B.V.V.Sangha's

**BASAVESHWAR ENGINEERING COLLEGE, BAGALKOTE**

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| **22UCH111C/211C** | **Chemistry for Computer Science (CS) stream** | **04-Credits** |
| **Hrs/Week: 3:0:2** | | **CIE Marks:**50 |
| **Total Hours:** 40 Hrs | | **SEE Marks:**50 |

**Course Objectives:**

- To enable students to acquire knowledge on principles of chemistry for engineering applications.
- To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
- To provide students with a solid foundation in analytical reasoning required to solve societal problems.

| **UNIT - I** | **10 Hrs** |
|---|---|

## Energy Systems

**Electrode System:** Introduction, types of electrodes. Reference electrode; Introduction, calomel electrode – construction, working and applications of calomel electrode. Ion selective electrodes; Introduction, construction, working and applications of glass electrode. Determination of pH using glass electrode. Concentration cell; Definition, construction and working. Numerical problems.

**Battery Systems:** Introduction to batteries, construction, working and applications of Lithium ion and Sodium ion batteries.

**Green Fuels:** Introduction, construction and working of solar photovoltaic cell, advantages, and disadvantages. Quantum Dot Sensitized Solar Cells (QDSSC's); Principle, Properties and Applications. Generation of energy (green hydrogen) by electrolysis of water and its advantages.

**Self Study:** Characteristics of batteries & Introduction to Fuel cell, MeOH – $O_2$ fuel cell, Applications.

| **UNIT – II** | **10 Hrs** |
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## Corrosion Science and Polymers

**Corrosion:** Introduction, electrochemical theory of corrosion, types of electro-chemical corrosion; differential metal corrosion and differential aeration corrosion (Waterline and Pitting). Factors affecting rate of corrosion. Corrosion Penetration Rate (CPR); Introduction and numerical problems.

**Corrosion control:** Introduction, Metal coating; Galvanization, surface conversion coating; Anodization and cathodic protection; Sacrificial anodic method.

**Polymers:** Introduction, Monomer, polymer, polymerization, degree of polymerization. Glass transition temperature ($T_g$), factors affecting $T_g$. Molecular weight - Number average and Weight average molecular weight, polydiversity and numerical problems. Conducting polymers; Synthesis and conducting mechanism of polyacetyline (n & p type) and commercial applications. Preparation, properties and commercial applications of Silicon rubber and ABS Plastics.

**Self Study:** Stress corrosion and Biodegradable polymers.

| UNIT - III | 10 Hrs |
|---|---|

## Display systems

**Liquid crystals (LC's);** Introduction, classification, positional and orientational order, director, requirement of a substance to exhibit liquid crystal state. Chemical constitution and liquid crystalline behavior, molecular ordering in liquid crystal phase, liquid crystal behavior in homologous series; PAA and MBBA homologous series, electro-optic effect in liquid crystals, construction of liquid crystal display and applications of Liquid Crystal in Displays.

**Light Emitting Diode (LED):** Introduction, working principle of LED. Application of LED.
**Organic Light Emitting Diode (OLED):** Introduction, Anatomy of OLED, Types of OLED. Comparison between LED and OLED. Advantages and Disadvantages of OLED, Applications of OLED. Quantum Light Emitting Diodes (QLED's); Properties and applications.
**Self Study:** Light emitting electrochemical cells.

| UNIT - IV | 10 Hrs |
|---|---|

## Analytical Techniques & E-Waste Management

**Analytical Techniques:** Sensors, Introduction, basic principle of sensor, Types of chemical sensors; Conductometric sensors, Electrochemical sensors and Optical sensors. Potentiometric sensors; Introduction, principle, working and application in the estimation of iron. Colorimetric sensors; Introduction, principle, working and application in the estimation of copper. Conductometric sensors; Introduction, principle, working and application in the estimation of weak acid.

