**Institute / School of Engineering** School of Applied Sciences

**Program Name** B.E

**Course Code** CHL4101

**Course Name** Engineering Chemistry

**Lecture / Tutorial (Per week)** 4-1-0 **Course Credits 4**

**Course Coordinator Name Ms.Taruna Manchanda**

1. **Scope and Objectives of the Course**
2. This course will introduce to students, engineering materials used in daily life such as plastics, polymers, their preparation, properties and applications.
3. This course will place emphasis on those areas considered most relevant in an engineering context such as water and its treatment for various purposes and corrosion and control of metallic materials.
4. This course will also teach elements of electrochemical processing and its applications to electro refining, electroplating and electrochemical power sources (batteries and fuel cells) and also providing the latest in battery technology like Lithium ion battery used for laptops.

This course will provide engineering students with a background in green chemistry importance for environment friendly chemical design, manufacturing. Also, how Green chemistry and Green Engineering provide sustainable chemistry and engineering for sustainable practices in industrial research laboratories.

This course also emphasis on latest technology which are utilizing the basic chemistry concept like LCD: liquid Crystal technology in which chemistry of liquid crystal is familiarizing to students and its application in laptops, TV screens etc.

1. **Textbooks**

**TB1:** ‘The Engineering Chemistry’ -CHITKARA UNIVERSITY PUBLICATION.

**TB2: ‘**Engineering Chemistry’ by O.G. Palanna, 2009, Tata McGraw Hill Publishing House.

**3**.**Reference Books**

**RB1: ‘**Engineering Chemistry’ by B. Sivasankar, 2008, Tata McGraw Hill Publishing House

**RB2:** ‘Physical Chemistry’ by Gilbert W. Castellan 3rd edition, Narosa Publishing House.

**4. Relevant websites**

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| **S.No.** | **Link of Journals, Magazines, websites and Research Papers** | **Salient Features** |
|  | [**http://www.sigmaaldrich.com/chemistry/greener-alternatives/green-chemistry.html**](http://www.sigmaaldrich.com/chemistry/greener-alternatives/green-chemistry.html) | **Green Chemistry** |
|  | [**http://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/readings-and-lecture-notes/lecnotes25.pdf**](http://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/readings-and-lecture-notes/lecnotes25.pdf) | **Electrochemistry** |
|  | [**http://www.chemistry.wustl.edu/~edudev/LabTutorials/Water/FreshWater/hardness.html**](http://www.chemistry.wustl.edu/~edudev/LabTutorials/Water/FreshWater/hardness.html)  <https://www.youtube.com/watch?v=90tbEzCT-q4> (for video lecture) | **Water Hardness** |
|  | [**http://lcp.elis.ugent.be/tutorials/lc**](http://lcp.elis.ugent.be/tutorials/lc)  <https://www.youtube.com/watch?v=RtZdYzFcJU8> (for video lecture) | **Liquid Crystals**  **and Phase Rule** |
|  | [**http://chemwiki.ucdavis.edu/Analytical\_Chemistry/Electrochemistry/Voltaic\_Cells/Case\_Study%3A\_Battery\_Types**](http://chemwiki.ucdavis.edu/Analytical_Chemistry/Electrochemistry/Voltaic_Cells/Case_Study%3A_Battery_Types)  <https://www.youtube.com/watch?v=OTdnvk-h3cE> (for video lecture)  <https://www.youtube.com/watch?v=jSNlmOwpxYg> (for video lecture)  <https://www.youtube.com/watch?v=5OxdXq91TV0> (for video lecture) | **Battery Technology and**  **Polymer**  **Corrosion** |

