A method.
3. Determination of Copper by Iodometry .

VI. Preparation of Phenol Formaldehyde resin (Bakelite)

REFERENCES

1. Vogel's Text book of Quantitative Chemical Analysis, J. Mendham et.al., Pearson Education, Sixth Edition, 2012.
2. Laboratory manual on Engineering Chemistry, Anupama Rajput, Dhanpat Rai& Co Publications.
3. Essentials of Experimental Engineering Chemistry, Shashichawla, DhanpatRai& Co Publications.

OUTCOME

The student is expected to learn from this laboratory course the concept of error and its analysis. It also allows the student to develop experimental skills to design new experiments in Engineering. With the exposure to these experiments the student can compare the theory and correlate with experiment.