**E-Waste:** Introduction, sources of e-waste, Composition, Characteristics, and Need of e-waste management. Toxic materials used in manufacturing electronic and electrical products, health hazards due to exposure to e-waste. Recycling and Recovery; Different approaches of recycling (separation, thermal treatments, hydrometallurgical extraction, pyrometallurgical methods, direct recycling). Extraction of gold from E-waste. Role of stake holders in environmental management of e-waste (producers, consumers, recyclers, and statutory bodies).

**Self Study:** Glucose sensor, Impact of heavy metals on environment & human health and control measures.

# PRACTICAL CONTENT

## List of Experiments

### *UNIT-I : Compulsory conducting experiments*

1. Estimation of total hardness of water by EDTA method
2. Potentiometric estimation of FAS using $K_2Cr_2O_7$
3. Determination of pKa of vinegar using pH sensor (Glass electrode)
4. Estimation of Copper present in electroplating effluent by optical sensor (colorimetry)
5. Conductometric estimation of acid mixture
6. Estimation of iron in TMT bar by diphenyl amine/external indicator method
7. Determination of Alkalinity of given water sample by dual indicator method.
8. Determination of Viscosity coefficient of lubricant (Ostwald's viscometer)

### *UNIT-II: Virtual experiments (any one)*

1. Electro-gravimetric estimation of metals
2. Preparation of urea formaldehyde resin
3. Synthesis of iron oxide nanoparticles
4. Electrolysis of water

### *UNIT-III: Open Ended Experiments (Suggestive) - (any one)*

1. Precipitation titration.
2. Determination of percentage of copper present in the brass piece.
3. Determination of percentage of CaO in cement solution.
4. Determination of manganese dioxide in pyrolusite ore.

**Reference books:**

1. Suba Ramesh etal. Engineering Chemistry, Wiley India Pvt. Ltd. New Delhi, - 2nd Edn. 2013
2. SS Dara & Dr. SS Umare, A Text book of Engineering Chemistry, S Chand & Co., Ltd., 12th Edn, 2011.
3. R.V. Gadag and Nityananda Shetty, A Text Book of Engineering Chemistry, I. K. International Publishing house. 2nd Edn, 2016.
4. F.W. Billmeyer, Text Book of Polymer Science, John Wiley & Sons, 4th Edn, 1999.
5. M. G. Fontana, N. D. Greene, Corrosion Engineering, McGraw Hill Publications, New York, 3rd Edn, 1996.
6. Kirby W. Beard, Linden's Handbook of Batteries, Mc.Graw Hill, 5th Edn, 2019.
7. Takatoshi Tsujimura, OLED Display Fundamentals and Applications, Wiley–Blackwell 1st Edition 2012
8. Laboratory Manual, Department of Chemistry, BEC Bagalkot 2023

9. Dr. Sudha Rani, Laboratory Manual on Engineering Chemistry, DhanapathRai Publishing Co. Ltd., 1st Edn, 1998.

**Web links and Video Lectures (e-Resources):**

- http://libgen.rs/
- https://nptel.ac.in/downloads/122101001/
- https://nptel.ac.in/courses/104/103/104103019/
- https://ndl.iitkgp.ac.in/
- https://www.youtube.com/watch?v=faESCxAWR9k
- https://www.youtube.com/watch?v=TBqXMWaxZYM&list=PLyhmwFtznRhuz8L1bb3X- 9IbHrDMjHWWh

**Course Outcomes:**

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|---|---|
| **CO1:** | Analyse the properties of raw materials in designing energy systems for industrial and social applications. |
| **CO2:** | Assess properties of metallic and polymer materials for variety of engineering applications. |
| **CO3:** | Choose appropriate materials for design of display systems. |
| **CO4:** | Identify and determine composition of various materials using sensors and develop e- waste management for electrical and electronic products. |

| **Course Outcomes** | **Programme Outcomes** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **CO1** | **3** | **1** | **1** | | | | **1** | | | | | |
| **CO2** | **3** | **1** | **1** | | | | **1** | | | | | |
| **CO3** | **3** | **1** | **1** | | | | **1** | | | | | |
| **CO4** | **3** | **1** | **1** | | | | **1** | | | | | |
| **CO5** | **3** | **1** | **1** | | | | **1** | | | | | |

