ENGINEERING CHEMISTRY-Syllabus

Course Category	Basic Sciences	**Course Code**	19BC1T01
Course Type	Theory	L-T-P-C	3-0-3-4.5
Prerequisites	Intermediate Chemsitry	Internal Assessment Semester End Examination Total Marks	40 60 100

COURSE OBJECTIVES	
1	To learn about the hardness of water, boiler troubles, Drinking water standards and methods of removal of hardness of water
2	To get knowledge on Electrochemical cells, Batteries and fuel cells and their applications
3	To study about the factors affecting corrosion, controlling methods and about organic coatings
4	To learn about Cement, its setting and hardness, methods of polymerization, Plastics and Elastomers
5	To study about Nano materials, their preparation and applications and to gain awareness on smart materials,

COURSE OUTCOMES	
Upon successful completion of the course, the student will be able to:	
CO1	Distinguish between temporary and permanent hardness of water.
CO2	Illustrate the principles and applications of Batteries and Fuel cells
CO3	Identify different types of corrosion and their controlling methods.
CO4	Illustrate the principles of setting and hardening of cement and explain about polymers and their engineering applications.
CO5	Analyze the importance of nano and smart materials and Illustrate the principle of BET & TEM.

Contribution of Course Outcomes towards achievement of Program : Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1		**2**	**1**	**2**		**3**	**3**				**3**	**1**	**1**		**1**
CO2	**2**	**1**			**2**		**1**				**2**	**2**			
CO3	**1**		**2**		**2**		**1**				**1**			**1**	
CO4	**3**		**1**	**2**		**1**	**1**				**2**		**1**		
CO5	**2**		**3**			**2**	**2**				**1**	**1**			

COURSE CONTENT	
UNIT I	**WATER TECHNOLOGY** **9 hrs** Introduction –Hard and Soft water, Estimation of hardness by EDTA Method - Boiler troubles - scale and sludge-priming and foaming and Caustic Embrittlement; Specifications for drinking water, Bureau of Indian Standards (BIS) and World health organization (WHO) standards, Industrial water – Primary and secondary treatments, zeolite and ion-exchange processes- desalination of brackish water, reverse osmosis (RO) and electro dialysis. **Learning outcomes:** After the completion of the Unit I, the student will be able to • **explain** the principles of reverse osmosis and electro dialysis. (**L-2)** • **compare** the quality of drinking water with BIS and WHO standards. (**L-2)** • **illustrate** boiler troubles associated with hard water. (**L-2)** • **demonstrate** the Industrial water treatment processes. (**L-2)**
UNIT II	**ENERGY SOURCES AND APPLICATIONS** **9 hrs** Electrode potential, determination of single electrode potential –Nernst's equation, Reference electrodes: Hydrogen and calomel electrodes – electrochemical series and its applications Batteries: Primary cell- dry or Leclanche cell, Secondary cell- Nickel-Cadmium cell – lithium batteries (Lithium-MnO_2); Fuel cells- H_2-O_2 fuel cell Solar energy: Photovoltaic cell and its applications. Fuels- Classification and characteristics-Liquid fuels- Refining of petroleum; gaseous fuels-LPG and CNG applications **Learning outcomes:** After the completion of the Unit II, the student will be able to • **define** electrode potential. (**L-1)** • **derive** Nernst's equation. (**L-2)** • **outline** the difference between primary and secondary cells. (**L-2)** • **identify** the applications of photo voltaic cell. (**L-2)** • **discuss** the applications of LPG and CNG (**L-2**)
UNIT III	**CORROSION ENGINEERING** **6+6 hrs** **III-A: Corrosion:** Definition – theories of corrosion-Dry corrosion: Metal oxide formation - pilling bed worth ratio; Electro chemical corrosion: Mechanism, Factors affecting corrosion (nature of the metal and nature of the environment). **III-B: Corrosion controlling methods:** Sacrificial and Impressed current cathodic protection. Metallic coatings – Galvanizing and Tinning- Electro plating and Electro less plating; Anodic inhibitors and Cathodic inhibitors. Organic coatings – Paints and Varnishes (constituents and their functions). **Learning outcomes:** After the completion of the Unit III, the student will be able to • **explain** theories of corrosion. (**L-2)** • **identify** the various factors affecting corrosion. (**L-3)** • **classify** different inhibitors of corrosion (**L-2**) • **choose** different organic coatings. (**L-3)** • **apply** the principles of corrosion control. **(L-3)**
UNIT IV	**ENGINEERING MATERIALS AND POLYMERS** **10 hrs** **Cement:** Portland cement, constituents, Manufacture of Portland Cement, Chemistry of setting and hardening of Cement (hydration, hydrolysis, equations). **Refectories-**Classification, properties(refractoriness, refractoriness under load, porosity) **Polymers**: Introduction-Methods of Polymerization (Emulsion and Suspension), Conducting polymers