**5. Course plan**

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| **Lecture Number** | Topics | **Text Book/ Reference Book / Other reading material** |
| 1 | Introduction, Sources of water, Impurities in water | TB1/TB2 |
| 2 | Hard and soft water, Units of hardness (Numericals included) | TB1/TB2 |
| 3-4 | Specification for boiler feed water Boiler problems: Scale and sludge formation, caustic embrittlement, priming, foaming, boiler corrosion due to oxygen and carbon dioxide. | TB1/TB2 |
| 5-6-7 | External treatment: Lime–soda process (Numericals included), Zeolite process | TB1/TB2 |
| 8-9 | Ion exchange process, Internal treatment (different types of conditioning) | TB1/TB2 |
| 10-11 | Specification of water for domestic use, Treatment for domestic use (break point chlorination); Treatment of brackish water (reverse osmosis, electro dialysis using ion selective membrane) | TB1/TB2 |
| 12 | Water quality parameters: Acidity, alkalinity, BOD, COD, dissolved oxygen, conductivity, pH | TB1/TB2 |
| 13 | Elementary ideas about polymers, Classification of polymers, types of polymerization. | TB1/TB2 |
| 14-15 | Chemical reaction for the synthesis of polymers: **Teflon, Polyester (Dacron), Nylon 6,6,** PMMA, Novolac, Phenol formaldehyde resins (Bakelite) , PC (Polycarbonate) | TB1/TB2 |
| 16-17 | Synthesis and Application of rubbers – Buna-N, Buna-S and Poly isoprene. Introduction and application of Electro-active, Conducting and Biopolymers | TB1/TB2 |
| 18 | Introduction to electrolytic and electrochemical cell , EMF of cell, Relationship between emf and thermodynamic properties (∆H, ∆S, ∆G) | TB1/TB2 |
| 19 | Numerical based on EMF of cells and thermodynamic parameters. | TB1/TB2 |
| **SESSIONAL TEST –I ( Oct 5/6/12 ,2015)** | | |
| 20-21-22 | Electroless plating, Preparation of PCB (Printed circuit board), Dry cell, lead storage batteries. | TB1/TB2 |
| 23-24 | Applications and function of batteries used in Laptops: Lithium ion battery, Gel battery. Nano battery | TB1/TB2 |
| 25-26 | Batteries used in rockets & submarine : Fuel cell (hydrogen-oxygen ­­alkaline fuel cell, molten carbonate fuel cell, Phosphoric acid fuel cell)**.**Batteries used in electronic devices :Solar cell | TB1/TB2 |
| 27-28-29 | Introduction, Characteristics of liquid crystals: Director and Effect of temperature on order parameter. Classification of liquid crystal: Smectic liquid crystal ( A,B,C), Nematic liquid crystal, Cholesteric liquid crystal, Molecular arrangement in various types of liquid crystals. | TB1/TB2 |
| 30-31 | Principle of liquid crystal Display (LCD), Polymer dispersed liquid crystals (PDLC). Applications of liquid crystal technology | TB1/TB2 |
| 32-33-34 | Introduction, Gibbs phase rule, Application of phase rule in one component system, Water system, Carbon dioxide system, Sulfur system | TB1/TB2 |
| 35-36 | Condensed phase rule, Two component system, Eutectic mixture, Lead silver system, Two component system, Potassium iodide -water system | TB1/TB2 |
| 37-38 | Ferric chloride water system, Iron Carbon system | TB1/TB2 |
| **SESSIONAL TEST –II ( Nov 16/17/23 ,2015)** | | |
| 39-40 | Introduction, Causes of corrosion, effects of corrosion, Types and mechanism of corrosion, chemical (dry corrosion), Electrochemical (wet) corrosion. Pilling Bedworth ratio | TB1/TB2 |
| 41-42 | Comparison of Chemical and electrochemical corrosion. Types of electrochemical corrosion, Other forms of corrosion (Underground or soil corrosion, Microbial corrosion, Erosion, Intergranular, Crevice, atmospheric corrosion) | TB1/TB2 |
| 43 | Passivity of corrosion, Factors influencing corrosion, Nature of the metal, Nature of corroding environment Prevention of corrosion, Use of protective measurements: Cathodic protection | TB1/TB2 |
| 44-45-46 | Weapons for mass destructions ,Chemistry for peaceful work : Green Chemistry, Principles of green chemistry and green engineering, Green chemistry in India (Examples of Microwave assisted synthesis) | TB1/TB2 |
| 47-48 | Traditional and alternative feedstock in the synthesis of adipic acid and urethane | TB1/TB2 |
| **SESSIONAL TEST –III ( Dec 3/4/5 ,2015)** | | |

**6. Evaluation Scheme:**

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| Component 1 | Sessional Tests (STs)\* | 40 |
| Component 2\*\* | End Term Examination\*\* | 60 |
|  | **Total** | **100** |

**\*** There shall be three Sessional Tests (STs) and average of the best two sessionals will be taken as final internal assessment.