B.V.V.Sangha's

**BASAVESHWAR ENGINEERING COLLEGE, BAGALKOTE**

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|---|---|---|
| **22UCH112C/212C** | **Chemistry for Mechanical Engineering (ME) stream** | **04-Credits** |
| **Hrs/Week: 3:0:2** | | **CIE Marks:**50 |
| **Total Hours:** 40 Hrs | | **SEE Marks:**50 |

**Course Objectives:**

- To enable students to acquire knowledge on principles of chemistry for engineering applications.
- To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
- To provide students with a solid foundation in analytical reasoning required to solve societal problems.

| **UNIT - I** | **10 Hrs** |
|---|---|

## Macromolecules for Engineering Applications

**Polymers:** Introduction, Monomer, polymer, polymerization, degree of polymerization, Glass transition temperature- factors affecting $T_g$. Molecular weight; number average and weight average, poly dispersity index, numerical problems. Synthesis, properties and industrial applications of Acrylo-Butadiene Styrene (ABS) plastics and silicone rubber.

**Fibers:** Introduction, synthesis, properties and industrial applications of Kevlar and Polyester.

**Plastics:** Introduction, synthesis, properties and industrial applications of poly-methyl methacrylate (PMMA) and Polyurethene (PU).

**Lubricants:** Introduction, classification, properties and applications of lubricants.

**Self Study:** Biodegradable polymer: Introduction, synthesis, properties and applications of polylactic acid(PLA) and polyhydroxybutyrate (PHB).

| **UNIT – II** | **10 Hrs** |
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## Corrosion Science and Metal Finishing

**Corrosion:** Introduction, electrochemical theory of corrosion, types of electrochemical corrosion - differential metal, differential aeration (waterline and pitting), stress corrosion (caustic embrittlement). Factors affecting rate of corrosion. Corrosion testing by weight loss method. Corrosion penetration rate (CPR)-numerical problems.

**Corrosion control:** Introduction, Metal coating; Galvanization, surface conversion coating; Anodization and cathodic protection; Sacrificial anodic method.

**Metal finishing:** Introduction, technological importances. Electroplating: Process, Factors affecting quality of electrodeposit. Determination of throwing power by Haring-Blum cell. Numerical problems on throwing Power. Electroplating of chromium (hard and decorative). Electroless plating: Introduction, Comparison between electroplating and electroless plating,

electroless plating of nickel.

**Self Study:** Use of corrosion inhibitors to control corrosion. Factors governing electroplating – Polarization, Decomposition potential and Over voltage.

| UNIT - III | 10 Hrs |
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## Fuels & Analytical Techniques

**Fuels:** Introduction, classification and characteristics of a good fuel, calorific value, Gross calorific value (GCV) and Net calorific value (NCV), determination of calorific value using bomb calorimeter, numerical problems on GCV and NCV.

**Bio fuels:** Introduction, synthesis of Bio gas, Bio ethanol and biodiesel; Advantages and limitations.

**Analytical Techniques:** Sensors, Introduction, basic principle of sensor, Types of chemical sensors; Conductometric sensors, Electrochemical sensors and Optical sensors. Potentiometric sensors; Introduction, principle, working and application in the estimation of iron. Colorimetric sensors; Introduction, principle, working and application in the estimation of copper. Conductometric sensors; Introduction, principle, working and application in the estimation of weak acid.

**Self Study:** Types of electrodes - Reference electrode, Calomel electrode; Construction, working and applications.

| UNIT - IV | 10 Hrs |
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## Phase Rule and Materials for Engineering Applications

**Phase rule:** Introduction, Definition of terms: phase, components, degree of freedom, phase rule equation. Phase diagram: One component: Water system and Sulphur System.

**Alloys:** Introduction, classification, composition, properties and applications of Stainless Steel, Solders, Brass and Alnico.

