FMTH0301/Rev.5.3

Course Plan

Semester: **Second Semester** Year: **2021-22**

Course Title: **Engineering Chemistry**	Course Code: **15ECHB102**
Total Contact Hours: **40**	Duration of ESA: **3 Hours**
ISA Marks: **50**	ESA Marks: **50**
Lesson Plan Authors: Dr. S. Dhanalakshmi Sri. Sandeep R Kurundawade Dr. Shweta J Malode	Date: 11/04/2022
Checked By: Dr. Ashok M Sajjan	Date: 12/04/2022

Prerequisites:

This Course requires the students to know about the fundamental chemical concepts of materials and their processes in Engineering and Technology.

Course Outcomes (COs):

At the end of the course student will be able to:

1. explain various types of bonds present in chemical compounds and discuss the salient features of Valence Bond Theory and Molecular Orbital Theory.
2. calculate the *emf* of a cell and describe the construction, working and applications of batteries and fuel cells.
3. explain the basic terms involved in polymer chemistry, outline the synthesis, properties and applications of different polymers and mechanism of conduction in conducting polymers.
4. explain electroplating and electroless plating processes.
5. explain the preparation, purification of silicon and the basic steps involved in the fabrication of electrical and electronic devices.
6. explain the properties and applications of various materials used in electrical and electronic industries.
7. explain the principle and methodology involved in potentiometer, colorimeter and describe the instrumentation and applications of UV-spectrophotometer.
8. outline the standards for water quality and describe the techniques involved in estimating the impurities present in water.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (Pos)

Course Title **Engineering Chemistry**	Semester: **II**
Course Code: **15ECHB102**	Year: **2021-22**

Course Outcomes (COs) / Program Outcomes (POs)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1. explain various types of bonds present in chemical compounds and discuss the salient features of Valence Bond Theory and Molecular Orbital Theory.	**M**													
2. calculate the *emf* of a cell and describe the construction, working and applications of batteries and fuel cells.	**M**													
3. explain the basic terms involved in polymer chemistry, outline the synthesis, properties and applications of different polymers and mechanism of conduction in conducting polymers.	**M**													
4. explain electroplating and electroless plating processes.	**M**													
5. explain the preparation, purification of silicon and the basic steps involved in the fabrication of electrical and electronic devices.	**M**													
6. explain the properties and applications of various materials used in electrical and electronic industries.	**M**													
7. explain the principle and methodology involved in Potentiometer, Colorimeter and describe the instrumentation and applications of UV-spectrophotometer.	**M**													
8. outline the standards for water quality and describe the techniques involved in estimating the impurities present in water.	**M**													

Degree of compliance **L**: Low **M**: Medium **H**: High

Competency addressed in the Course and corresponding Performance Indicators

Graduate Attributes			
Attribute 1: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization for the solution of complex engineering problems.			
Competency		**Performance Indicators**	
1.2	Demonstrate the competence in basic sciences	1.2.1	Apply laws of natural science to an Engineering problem
		1.2.2	Apply knowledge of basics of chemistry

E.g.: 1.2.1: Represents program outcome ‘1’, competency ‘2’ and performance indicator ‘1’.

Course Content

Course Code: **15ECHB102**	Course Title: **Engineering Chemistry**	
L-T-P: **3-0-0**	Credits: **03**	Contact Hrs: **40**
ISA Marks: **50**	ESA Marks: **50**	Total Marks: **100**
Teaching Hrs: 4**0**		Exam Duration: **3 Hrs.**

Content

Unit - 1	**Hrs**
Chapter No.: 1 Chemical Bonding Introduction, Ionic bond, factors influencing the formation of ionic bond: ionization energy, electron affinity & electro negativity and properties of ionic compounds. Covalent bond: Valence Bond Theory & Molecular Orbital Theory - formation of hydrogen molecule, factors influencing the formation of covalent bond, polar & non-polar covalent bond, dipole moment, problems on calculation of percentage of ionic character and properties of covalent compounds. Co-ordinate bond: formation of hydronium ion and ammonium ion.	**04**
Chapter No.: 2 Electrochemical Energy Systems Electrode potential, Nernst equation, formation of a cell. Reference electrodes: Calomel electrode, determination of electrode potential, numerical problems on E, E^0cell and E_{cell}. Batteries: Classification, characteristics, lead – acid battery and lithium ion battery. Fuel cells: methanol - oxygen fuel cell.	**06**
Chapter No.: 3 Polymers Introduction: polymerization: mechanism of polymerization taking ethylene as an example. Determination of molecular weight of a polymer - numerical problems. Commercial polymers: Plexi glass, Polyurethane and Polystyrene. Polymer composites: Carbon fibre and Epoxy resin – synthesis, properties and applications. Introduction to conducting polymers, mechanism of conduction in polyacetylene and applications.	**06**
Unit - 2	
Chapter No.: 4 Plating Techniques Introduction: technological importance. Electroplating, principles of electroplating, factors affecting the nature of electro deposit: throwing power, numerical problems on throwing power, electroplating process of gold by acid cyanide bath. Electroless plating; advantages of electroless plating over electroplating. Electroless plating of copper and its application in the manufacture of PCB.	**04**
Chapter No.: 5 Wafer Technology Introduction: physical and chemical properties of silicon, purification of silicon: chemical vapor deposition (CVD) process, zone refining process, crystal growth; preparation of single crystal silicon by Czhochralski crystal pulling technique, numerical problems; crystal slicing and wafer preparation. Fabrication processes: thermal oxidation, diffusion, ion implantation, numerical problems, epitaxial growth, masking, photolithography, wet etching and dry etching.	**09**