	– Mechanism of conduction in poly acetylene – applications, Bio – degradable polymers. **Plastics**: Thermoplastics and thermo setting resins; Moulding of plastics – Compression and Injection moulding - Preparation, properties and applications of Polystyrene and Bakelite. **Elastomers**: Natural Rubber, Vulcanization of rubber; Synthetic Rubbers -Preparation, properties and applications of Buna-S and Thiokol. **Learning outcomes:** After the completion of the Unit IV, the student will be able to • **illustrate** the chemical reactions involved in the manufacturing of cement and properties of refractories. (**L-2)** • **identify** preparation and properties of different polymers. **(L-3)** • **distinguish** between thermoplastic and thermo setting resins. (**L-4)** • **identify** applications of conducting polymers **(L-3)**
UNIT V	**NANO AND SMART MATERIALS** **8 hrs** **Nano Materials:** Introduction to Nano materials, Preparation of Carbon Nano Tubes(CNTs) by Laser Ablation and Chemical Vapor Deposition Methods, Fullerenes -Preparation, Properties and Applications; Chemical synthesis of nano materials : Sol-gel method, Characterization of nano mateirals by BET & TEM (basic principles), Applications of nano materials in waste water treatment, lubricants, Medicine and sensors. **Smart Materials:** Introduction – Types of smart materials-Self healing materials, Shape memory alloys and uses of smart materials. **Learning outcomes:** After the completion of the Unit V, the student will be able to • **classify** nano materials. (**L-2)** • **explain** the synthesis and characterization methods of nano materials. (**L-2)** • **explain** principles of BET & TEM. **(L-4)** • **identify** different types of smart materials. (**L-2)**

TEXT BOOKS	
1.	P.C. Jain and M. Jain, Engineering Chemistry, 15/e, Dhanapat Rai & Sons, Delhi (2014).
2.	Engineering Chemistry by Shikha Agarwal: Cambridge University Press,2019 edition .
REFERENCE BOOKS	
1.	Sashi Chawla, A Textbook of Engineering Chemistry, Dhanapath Rai and sons, (2003)
2.	S.S. Dara, A Textbook of Engineering Chemistry, S.Chand & Co, (2010)
3.	N. Krishna Murthy and Anuradha, A text book of Engineering Chemistry, Murthy Publications (2014)
WEB RESOURCES	
1.	Water Technology 1.https://www.scribd.com/document/.../Engineering-Chemistry-Unit-I-Water-Treatment 2.www.lenntech.com/applications/process/boiler/boiler-water-treatment.htm
2.	Energy Sources and Applications https://en.wikipedia.org/wiki/Electrochemical_cell
3.	Corrosion Engineering &Corrosion controlling methods https://en.wikipedia.org/wiki/Corrosion
4.	Engineering Materials and Polymers https://en.wikipedia.org/wiki/Polymer_chemistry
5.	Nano and Smart Materials https://en.wikipedia.org/wiki/Nanomaterials

APPLIED CHEMISTRY-Syllabus

Course Category	Basic Sciences	Course Code	19BC1T02 /19BC2T02
Course Type	Theory	L-T-P-C	3-0-3-4.5
Prerequisites	Intermediate Chemistry	Internal Assessment Semester End Examination Total Marks	40 60 100

COURSE OBJECTIVES	
1	To learn about Electrochemical cells, Batteries and Fuel cells
2	To know about spinels, magnetic materials and semi conductors
3	To study about Nano materials, their preparation, characterization, applications and also about principles of green chemistry and green engineering applications
4	To know about Polymers, plastics and Elastomers
5	To learn about non conventional energy sources and also Spectroscopic techniques

COURSE OUTCOMES	
Upon successful completion of the course, the student will be able to:	
CO1	To compare different types of batteries and explain the merits of fuel cell. (**L-1)**
CO2	Discuss the use and importance of semiconductors, magnetic materials and spinels.(**L-4**)
CO3	To explain the Green methods of Synthesis and applications of Green technologies **(L-3)**
CO4	Analyze the importance of polymers in engineering applications. **(L-4)**
CO5	List out various sources of non conventional energy**.(L-5)**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	2	2	2		2				2		1	
CO2	2	2	1			1	1				1			
CO3	1	1		1	2							1		
CO4	2	2		1			1					1		
CO5	**1**	1	1				1				2	1	1	