**Nano materials:** Introduction, Size dependent properties of nanomaterials - surface area and catalytic, Thermal, Electrical, Optical, Magnetic and Mechanical properties. Synthesis of nanomaterials by sol-gel method and co-precipitation method. Synthesis of carbon nanotubes by Chemical Vapour Deposition (CVD) method, properties and engineering applications. Nanomaterials for water treatment, Introduction and example.

**Self Study:** Phase diagram of two component Pb – Ag system

# PRACTICAL CONTENT

## List of Experiments

### *UNIT-I : Compulsory conducting experiments*

1. Estimation of total hardness of water by EDTA method
2. Potentiometric estimation of FAS using $K_2Cr_2O_7$
3. Determination of pKa of vinegar using pH sensor (Glass electrode)
4. Estimation of Copper present in electroplating effluent by optical sensor (colorimetry)
5. Conductometric estimation of acid mixture
6. Estimation of iron in TMT bar by diphenyl amine/external indicator method
7. Determination of Alkalinity of given water sample by dual indicator method.
8. Determination of Viscosity coefficient of lubricant (Ostwald's viscometer)

### *UNIT-II: Virtual experiments (any one)*

5. Electro-gravimetric estimation of metals
6. Preparation of urea formaldehyde resin
7. Synthesis of iron oxide nanoparticles
8. Electrolysis of water

### *UNIT-III: Open Ended Experiments (suggestive) - (any one)*

5. Precipitation titration.
6. Determination of percentage of copper present in the given brass piece.
7. Determination of percentage of CaO in cement solution.
8. Determination of manganese dioxide in pyrolusite ore.

**Reference books:**

8. Suba Ramesh etal., Engineering Chemistry, Wiley India Pvt. Ltd. New Delhi, 2nd Edn. 2013
9. S.S. Dara & Dr. SS Umare, A Text book of Engineering Chemistry, S Chand & Company Ltd., 12th Edition, 2011.
10. R.V. Gadag and Nityananda Shetty, A Text Book of Engineering Chemistry, I. K. International Publishing house. 2nd Edition, 2016.
11. F.W. Billmeyer,Text Book of Polymer Science, John Wiley & Sons, 4th Edition, 1999.
12. G.A. Ozin & A.C. Arsenault,Nanotechnology A Chemical Approach to Nanomaterials, RSC Publishing, 2nd Edition 2005.
13. M. G. Fontana, N. D. Greene, Corrosion Engineering, McGraw Hill Publications, New York, 3rd Edition, 1996.
14. Laboratory Manual, Department of Chemistry, BEC Bagalkot 2023 Edition

15. Dr. Sudha Rani, Laboratory Manual on Engineering Chemistry, Dhanapath Rai Publishing Co. Ltd., 1st Edition, 1998.

**Web links and Video Lectures (e-Resources):**

- http://libgen.rs/
- https://nptel.ac.in/downloads/122101001/
- https://nptel.ac.in/courses/104/103/104103019/
- https://ndl.iitkgp.ac.in/
- https://www.youtube.com/watch?v=faESCxAWR9k
- https://www.youtube.com/watch?v=TBqXMWaxZYM&list=PLyhmwFtznRhuz8L1bb3X- 9IbHrDMjHWWh

**Course Outcomes:**
At the end of the course the student will be able to;

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| **CO1:** | Identify and determine composition of various materials using sensors and synthesis of polymers for specific engineering applications. |
| **CO2:** | Assess and describe the forms, mechanisms, control of corrosion and surface modifications. |
| **CO3:** | Identify suitable sensor for the estimation of elements and fuel for future generation. |
| **CO4:** | Outline the application of structural materials for engineering applications. |

| **Course Outcomes** | **Programme Outcomes** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **CO1** | **3** | **1** | **1** | | | | **1** | | | | | |
| **CO2** | **3** | **1** | **1** | | | | **1** | | | | | |
| **CO3** | **3** | **1** | **1** | | | | **1** | | | | | |
| **CO4** | **3** | **1** | **1** | | | | **1** | | | | | |