Chapter No.: 6 Material Chemistry Liquid crystals: types of liquid crystals, applications of liquid crystals in display system. Fluorescence and Phosphorescence - Jablonski diagram. Thermoelectric and Piezoelectric materials - meaning, properties and applications.	**03**
Unit – 3	
Chapter No.: 7 Instrumental methods of measurement Advantages over conventional methods. Electro analytical methods: Potentiometer - principle, methodology and applications. Opto analytical methods: Colorimeter - Principle, methodology and applications. Spectral methods of analysis: UV Spectrophotometer-Instrumentation and applications.	**04**
Chapter No.: 8 Environmental Chemistry Water: sources and ill effects of water pollutants – fluoride and nitrate; determination of total hardness of water by EDTA method - numerical problems. Sewage: determination of Biological Oxygen Demand by Winkler's method - numerical problems and determination of Chemical Oxygen Demand - numerical problems.	**04**

Text Books:

1. A text Book of Engineering Chemistry, 1st edition, Dara. S. S, S. Chand & Co. Ltd., 2009, New Delhi.
2. A text Book of Engineering Chemistry, 16th edition, Jain P.C and Jain M, Dhanpat Rai Publications, 2006, New Delhi.
3. Engineering Chemistry, 3rd Edition, Krishnamurthy. N., Vallinayaga. P. and Madhavan. D., PHI/E-Books Premium, 2014

Reference Books:

1. Text book of Inorganic Chemistry, P. L. Soni, Sultan Chand, 1999, New Delhi.
2. Hand book of batteries, 3rd edition, David Linden, Thomas B Reddy, McGraw Hill publications, 2001, New York.
3. Polymer Science, 6th edition, Gowariker V.R, Viswanatan N.V, Sreedhar J., New Age International (P) ltd., 2007, New Delhi.
4. Solid State Devices & Technology, 4th Edition, V. Suresh Babu, Sanguine Technical Publishers, 2005, Bangalore.
5. Materials Science and Engineering: An introduction, 9th Edition, Callister William D, John Wiley and Sons, 2007, New York.
6. Instrumental Methods of Chemical Analysis, 5th edition, Gurdeep R Chatwal, Sham K Anand, Himalaya Publishing House, Pvt. Ltd, 2010, Mumbai.
7. VLSI Technology, 2nd Edition, S. M. Sze, McGraw-Hill Series in Electrical and Computer Engineering, 1998, New York.

Evaluation Scheme

Exam	Assessment	Weightage in Marks
ISA	Post Test	05
	Assignment	05
	Minor Exam - 1	20
	Minor Exam - 2	20
ESA	SEE	50
Total		**100**

Course Unitization for In Semester Assessment and End Semester Assessment

Topics / Chapters	Teaching Credits	No. of sub questions in Minor Exam - 1	No. of sub questions in Minor Exam - 2	No. of sub questions in ESA
Unit I				
1. Chemical Bonding	4	2	--	2
2. Electrochemical Energy Systems	6	4	--	4
3. Polymers	6	3	--	3
Unit II				
4. Plating Technology	4	--	2	2
5. Wafer Technology	9	--	5	5
6. Material Chemistry	3	--	2	2
Unit III				
7. Instrumental Methods of Measurement	4	--	--	3
8. Environmental Chemistry	4	--	--	3

Note:

1. Post test will be conducted with prior intimation.
2. Each question in Minor Exam carries 20 marks and may consist of sub-questions.
3. Mixing of sub-questions from different chapters within a unit (only for Unit I and Unit II) is allowed in Minor Exam - I, Minor Exam - II and ESA.
4. Answer 5 full questions of 20 marks each (two full questions from Unit I, two full questions from Unit II and one full question from Unit III) out of 8 questions in ESA.