\* Complete syllabus will be covered in ST-3 and End Term Examination

\*\*The End Term Comprehensive examination will be held at the end of semester. The mandatory requirement of 75% attendance in all theory classes is to be met for being eligible to appear in this component

7..Syllabus

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| **Contents** | **Lectures** | **Weightage in End term exams** |
| **Water Technology**  Introduction, Sources of water, Impurities in water, Hard and soft water, Units of hardness (Numericals included), Specification for boiler feed water, Boiler problems**:** Scale and sludge formation, Caustic embrittlement, Priming and Foaming, Boiler corrosion due to oxygen and carbon dioxide, External treatment: Lime –soda process (Numericals included), Zeolite process, Ion exchange process, Internal treatment (different types of conditioning), Specification of water for domestic use, Treatment for domestic use(break point chlorination); Treatment of brackish water( reverse osmosis, electrodialysis using ion selective membrane). Water quality parameters: Acidity, alkalinity, BOD, COD, Dissolved oxygen, Conductivity, pH | **12** | **20%** |
| **Polymer Sciences**  Elementary ideas about polymers, Classification of polymers, Types of polymerization, Chemical reaction for the synthesis of polymers: **Teflon, Polyester (Dacron), Nylon6,6;** PMMA ,Novolac, Phenol formaldehyde resin(Bakelite), PC(Polycarbonate). Synthesis and Application of rubbers – Buna-N, Buna-S and Poly isoprene. Introduction and Application of Electro active , Conducting and Biopolymers. | **5** | **15%** |
| **Battery Technology**  Introduction to electrolytic and electrochemical cell, EMF of cell, Relationship between emf and thermodynamic properties (∆H, ∆S, ∆G). Numerical based on EMF of cells and thermodynamic parameters. Electroless plating, Preparation of PCB (Printed circuit board), Dry cell, lead storage batteries. Applications and function of batteries used in Laptops: Lithium ion battery and Nano batteries. Batteries used in rockets & submarine: Fuel cell (hydrogen-oxygen ­­alkaline fuel cell, molten carbonate fuel cell**, Phosphoric acid fuel cell).** Batteries used in electronic devices :Solar cell | **9** | **15%** |
| **Liquid Crystal Technology**  Introduction, Characteristics of liquid crystals: Director and Effect of temperature on order parameter. Classification of liquid crystal: Smectic liquid crystal (Smectic A,B,C), Nematic liquid crystal, Cholesteric liquid crystal, Molecular arrangement in various types of liquid crystals. Principle of liquid crystal Display (LCD) , Application of polymer dispersed liquid crystals (PDLCs) | **5** | **15%** |
| **Phase Equilibrium**  Introduction, Gibbs phase rule, Application of phase rule in one component system, Water system, Carbon dioxide system, Sulfur system Condensed phase rule, Two component system, Eutectic mixture, Lead silver system. Two component system: Potassium iodide -water system, Ferric chloride water system and Iron-Carbon system | **7** | **15%** |
| **Corrosion and its control**  Introduction, Causes of corrosion, effects of corrosion, Types and mechanism of corrosion, Direct chemical (dry) corrosion. Electrochemical (wet) corrosion, Pilling Bedworth ratio. Comparison of Chemical and electrochemical corrosion. Types of electrochemical corrosion, Other forms of corrosion (Underground or soil corrosion, Microbial corrosion, Erosion corrosion, Intergranular ,Crevice, atmospheric corrosion), Passivity of corrosion, Factors influencing corrosion: Nature of the metal, Nature of corroding environment, Prevention of corrosion, Use of protective measurements: Cathodic protection | **5** | **10%** |
| **Green Chemistry and Green Engineering**  Weapons for mass destruction and chemistry for peaceful work., Principles of green chemistry and Green Engineering, Green Chemistry in India (examples of Microwave assisted synthesis),Traditional synthesis of adipic acid and urethane. | **5** | **10%** |

**This Document is approved by:**

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| **Designation** | **Name** | **Signature** |
| Course Coordinator | Ms.Taruna Manchanda |  |
| Dy.Dean | Dr. Jyotsna Kaushal |  |
| Date |  |  |