B.V.V.Sangha's

**BASAVESHWAR ENGINEERING COLLEGE, BAGALKOTE**

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|---|---|---|
| **22UCH109C/209C** | **Chemistry for Electrical Sciences (ES) Stream** | **04-Credits** |
| **Hrs. /Week: 3:0:2** | | **CIE Marks:**50 |
| **Total Hours:** 40 Hrs. | | **SEE Marks:**50 |

**Course Objectives:**

- To enable students to acquire knowledge on principles of chemistry for engineering applications.
- To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
- To provide students with a solid foundation in analytical reasoning required to solve societal problems.

| **UNIT - I** | **10 Hrs** |
|---|---|

## Energy Systems

**Electrode System:** Introduction, types of electrodes. Reference electrode; Introduction, calomel electrode – construction, working and applications of calomel electrode. Ion selective electrode; definition, construction, working and applications of glass electrode. Determination of pH using glass electrode. Concentration cell;
and working. Numerical problems.

**Batteries:** Introduction, Components and classification of batteries. Construction, working and applications of modern batteries; Na-ion battery, solid state battery (Li-polymer battery) and flowbattery (Vanadium redox flow battery).

**Fuel Cells**: Introduction, construction, working and applications of methanol–oxygen and polymer electrolyte membrane (PEM) fuel cell.

**Solar Cell:** Introduction, Semiconductors as solar cell materials. Construction and working of Solar Photo voltaic cell, advantages and disadvantages.

**Self study:** Characteristics of batteries. A note on Quantum dot sensitized solar cells (QDSSC) and applications.

| **UNIT – II** | **10 Hrs** |
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## Corrosion Science and E-waste management

**Corrosion:** Introduction, electrochemical theory of corrosion, types of corrosion-differential metal corrosion and differential aeration corrosion (Water line and pitting). Factors affecting rate of corrosion. Corrosion Penetration Rate (CPR); Introduction and numerical problems.

**Corrosion control:** Introduction, Metal coating; galvanization, Surface conversion coating; anodization and cathodic protection; sacrificial anodic method.

**E-Waste:** Introduction, sources of e-waste, Composition, Characteristics, and Need of e-waste management. Toxic materials used in manufacturing electronic and electrical products, health hazards due to exposure to e-waste. Recycling and Recovery; Different approaches of recycling (separation, thermal treatments, hydrometallurgical extraction, pyrometallurgical

methods, direct recycling). Extraction of gold from E-waste. Role of stake holders in environmental management of e-waste (producers, consumers, recyclers, and statutory bodies).

**Self study:** Stress corrosion and impact of heavy metals on human health.

| UNIT - III | 10 Hrs |
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## Display systems

**Display Systems**

Liquid crystals (LC's); Introduction, classification, positional and orientational order, director, requirement of a substance to exhibit liquid crystal state. Chemical constitution and liquid crystalline behavior, molecular ordering in liquid crystal phase, liquid crystal behavior in homologous series; PAA and MBBA homologous series, electro-optic effect in liquid crystals, construction of liquid crystal display and applications of Liquid Crystal in Displays (LCD's).

**Light Emitting Diode (LED):** Introduction, working principle of LED. Application of LED.

**Organic Light Emitting Diode (OLED):** Introduction, Anatomy of OLED, Types of OLED. Comparison between LED and OLED. Advantages and Disadvantages of OLED, Applications of OLED. Quantum Light Emitting Diodes (QLED's); Properties and applications.

**Self Study:** Light emitting electrochemical cells.

| UNIT - IV | 10 Hrs |
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## Analytical technique and Polymers

**Analytical Techniques:** Sensors, Introduction, basic principle of sensor, Types of sensors; Conductometric sensors, Electrochemical sensors and Optical sensors. Potentiometric sensors; Introduction, principle, working and application in the estimation of iron. Colorimetric sensors; Introduction, principle, working and application in the estimation of copper. Conductometric sensors; Introduction, principle, working and application in the estimation of weak acid.