Course Assessment Plan (CAP)

Course : Engineering Chemistry		Course Code: 15ECHB102			
Course outcomes (COs)	**Weightage in assessment**	**Assessment Methods**			
		Post Test and Assignment	**Minor Exam - 1**	**Minor Exam - 2**	**ESA**
1. explain various types of bonds present in chemical compounds and discuss the salient features of Valence Bond Theory and Molecular Orbital Theory.	10.0%	✓	✓		✓
2. calculate the *emf* of a cell and describe the construction, working and applications of batteries and fuel cells.	15.0%	✓	✓		✓
3. explain the basic terms involved in polymer chemistry, outline the synthesis, properties and applications of different polymers and mechanism of conduction in conducting polymers.	15.0%	✓	✓		✓
4. explain electroplating and electroless plating processes.	10.0%	✓		✓	✓
5. explain the preparation, purification of silicon and the basic steps involved in the fabrication of electrical and electronic devices.	22.5%	✓		✓	✓
6. explain the properties and applications of various materials used in electrical and electronic industries.	07.5%	✓		✓	✓
7. explain the principle and methodology involved in Potentiometer, Colorimeter and describe the instrumentation and applications of UV-spectrophotometer.	10.0%	✓			✓
8. outline the standards for water quality and describe the techniques involved in estimating the impurities present in water.	10.0%	✓			✓
Weightage		**10%**	**20%**	**20%**	**50%**

Date: 12-04-2022 **Coordinator, Chemistry Department** **Head of Department**

Chapter-wise Plan

Course Code and Title: : **15ECHB102 / Engineering Chemistry**	
Chapter Number and Title: **01. Chemical Bonding**	Planned Hours: **04 hrs**

Learning Outcomes:

At the end of the topic the student should be able to:

Topic Learning Outcomes	COs	BL	CA Code
1. explain the formation of ionic bond, covalent bond and the factors influencing the bond formation.	CO1	L2	1.2
2. discuss the salient features of Valence Bond Theory and Molecular Orbital Theory.	CO1	L2	1.2
3. explain dipole moment and calculate the % of ionic character in a bond.	CO1	L3	1.2
4. describe the formation of co-ordinate bond.	CO1	L2	1.2

Lesson Schedule **Class No. Chunks covered per hour**
1. Introduction, ionic bond, factors influencing the formation of ionic bond: ionization energy, electron affinity & electro negativity and properties of ionic compounds.
2. Covalent bond: Valence Bond Theory & Molecular Orbital Theory - formation of hydrogen molecule, factors influencing the formation of covalent bond,
3. Polar & non-polar covalent bond, dipole moment, problems on calculation of percentage of ionic character and properties of covalent compounds.
4. Co-ordinate bond: formation of hydronium ion and ammonium ion.

Review Questions

Sr. No . Questions	TLOs	BL	PI Code
1. What is Ionic bond? Explain the factors influencing the ionic bond formation.	TLO1	L2	1.2.2
2. Discuss the energy changes during the formation of covalent bond taking H_2 as an example.	TLO1	L2	1.2.2
3. Explain the salient features of Valence Bond Theory.	TLO2	L2	1.2.2
4. Explain the salient features of Molecular Orbital Theory and draw MO diagram of H_2 molecule & calculate its bond order.	TLO2	L2	1.2.2

5. Dipole moment of HCl molecule is 1.03D. For complete transfer of electrons, the charge on H^+ & Cl^- ions would be equal to 4.8 x 10^{-10}esu. The length of HCl bond is 1.275 x 10^{-8}cm. Calculate the % of ionic character in HCl.	TLO3	L3	1.2.1
6. The dipole moment of LiH is 1.964 x 10^{-29} coulomb meter. When LiH forms Li^+ and H^- ions by complete transfer of electrons, the charge on the ion is 1.602 x 10^{-19} coulombs and bond length is 1.596 x 10^{-10}m. Calculate the percentage of ionic character in LiH.	TLO3	L3	1.2.1
7. Explain the formation of hydronium ion and ammonium ion.	TLO4	L2	1.2.2

Sr. No.	Post Test Questions	TLOs	BL	PI Code
1	The number of _____ is most important in determining how an atom will bond (a) Neutrons (b) Valence electrons (c) Protons (d) Electrons in the innermost shell	TLO1	L1	1.2.2
2	Which of the following is true for the formation of stable bonds according to valence bond theory? (a) Greater overlapping between atomic orbitals (b) Close proximity between two atoms (c) Pairing of electrons having opposite spins (d) All of the above	TLO2	L1	1.2.2
3	Bond order of H_2 molecule is _____. (a) 1 (b) 1.5 (c) 0 (d) 2	TLO2	L1	1.2.2
4	The unequal sharing of bonded pair of electrons between two atoms in a molecule causes (a) Dipole (b) Radical formation (c) Covalent bond (d) Decomposition of molecule	TLO3	L1	1.2.2
5	When two atoms A and B form an electron-pair bond and A does not provide its electrons for bonding, the bond present between A and B must be (a) ionic (b) covalent (c) dative (d) Hydrogen	TLO4	L1	1.2.2