COURSE CONTENT	
UNIT I	**ELECTROCHEMICAL ENERGY SYSTEMS** **9hrs** Electrode Potential, Nernst Equation for a single electrode, EMF of the cell, Electro chemical Series and uses, Types of Electrodes - Hydrogen and Calomel electrode, Electrochemical Cell, Galvanic Cell vs Electrolytic Cell, Types of Ion Selective Electrodes- glass membrane electrode **Batteries**- Characteristics, classification and Important applications. Classical batteries- Dry/Lechlanche cell, Modern batteries- Zinc air, Lithium cells-Li MnO_2 cell. **Fuel cells**- Introduction, H_2-O_2 fuel cell. **Learning outcomes:** After the completion of the Unit I, the student will be able to • **Explain** the significance of electrode potentials.**(L-2)** • **Compare** different types of cells and batteries. **(L-2)** • **Classify** ion selective electrodes. (**L-2**) • **Explain** the concepts involved in the construction of lithium cells. **(L-2)** • **Apply** redox principles for construction of batteries and fuel cells. (**L-3)**
UNIT II	**SOLID STATE CHEMISTRY** Solids – Crystalline and amorphous solids- 2D and 3D close packing of atoms and ions - spinels - normal and inverse spinels, semi conductor – Elemental semi conducting materials - Non-elemental semiconducting Materials:- Stoichiometric, non stoichiometric controlled valency & Chalcogen semiconductors, Preparation of Semiconductors by Zone refining and Czocharlski crystal pulling method. Semiconducting Devices - p-n junction diode as rectifier and junction transistor. Electrical Insulators and Applications of solid, liquid and gaseous insulators. Magnetic materials- Ferro and ferri magnetism. Hall effect and its applications. **Learning Outcomes:** After the completion of the Unit II, the student will be able to • Explain 2D and 3D close packing of crystals (**L-3**) • identify different types of spinels. (**L-3**) • describe the mechanism of photo copying. (**L-2**) • explain the applications of electrical insulators. (**L-3**)
UNIT III	**NANOMATERIALS AND GREEN CHEMISTRY** **7+5 hrs** **III-A: Nano Materials:** Introduction to Nano materials, Preparation of Carbon Nano Tubes(CNTs) by Laser Ablation and Chemical Vapor Deposition Methods, Fullerenes -Preparation, Properties and Applications; Chemical synthesis of nano materials : Sol-gel method, Characterization of nano mateirals by BET & TEM (basic principles), Applications of nano materials in waste water treatment, lubricants, Medicine and sensors. **III-B: Green Chemistry:** Introduction-Principles of green chemistry, Green synthesis Methods- Phase Transfer Catalysis (PTC), Super critical fluid extraction method, Green engineering applications in environmental and power quality monitoring. **Learning outcomes:** After the completion of the Unit III, the students will be able to • **explain** the basic principles of green chemistry. **(L-3)** • **identify** different preparation methods of CNTs**. (L-3)** • **discuss** the applications in green engineering. **(L-2)**
UNIT IV	**POLYMER CHEMISTRY** **10hrs** **Polymers**: Introduction-Methods of Polymerization (Emulsion and Suspension), Conducting polymers – Mechanism of conduction in poly acetylene – applications, Bio – degradable polymers. **Plastics**: Thermoplastics and thermo setting resins; Preparation, properties and applications of

	Polystyrene and Bakelite. **Elastomers**: Natural Rubber, Vulcanization of rubber; Synthetic Rubbers -Preparation, properties and applications of Buna-S and Thiokol. **Learning Outcomes:** ***At the end of this unit, the students will be able to*** ● **explain** different types of polymerisation mechanisms (**L-2**) ● **distinguish** between thermoplastic and thermo setting resigns **(L-4)** ● **explain** the preparation, properties and applications of Bakelite and polystyrene (**L-2**) ● **describe** the mechanism of conduction in conducting polymers (**L-2**) ● **discuss** Buna-S and Thiokol elastomers and their applications (**L-2**)
UNIT V	**Non Conventional Energy Sources & Spectroscopic Techniques** **9 hrs** Non Conventional Energy Sources : Introduction-Photo voltaic cell & Organic Photo voltaic cell - Design, Principle, advantages and disadvantages; Hydropower-Geo thermal Power -Tidal Power-Ocean thermal Energy Conversion. Spectroscopic Techniques: Electro Magnetic Spectrum- Introduction, Principles of UV and IR Spectroscopic techniques and their applications. **Learning outcomes** After the completion of the Unit V, the student will be able to ● **list** different non conventional energy sources. (**L-1)** ● **explain** the basic principle involved in the working of power plants. (**L-2)** ● **compare** Spectroscopic techniques and their importance . **(L-2)**