**Polymers:** Introduction, Monomer, polymer, polymerization, degree of polymerization. Glass transition temperature, factors affecting glass transition temperature, Molecular weight; Number average and Weight average molecular weight. Poly dispersity. Numerical problems. Conducting polymers; synthesis and conducting mechanism of polyacetylene (n & p type). Preparation, properties and commercial applications of silicon rubber. Acrylonitrile Butadiene Styrene (ABS) plastics

**Self Study:** Methods of polymerization. Polymer composites. Glucose sensor

# PRACTICAL CONTENT

## List of Experiments

### *UNIT-I : Compulsory conducting experiments*

9. Estimation of total hardness of water by EDTA method
10. Potentiometric estimation of FAS using $K_2Cr_2O_7$
11. Determination of pKa of vinegar using pH sensor (Glass electrode)
12. Estimation of Copper present in electroplating effluent by optical sensor (colorimetry)
13. Conductometric estimation of acid mixture
14. Estimation of iron in TMT bar by diphenyl amine/external indicator method
15. Determination of Alkalinity of given water sample by dual indicator method.
16. Determination of Viscosity coefficient of lubricant (Ostwald's viscometer)

### *UNIT-II: Virtual experiments (any one)*

9. Electro-gravimetric estimation of metals
10. Preparation of urea formaldehyde resin
11. Synthesis of iron oxide nanoparticles
12. Electrolysis of water

### *UNIT-III: Open Ended Experiments (Suggestive) - (any one)*

9. Precipitation titration.
10. Determination of percentage of copper present in the given brass piece.
11. Determination of percentage of CaO in cement solution.
12. Determination of manganese dioxide in pyrolusite ore.

**Reference books:**

16. Suba Ramesh etal. Engineering Chemistry, Wiley India Pvt. Ltd. New Delhi, 2013- 2nd Edn.
17. SS Dara & Dr. SS Umare, A Text book of Engineering Chemistry, S Chand & Company Ltd., 12th Edn, 2011.
18. R.V. Gadag and Nityananda Shetty, A Text Book of Engineering Chemistry, I. K. International Publishing house. 2nd Edn, 2016.
19. F.W. Billmeyer, Text Book of Polymer Science, John Wiley & Sons, 4th Edn, 1999.
20. M. G. Fontana, N. D. Greene, Corrosion Engineering, McGraw Hill Publications, New York, 3rd Edn, 1996.
21. Kirby W. Beard, Linden's Handbook of Batteries, McGraw Hill, 5th Edn, 2019.
22. Takatoshi Tsujimura, OLED Display Fundamentals and Applications, Wiley–Blackwell , 2012
23. H. Panda, "Handbook on Elctroplating with Manufacture of Electrochemicals", ASIA

PACIFIC BUSINESS PRESS Inc., 5th Edn 2017.

9. Damien W. M. Arrigan Electrochemical Strategies in Detection science, Royal Society of Chemistry,1st Edn. 2016.
10. Laboratory Manual, Department of Chemistry, BEC Bagalkot, 2023
11. Dr. Sudha Rani, Laboratory Manual on Engineering Chemistry, Dhanapath Rai Publishing Co. Ltd., 1st Edn,1998.

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- http://libgen.rs/
- https://nptel.ac.in/downloads/122101001/
- https://nptel.ac.in/courses/104/103/104103019/
- https://ndl.iitkgp.ac.in/
- https://www.youtube.com/watch?v=faESCxAWR9k
- https://www.youtube.com/watch?v=TBqXMWaxZYM&list=PLyhmwFtznRhuz8L1bb3X- 9IbHrDMjHWWh
- https://www.youtube.com/watch?v=j5Hml6KN4TI

**Course Outcomes:**

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|---|---|
| **CO1:** | Analyse the properties of raw materials in designing energy system for industrial and social application. |
| **CO2:** | Assess and evaluate the forms, mechanism, control of corrosion and develop e-waste management of electrical and electronic products. |
| **CO3:** | Choose appropriate small material for design of display system. |
| **CO4:** | Identify and determine composition of various material using sensors and synthesis of polymers specific purpose. |

| **Course Outcomes** | **Programme Outcomes** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **CO1** | **3** | **1** | **1** | | | | **1** | | | | | |
| **CO2** | **3** | **1** | **1** | | | | **1** | | | | | |
| **CO3** | **3** | **1** | **1** | | | | **1** | | | | | |
| **CO4** | **3** | **1** | **1** | | | | **1** | | | | | |