Assignment Questions	TLOs	BL	PI Code
1. Explain the salient features of Molecular Orbital Theory and draw MO diagram of H_2 molecule & calculate its bond order.	TLO2	L2	1.2.2
2. The dipole moment of HF is 1.98D when HF forms H^+ and F^- ions by complete transfer of electrons. The charge on the ion is 4.8 x 10^{-10} esu and bond length is 0.98 x 10^{-8} cm. Calculate the % of ionic character in HF.	TLO3	L3	1.2.1

Chapter-wise Plan

Course Code and Title: : **15ECHB102 / Engineering Chemistry**	
Chapter Number and Title: **02. Electrochemical Energy Systems**	Planned Hours: **06 hrs**

Learning Outcomes:

At the end of the topic student should be able to:

Topic Learning Outcomes	COs	BL	CA Code
1. define single electrode potential and derive Nernst equation for electrode potential of an electrode	CO2	L1	1.2
2. explain the construction, working and applications of calomel electrode.	CO2	L2	1.2
3. calculate *emf* of a cell with the given data.	CO2	L3	1.2
4. discuss battery characteristics and calculate battery voltage, capacity and % of energy efficiency.	CO2	L2	1.2
5. explain the construction, working and applications of Lead - acid and Lithium ion batteries.	CO2	L2	1.2
6. define fuel cell and describe construction, working and applications of Methanol – Oxygen fuel cell.	CO2	L2	1.2

Lesson Schedule **Class No. - Chunks covered per hour**
1. Electrode potential, Nernst equation
2. formation of a cell; Reference electrodes: Calomel electrode
3. determination of electrode potential, Numerical problems on E, E^0_{cell} and E_{cell}.
4. Batteries: Classification, characteristics,
5. lead-acid battery and lithium ion battery
6. Fuel cells: Methanol – Oxygen fuel cell.

Review Questions

Sr. No. - Questions	TLO	BL	PI Code
1. What is single electrode potential? Derive an expression for electrode potential of an electrode.	TLO1	L2	1.2.2
2. What are reference electrodes? Explain the construction, working and applications of calomel electrode.	TLO2	L2	1.2.2
3. Explain capacity, voltage and energy efficiency of a battery?	TLO4	L2	1.2.2

4. Explain the construction, working and applications of lead-acid battery and lithium ion battery.	TLO5	L2	1.2.2
5. Describe the construction, working and applications of methanol-oxygen fuel cell. Discuss the suitability of using methanol as a fuel and sulphuric acid as an electrolyte in the fuel cell.	TLO6	L2	1.2.2
6. The standard electrode potential of Cd electrode is –0.40 V. If the Cd electrode is dipped in 0.025 M $CdSO_4$ solution at 25 ^{0}C, what is the potential developed?	TLO3	L3	1.2.1
7. The *emf* of a cell Mg/Mg^{2+} (0.01) || Cu^{2+}/Cu is measured to be 2.78V at 298K. The standard electrode potential of Mg electrode is –2.37V. Calculate the electrode potential of copper electrode.	TLO3	L3	1.2.1
8. The E^0 values of Li/Li^+, Zn/Zn^{++}, Cu/Cu^{++}, and Ag/Ag+ are -3.0V, -0.77V, +0.33V and +0.80V respectively. Which combination of the electrodes you use to construct a cell of highest *emf* if the ionic concentrations are 0.1M, 1.0M, 10M and 0.01M in the same order. Justify your answer.	TLO3	L3	1.2.1
9. Calculate the potential of Zn-Ag cell at 298K if the concentration of Zn^{+2} and Ag^+ are $1.3x10^{-3}$ M and $5.2x10^{-6}$ M respectively. E^0 value of the cell at 298K is 1.5V. Calculate the change in free energy ΔG for the reduction of one mole of Ag^+. Given: 1 Faraday = 96.5 kJ/V mole.	TLO3	L3	1.2.1
10. An electrochemical cell consists of Mg electrode dipped in 0.05M $Mg(NO_3)_2$ solution and Ag electrode dipped in 0.4M $AgNO_3$ solution. The standard electrode potentials of Mg and Ag electrodes are -2.37V and 0.80V respectively. Represent the cell, write the cell reactions and calculate the *emf* of the cell.	TLO3	L3	1.2.1
11. If the emf of Zn/Zn^{+2}(1M) || Ni^{+2}(1M)/Ni is 0.51V and Ni/Ni^{+2}(1M) || SCE is 0.49V, then calculate $E^o_{Zn^{+2}/Zn}$. Given: E^o_{SCE} = 0.24V.	TLO3	L3	1.2.1
12. Calculate the voltage in the following cell Mn/Mn^{+2} || Fe^{+2}/Fe, when Fe rod is immersed in 1M $FeSO_4$ solution and Mn rod is immersed in 0.1M $MnSO_4$ solution. Given: $E^0_{Fe^{+2}/Fe}$ = -0.4V and $E^0_{Mn^{+2}/Mn}$ = -1.18V.	TLO3	L3	1.2.1