TEXT BOOKS	
1.	P.C. Jain and M. Jain, Engineering Chemistry, 15/e, Dhanapat Rai & Sons, Delhi (2014).
2	Engineering Chemistry by Shikha Agarwal: Cambridge University Press,2019 edition
REFERENCE BOOKS	
1.	Sashi Chawla, A Textbook of Engineering Chemistry, Dhanapath Rai and sons, (2003)
2.	B.S Murthy and P. Shankar, A Text Book of NanoScience and NanoTechnology, University Press (2013).
3.	S.S. Dara, A Textbook of Engineering Chemistry, S.Chand & Co, (2010)
WEB RESOURCES	
1.	Electrochemical Energy Systems https://en.wikipedia.org/wiki/Electrochemical_cell
2.	Solid state chemistry https://en.wikipedia.org/wiki/Solid-state_chemistry www.engineeringenotes.com › Engineering › Electronics › Semiconductors
3.	Nanomaterials and Green Chemistry https://en.wikipedia.org/wiki/Green_chemistry https://www.acs.org/.../greenchemistry/principles
4.	Polymer Chemistry https://en.wikipedia.org/wiki/Polymer_chemistry
5.	Non Conventional Energy Sources & Spectroscopic Techniques *https://en.wikipedia.org/wiki/Geothermal_power;* https://en.wikipedia.org/wiki/Ocean_thermal_energy_conversion www.rsc.org/learn-chemistry/collections/spectroscopy/introduction

PRAGATI ENGINEERING COLLEGE

(Approved by AICTE, Permanently Affiliated to JNTUK Kakinada & Accredited by NAAC)
1-378, ADB Road, Surampalem – 533 437, Near Peddapuram, E.G.Dist., A.P.
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Learning is Supreme Deity

ENGINEERING CHEMISTRY

SYALLABUS FOR LABORATORY COURSES [Credits: 1.5]

(COMMON FOR CIVIL&MECH)

Lab code: 19BC1LC01

Introduction to chemistry laboratory – Molarity, Normality, Primary, Secondary standard solutions, Volumetric titrations, Quantitative analysis

1. Estimation of HCI using standard Na2CO3 solutions
2. Determination of alkalinity of a sample containing Na_2CO_3 and NaOH
3. Estimation of KMnO4 using standard Oxalic acid solution.
4. Estimation of Ferrous iron using standard K2Cr2O7 solution
5. Determination of Temporary and permanent Hardness water using standard EDTA solution.
6. Determination of pH of the given sample solution using pH meter
7. Determination of Iron (III) using Colorimetric method
8. Conductometric Titrations between strong acid and strong base
9. Conductometric Titrations between strong acid and weak base
10. Estimation of Vitamin – C
11. Preparation of Phenol - Formaldehyde Resin
12. Determination of viscosity of a liquid
13. Determination of surface tension of a liquid
14. Preparation of Nano particles.(Cu/Zn)

After the completion of the laboratory course, the student will be able to

- **estimate** the metal content (Fe, Cr & Cu). **(L-3)**
- **compare** viscosities of different oils. **(L-2)**
- Synthesise nano materials **(L-3)**
- **analyze** the quality of ground water sample. **(L-4)**

TEXT BOOKS

1. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B Vogel's Quantitative Chemical Analysis 6/e, Pearson publishers (2000).

2. N.K Bhasin and Sudha Rani Laboratory Manual on Engineering Chemistry 3/e, Dhanpat Rai Publishing Company (2007).

Signatures of Members of BOS

University Nominee	Subject Expert	Subject Expert	Industry Personnel	BOS Chairman
Member	Member	Member	Member	Member

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APPLIED CHEMISTRY

Syallabus for Laboratory Courses

(Common for EEE(I SEM) /ECE,CSE&IT(II SEM)

Lab code: 19BC1LC02/19BC2LC02

Introduction to chemistry laboratory – Molarity, Normality, Primary, Secondary standard solutions, Volumetric titrations, Quantitative analysis, Quantitative analysis etc.,

1. Estimation of HCI using standard Na_2CO_3 solutions
2. Determination of alkalinity of a sample containing Na_2CO_3 and NaOH
3. Estimation of $KMnO_4$ using standard Oxalic acid solution.
4. Estimation of Ferric iron using standard $K_2Cr_2O_7$ solution
5. Determination of Total Hardness water using standard EDTA solution.
6. Determination of pH of the given sample solution using pH meter
7. Determination of Mg^{+2} present in an antacid
8. Conductometric Titrations between strong acid and strong base
9. Conductometric Titrations between strong acid and weak base
10. Estimation of Vitamin – C
11. Preparation of Phenol - Formaldehyde Resin
12. Estimation of iron using Colorimeter
13. Determination of surface tension of a liquid
14. Preparation of Nano particles (Cu/Zn).

After the completion of the laboratory course, the student will be able to

- **estimate** the metal content (Fe, Cr & Cu). (**L-3)**
- **compare** Surface Tension of different liquids. (**L-2)**
- Synthesise nano particles (**L-3)**
- **analyze** the quality of ground water sample. (**L-4)**

TEXT BOOKS

1. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B Vogel's Quantitative Chemical Analysis 6/e, Pearson publishers (2000).

2.N.K Bhasin and Sudha Rani Laboratory Manual on Engineering Chemistry 3/e, Dhanpat Rai Publishing Company (2007).

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