B.V.V.Sangha's

**BASAVESHWAR ENGINEERING COLLEGE, BAGALKOTE**

| | | |
|---|---|---|
| **22UCH110C/210C** | **Chemistry for Civil Sciences (CVS) Stream** | **04-Credits** |
| **Hrs./Week: 3:0:2** | | **CIE Marks:**50 |
| **Total Hours:** 40 Hrs | | **SEE Marks:**50 |

**Course Objectives:**

- To enable students to acquire knowledge on principles of chemistry for engineering applications.
- To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
- To provide students with a solid foundation in analytical reasoning required to solve societal problems.

| **UNIT - I** | **10 Hrs.** |
|---|---|

## Chemistry of Water and Environment

**Water technology:** Introduction, water quality parameters, hardness of water, determination of all types of hardness by EDTA method, numerical problems. Determination of chlorides; Mohr's method. Softening of water by ion exchange method, desalination of water by electrodialysis, Reverse and Forward osmosis: Introduction, Process and applications.

**Water pollution:** Sources, Potable water quality parameters, Sewage, Aerobic and Anaerobic Oxidation. Sewage treatment; Primary, secondary (activated sludge process) and tertiary treatment. Industrial waste water treatment. Determination of Biological Oxygen Demand (BOD), Chemical oxygen demand (COD) and Numerical problems.

**Self Study:** Determination of DO in water samples by Winkler's method. Impact of heavy metals on human health.

| **UNIT – II** | **10 Hrs.** |
|---|---|

## Corrosion Science and Analytical Techniques

**Corrosion:** Introduction, electrochemical theory of corrosion, types of electrochemical corrosion; differential metal corrosion, differential aeration corrosion (waterline and pitting), stress corrosion (caustic embrittlement). Factors affecting rate of corrosion. Corrosion testing by weight loss method. Corrosion penetration rate (CPR)-numerical problems.

**Corrosion control:** Introduction, Metal coating; galvanization, Surface conversion coating; anodization and cathodic protection; sacrificial anodic method.

**Analytical Techniques:** Sensors, Introduction, basic principle of sensor, Types of chemical sensors; Conductometric sensors, Electrochemical sensors and Optical sensors. Potentiometric sensors; Introduction, principle, working and application in the estimation of iron. Colorimetric sensors; Introduction, principle, working and application in the estimation of copper. Conductometric sensors; Introduction, principle, working and application in the estimation of weak acid. pH-sensors and its application in the determination of soil sample.

**Self Study:** Use of Corrosion inhibitors to control corrosion. Corrosion control by organic coatings.

| UNIT - III | 10 Hrs. |
|---|---|

## Structural Materials

**Metals and Alloys:** Introduction, Properties and application of Iron and its alloys (Eg. Wrought iron and steel). Aluminium and its alloys (Eg. Duralium and Magnalium)
**Cement:** Introduction, composition, properties, classification, manufacturing process of cement, process of setting and hardening of cement.
**Refractories:** Introduction, classification based on chemical composition, properties and application of refractory materials.

**Nano materials:** Introduction, Size dependent properties of nanomaterials - surface area and catalytic, Thermal, Electrical, Optical, Magnetic and Mechanical properties. Synthesis of nanomaterials by sol-gel method and co-precipitation method. Synthesis of carbon nanotubes by Chemical Vapour Deposition (CVD) method, properties and engineering applications. Nanomaterials for water treatment, Introduction and example.

**Self Study:** Glass - Introduction, Composition, Types, Properties and applications

| UNIT - IV | 10 Hrs. |
|---|---|

## Polymers and Composites

**Polymer:** Introduction, monomer, polymer, polymerization, degree of polymerization, Glass transition temperature (Tg); Factors affecting Tg of a polymer. Molecular weight of polymers, Weight average and number average molecular weight of polymer. Polydispersity in polymers. Numerical problems. Synthesis, properties and engineering applications of Acrylo Butadiene Styrene (ABS) plastics and Silicon rubber. Adhesives - Introduction, Synthesis, Properties and applications of epoxy resin.