Sr. No.	Post Test Questions	TLOs	BL	PI Code
1	Gibbs free energy change for a cell reaction is negative. What does it indicates? (a) cell will work under standard conditions (b) cell reaction is spontaneous (c) cell reaction is non spontaneous (d) None of these	TLO1	L1	1.2.2
2	Nernst equation for an electrode is based on the variation of electrode potential of an electrode with (a) temperature only (b) concentration of electrolyte only (c) Both (a) and (b) (d) density of the electrodes	TLO2	L1	1.2.2
3	What is the standard electrode potential of Cu^{2+}/Cu if its electrode potential at 25°C is 0.296 V and $[Cu^{2+}]$ is 0.015M. (a) 0.305 V (b) 0.35 V (c) -0.35 V (d) -0.305 V	TLO3	L3	1.2.1
4	The capacity of a battery is expressed in terms of (a) Current rating (b) Voltage rating (c) Ampere hour rating (d) None of the above	TLO4	L1	1.2.2
5	An electrochemical cell in which fuel gives up electrons at one electrode and O_2 gains electrons at another electrode is known as (a) Electrolytic cell (b) Fuel cell (c) Concentration cell (d) None of these	TLO6	L1	1.2.2

Assignment Questions	TLO	BL	PI Code
1. Define single electrode potential. Derive Nernst equation for electrode potential of an electrode.	TLO1	L2	1.2.2
2. Explain the construction, working and applications of lithium ion battery	TLO5	L2	1.2.2
3. Describe the construction, working and applications of methanol-oxygen fuel cell. Discuss the suitability of using methanol as a fuel and sulphuric acid as an electrolyte in the fuel cell.	TLO6	L2	1.2.2
4. Calculate the voltage in the following cell Mn/Mn^{+2} || Fe^{+2}/Fe, when Fe rod is immersed in 1M $FeSO_4$ solution and Mn rod is immersed in 0.1M $MnSO_4$ solution. Given: $E^0_{Fe^{+2}/Fe} = -0.4V$ and $E^0_{Mn^{+2}/Mn} = -1.18V$.	TLO3	L3	1.2.1

Chapter-wise Plan

Course Code and Title: **: 15ECHB102 / Engineering Chemistry**	
Chapter Number and Title: **03. Polymers**	Planned Hours: 06 hrs

Learning Outcomes:

At the end of the topic student should be able to:

Topic Learning Outcomes	COs	BL	CA Code
1. describe the free radical mechanism of polymerization of ethylene.	CO3	L2	1.2
2. calculate the molecular weight of a polymer using given data.	CO3	L3	1.2
3. discuss the synthesis, properties and applications of PMMA, polyurethane and polystyrene.	CO3	L2	1.2
4. explain polymer composites.	CO3	L2	1.2
5. explain the synthesis, properties and applications of carbon fiber and epoxy resin.	CO3	L2	1.2
6. explain the mechanism of conduction in polyacetylene.	CO3	L2	1.2

Lesson Schedule **Class No. - Chunks covered per hour**
1. Introduction, polymerization - mechanism of polymerization taking ethylene as an example,
2. Determination of molecular weight of a polymer - numerical problems.
3. Commercial polymers - Plexi glass, Polyurethane and
4. Polystyrene. Polymer composites: Carbon fiber and
5. Epoxy resin - synthesis, properties and applications.
6. Introduction to conducting polymers, mechanism of conduction in polyacetylene and applications.

Review Questions

Sr. No - Questions	TLO	BL	PI Code
1. Explain the free radical mechanism of addition polymerization by taking ethylene as an example.	TLO1	L2	1.2.2
2. Discuss the preparation, properties and applications of PMMA and Polyurethane.	TLO3	L2	1.2.2
3. Explain the synthesis, properties and applications of Epoxy resin.	TLO5	L2	1.2.2
4. Explain the mechanism of conduction in polyacetylene.	TLO6	L2	1.2.2

5. Calculate the molecular weight of the given addition polymer: $[-CH_2-CH(CH_3)-]_{1000}$. Given: atomic mass of C = 12, H = 1.	TLO2	L3	1.2.1
6. A polymer sample contains 1, 2, 3 & 4 molecules having molecular weights 1 $X10^5$, 2 X 10^5, 3 X 10^5 and 4 X 10^5 respectively. Calculate the number average and weight average molecular weight of the polymer.	TLO2	L3	1.2.1
7. A polymer of polypropylene is found to have the following composition. (i) R -$[CH_2-CH(CH_3)-]_{400}$ R 20% (ii) R -$[CH_2-CH(CH_3)-]_{500}$ R 30% (iii) R -$[CH_2-CH(CH_3)-]_{600}$ R 50% Calculate the number average and weight average molecular masses of the polymer (atomic mass of C = 12, H = 1, neglect the molecular mass of R).	TLO2	L3	1.2.1