**Fibers:** Introduction, Synthesis, Properties and applications of Rayon and Nylon fibers.
**Polymer composites:** Introduction, FRPC (Fiber reinforced polymers composites) - Types, properties and applications.
**Geo polymer concrete:** Introduction, constituents, properties & applications.
**Biodegradable polymers:** Introduction, Synthesis, properties and applications of polylactic acid (PLA)and poly hydroxy butyrate (PHB).

**Self Study:** Inorganic polymers – Introduction, Types, Polysulphides - Synthesis, Properties and applications.

# PRACTICAL CONTENT

## List of Experiments

### *UNIT-I : Compulsory conducting experiments*

17. Estimation of total hardness of water by EDTA method
18. Potentiometric estimation of FAS using $K_2Cr_2O_7$
19. Determination of pKa of vinegar using pH sensor (Glass electrode)
20. Estimation of Copper present in electroplating effluent by optical sensor (colorimetry)
21. Conductometric estimation of acid mixture
22. Estimation of iron in TMT bar by diphenyl amine/external indicator method
23. Determination of Alkalinity of given water sample by dual indicator method.
24. Determination of Viscosity coefficient of lubricant (Ostwald's viscometer)

### *UNIT-II: Virtual experiments (any one)*

13. Electro-gravimetric estimation of metals
14. Preparation of urea formaldehyde resin
15. Synthesis of iron oxide nanoparticles
16. Electrolysis of water

### *UNIT-III: Open Ended Experiments (Suggestive) - (any one)*

13. Precipitation titration.
14. Determination of percentage of copper present in the given brass piece.
15. Determination of percentage of CaO in cement solution.
16. Determination of manganese dioxide in pyrolusite ore

**Reference books:**

24. Suba Ramesh etal. "Engineering Chemistry", Wiley India Pvt. Ltd. New Delhi, - 2nd Edn. 2013
25. SS Dara & Dr. SS Umare, A Text book of Engineering Chemistry, S Chand & Company Ltd., 12th Edn, 2011.
26. R.V. Gadag and Nityananda Shetty, A Text Book of Engineering Chemistry, I. K. International Publishing house. 2nd Edn, 2016.
27. F.W. Billmeyer, Text Book of Polymer Science, John Wiley & Sons, 4th Edn, 1999.
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31. Laboratory Manual, Department of Chemistry, BEC Bagalkot 2023 Edn.
32. Dr. Sudha Rani, Laboratory Manual on Engineering Chemistry, Dhanapath Rai Publishing Co. Ltd., 1st Edn, 1998.

**Web links and Video Lectures (e-Resources):**

- http://libgen.rs/
- https://nptel.ac.in/downloads/122101001/
- https://nptel.ac.in/courses/104/103/104103019/
- https://ndl.iitkgp.ac.in/
- https://www.youtube.com/watch?v=faESCxAWR9k
- https://www.youtube.com/watch?v=TBqXMWaxZYM&list=PLyhmwFtznRhuz8L1bb3X- 9IbHrDMjHWWh

**Course Outcomes:**

| | |
|---|---|
| **CO1:** | Able to evaluate quality of water and its treatment methods for domestic and Industrial applications. |
| **CO2:** | Identify and evaluate composition of materials and mechanism involved in corrosion with controlling measures. |
| **CO3:** | Outline the application of structural materials for engineering application. |
| **CO4:** | Outline the various polymers and their properties with application in various Engineering field. |

| **Course Outcomes** | **Programme Outcomes** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **CO1** | **3** | **1** | **1** | | | | **1** | | | | | |
| **CO2** | **3** | **1** | **1** | | | | **1** | | | | | |
| **CO3** | **3** | **1** | **1** | | | | **1** | | | | | |
| **CO4** | **3** | **1** | **1** | | | | **1** | | | | | |