Sr. No.	Post Test Questions	TLOs	BL	PI Code
1	Which of the following happens in initiation step of the free radical polymerization? (a) Decomposition of initiator (b) Renewal of inhibitor (c) Addition of monomer molecules to the growing chains (d) Disproportionation	TLO1	L1	1.2.2
2	Calculate the molecular weight of the given addition polymer: $[-CH_2-CH(CH_3)-]_{1200}$. Given: atomic mass of C = 12, H = 1. (a) 50400 (b) 51400 (c) 51000 (d) 54000	TLO2	L3	1.2.1
3	Which polymer is used in making the artificial dentures? (a) PMMA (b) Polyurethane (c) Natural rubber (d) None of the above	TLO3	L1	1.2.2
4	Which of the following does not combine with fiber to give composites? (a) Metals (b) Ceramics (c) Non-metals (d) Polymers	TLO4	L1	1.2.2
5	Epoxy resin is manufactured using which one of the following? (a) Bisphenol-A (b) Acrylo nitrile (c) Acetyl chloride (d) None of these	TLO5	L1	1.2.2

Assignment Questions	TLO	BL	PI Code
1. What are polymers? Explain the free radical mechanism of addition polymerization by taking ethylene as an example.	TLO1	L2	1.2.2
2. Discuss the synthesis, properties and applications of plexi glass and polystyrene	TLO3	L2	1.2.2
3. Explain the mechanism of conduction in polyacetylene.	TLO6	L2	1.2.2
4. A polymer sample contains 10, 20, 30 & 40 molecules having molecular weights 1 $X10^3$, 2 X 10^3, 3 X 10^3 and 4 X 10^3 respectively. Calculate the number average and weight average molecular weight of the polymer	TLO2	L3	1.2.1

Chapter-wise Plan

Course Code and Title: : **15ECHB102 / Engineering Chemistry**	
Chapter Number and Title: **04. Plating Techniques**	Planned Hours: **04 hrs**

Learning Outcomes:

At the end of the topic student should be able to:

Topic Learning Outcomes	COs	BL	CA Code
1. understand the importance of plating techniques.	CO4	L1	1.2
2. calculate the throwing power of the plating bath solution.	CO4	L3	1.2
3. explain the electroplating process of gold.	CO4	L2	1.2
4. list out the advantages of electroless plating over electroplating and discuss the process of electroless plating in the preparation of PCB.	CO4	L2	1.2

Lesson Schedule **Class No. - Chunks covered per hour**
1. Introduction, technological importance. Electroplating, Principles of electroplating, Factors affecting nature of electro deposit - Throwing Power of plating bath solution
2. Numerical problems; Electroplating Process of gold by acid cyanide bath.
3. Electroless plating, advantages over electroplating,
4. Electroless plating process of Cu and its application in the manufacture of PCB.

Review Questions

Sr. No	Questions	TLOs	BL	PI code
1.	Give the importance of plating techniques.	TLO1	L1	1.2.2
2.	Explain the determination of throwing power of plating bath solution using Haring - Blum cell.	TLO2	L2	1.2.2
3.	Calculate the percentage of throwing power of plating bath solution in a Haring - Blum cell if the distances between the two cathodes are 6.6 cm and 4 cm from the anode and the masses of the plating on the cathodes are 52 mg and 55 mg respectively.	TLO2	L3	1.2.1
4.	The throwing power of an electrolyte in a Haring Blum cell is 75%. In an experiment, 68 mg of the metal was deposited at the nearest cathode kept at a distance of 4.8 cm from the cathode. At what distance must the cathode be kept if the metal deposited on it is 64 mg?	TLO2	L3	1.2.1

5. Calculate the percentage of throwing power of a plating bath in a Haring - Blum cell if the distances of the two cathodes from the anode are 6 cm and 5 cm and the quantities of metal deposited are 72 mg and 75 mg respectively. In the same cell if one of the cathode which was fixed at 6 cm was moved to 8 cm from the anode, calculate mass of metal deposited on the electrode.	TLO2	L3	1.2.1
6. Discuss the process of gold plating using acid cyanide bath and mention its engineering applications.	TLO3	L2	1.2.2
7. What is electroless plating? Mention the advantages of electroless plating over electro plating.	TLO4	L1	1.2.2
8. What is electroless plating? Describe the electroless plating of copper in the preparation of PCB.	TLO4	L2	1.2.2

Sr. No.	Post Test Questions	TLOs	BL	PI Code
1	What is the main principle of electroplating? (a) Hydrolysis (b) Neutralization (c) Esterification (d) Saturation	TLO1	L1	1.2.2
2	Total number of cathodes used in Haring-Blum cell is _____. (a) Two (b) One (c) Three (d) Four	TLO2	L1	1.2.2
3	Identify the electrolyte used in gold deposition. (a) Potassium gold cyanide solution (b) Monopotassium dihydrogen phosphate (c) Chromium sulphide (d) Potassium citrate	TLO3	L1	1.2.2
4	Which reducing agent is used in electroless plating of copper? (a) EDTA (b) Formaldehyde (c) $CuSO_4$ (d) None of these	TLO4	L1	1.2.2
5	Uniform coating is achieved on the surface of the irregular objects by (a) Electroplating (b) Electroless plating (c) Immersion plating (d) Chemical conversion coating	TLO4	L1	1.2.2

Assignment Questions	TLOs	BL	PI code
1. Describe the electroless plating of copper in the preparation of PCB.	TLO4	L2	1.2.2
2. Explain the determination of throwing power of plating bath solution using Haring - Blum cell and calculate the throwing power of the plating bath solution in a Haring - Blum cell if the distances between the two cathodes are 7 cm and 5 cm from the anode and the masses of the plating on the cathodes are 88 mg and 90 mg respectively.	TLO2	L3	1.2.1

Chapter-wise Plan

Course Code and Title: : **15ECHB102 / Engineering Chemistry**	
Chapter Number and Title: **05. Wafer Technology**	Planned Hours: **09 hrs**

Learning Outcomes:

At the end of the topic student should be able to:

Topic Learning Outcomes	COs	BL	CA Code
1. list the physical and chemical properties of silicon.	CO5	L1	1.2
2. describe the preparation of electronic grade silicon and its purification by zone refining process.	CO5	L2	1.2
3. explain the production of single crystal silicon by Czhochralski crystal pulling technique and calculate concentration and amount of dopant.	CO5	L3	1.2
4. explain the fabrication process of silicon by thermal oxidation, diffusion and ion implantation methods.	CO5	L2	1.2
5. determine the thickness of SiO_2 developed on silicon during the fabrication process.	CO5	L3	1.2
6. calculate the concentration of dopant to be maintained in silicon melt to develop silicon wafers suitable for engineering application.	CO5	L3	1.2
7. calculate the time for ion implantation process to achieve required dopant concentration at required area and depth of silicon wafer.	CO5	L3	1.2
8. explain the process of growing a crystalline layer over a substrate by homo epitaxy and hetero epitaxy.	CO5	L2	1.2
9. discuss the process of photolithography.	CO5	L2	1.2

Lesson Schedule **Class No. Chunks covered per hour**
1. Introduction, physical and chemical properties of silicon;
2. Preparation of electronic grade silicon by CVD process,
3. Purification of silicon by Zone refining
4. Crystal growth - preparation of single crystal silicon by Czhochralski crystal pulling technique - numerical problems; Crystal slicing and wafer preparation.
5. Fabrication process: Thermal oxidation,
6. Diffusion
7. Ion implantation - numerical problems
8. Epitaxial growth,
9. Masking, photolithography, wet etching and dry etching.

Review Questions

Sr. No - Questions	TLO	BL	PI code
1. Explain with neat diagram, the manufacture of electronic grade silicon by CVD process.	TLO2	L2	1.2.2
2. Describe the process of zone refining in the purification of silicon.	TLO2	L2	1.2.2
3. Discuss in detail the process of Czhochralski crystal pulling technique in the production of single crystal silicon.	TLO3	L2	1.2.2
4. A silicon crystal is to be grown by Czhochralski process and is to contain 5 x 10^{15} boron atoms per cm^3. Given: K_0 = 0.8 for 'B' in Si, atomic weight of 'B' = 10.81g/mole, density of Si = 2.33g/cm^3, Avogadro number = 6.023X10^{23} atoms/mole. (a) Determine the initial concentration of boron atoms in the melt to produce the required density. (b) If initial amount of silicon in the crucible is 50 kg, how many grams of boron should be added?	TLO3	L3	1.2.1
5. Define segregation constant (K_0). A semiconductor crystal with acceptor concentration, N_A is 2x10^{16} atoms/cm^3 must be obtained by Czhochralski crystal pulling technique. What weight of Boron must be added to the melt if it contains 10 Kg of Si? Given: K_0 = 0.8 for Boron in Si; Atomic weight of B = 10.81g/mole, Density of Silicon = 2.33 g/cm^3, Avogadro number = 6.023 x 10^{23} atoms/mole	TLO3	L3	1.2.1
6. A silicon crystal is to be pulled from the melt and doped with phosphorus. If Si weight is 1 Kg, how many grams of phosphorus should be introduced to achieve a donor concentration of 2 x 10^{15} atoms/cm^3 during initial growth? Given: K_0 = 0.32 for 'P' in Si; Atomic weight of 'P' = 30.97g/mole, Density of Si = 2.33g/cm^3, Avogadro number = 6.023 x 10^{23} atoms/mole.	TLO3	L3	1.2.1
7. Describe the fabrication process of silicon wafers by thermal oxidation with relevant reactions.	TLO4	L2	1.2.2
8. Explain with neat diagram the process of diffusion for the development of silicon wafers of known dopant concentration.	TLO4	L2	1.2.2
9. Describe the technique of ion implantation used for doping process with neat diagram.	TLO4	L2	1.2.2
10. Determine the ratio of silicon consumed to the thickness of grown SiO_2 layer over the wafer. If SiO_2 layer of 1000 ^oA is to be grown, what would be the thickness of used silicon? Given: Atomic weight of Si = 28.09 g/mol. Density of Si = 2.33 g/cm^3. Molecular weight of SiO_2 = 60.08 g/mol. Density of SiO_2 = 2.20 g/cm^3.	TLO5	L3	1.2.1

11. Determine the ratio of Si consumed to the thickness of grown SiO_2 layer over the wafer. If 100 ^oA thick Si is used for the process, what would be the thickness of SiO_2 grown? Given: Atomic weight of silicon = 28.09 g/mol. Density of silicon = 2.33 g/cm^3. Molecular weight of SiO_2 = 60.08 g/mol. Density of SiO_2 = 2.20 g/cm^3.	TLO5	L3	1.2.1
12. Calculate the increase in thickness of Silicon wafer during the process of oxidation, if 50 ^oA thick Si is used for the process. Given: Atomic weight of Si = 28.09 g/mol. Density of Si = 2.33 g/cm^3. Molecular weight of SiO_2 =60.08 g/mol. Density of SiO_2 = 2.20 g/cm^3.	TLO5	L3	1.2.1
13. Phosphorus is implanted in n-type silicon sample with a uniform doping concentration of 5 x 10^{16} atoms/cm^3. If the beam current density is 2.5 µA/cm^2 and the implantation time is 8 minutes, calculate the implantation dose.	TLO7	L3	1.2.1
14. What is epitaxial growth? Explain with neat diagram a typical vapour phase epitaxial growth system.	TLO8	L2	1.2.2
15. Explain with neat diagram different lithographic steps involved in selective diffusion over a wafer.	TLO9	L2	1.2.2

Sr. No.	Post Test Questions	TLOs	BL	PI Code
1	The most commonly used semiconductor for wafer is ____. (a) Germanium (b) Carbon (c) Gallium (d) Silicon	TLO1	L1	1.2.2
2	A seed crystal is (a) single crystal containing the donor or acceptor impurities. (b) crystal in the liquid state. (c) single crystal with a particular orientation. (d) crystal formed by expitaxial growth.	TLO3	L1	1.2.2
3	A silicon crystal is to be grown by Czhochralski process and is to contain 5 x 10^{15} boron atoms per cm^3. Given K_o = 0.8 for boron in silicon, Determine the initial concentration of boron atoms in the melt to produce the required density. (a) 6.25 X 10^{15} atoms/cm^3 (b) 6.50 X 10^{15} atoms/cm^3 (c) 6.05 X 10^{15} atoms/cm^3 (d) 6.75 X 10^{15} atoms/cm^3	TLO3	L3	1.2.1
4	If SiO_2 layer of 1500Å is to be grown on silicon wafer, what would be the thickness of used silicon? (a) 660 Å (b) 550 Å (c) 440 Å (d) 600 Å	TLO5	L3	1.2.1
5	Boron is implanted in p-type silicon sample with a uniform doping concentration of 2 x 10^{15} atoms/cm^3. If the beam current density is 1X10^{-3} A/cm^2, what is the time required to realize the implantation dose of 5 x10^{15} per cm^{-2}. Given: Electric charge = q = 1.6X10^{-19} A-Sec (a) 0.8 sec (b) 8 sec (c) 80 sec (d) 0.08 sec	TLO7	L3	1.2.1

Assignment Questions	TLO	BL	PI code
1. Explain with neat diagram, the manufacture of electronic grade silicon by CVD process.	TLO2	L2	1.2.2
2. Discuss in detail the process of Czhochralski crystal pulling technique in the production of single crystal silicon.	TLO3	L3	1.2.1
3. Explain the fabrication process of silicon wafers by thermal oxidation with relevant reactions.	TLO4	L2	1.2.2
4. Describe the technique of ion implantation used for doping process with a neat block diagram.	TLO4	L2	1.2.2
5. Define segregation constant (K_0). A Silicon crystal is to be pulled from the melt by Czhochralski process and doped with Phosphorous. If silicon weighs 25 kg, how many milligrams of phosphorous should be introduced to achieve a donor concentration of 3 x 10^{15} atoms/cm^3 during initial growth? Given: K_0 for 'P' in Si is 0.32; Atomic weight of 'P' = 30.97 g/mole; Density of Si is 2.33 g/cm^3; Avogadro number = 6.023 x 10^{23} atoms/mole.	TLO3	L3	1.2.1

Chapter-wise Plan

Course Code and Title: : **15ECHB102 / Engineering Chemistry**	
Chapter Number and Title: **06. Material Chemistry**	Planned Hours: **03 hrs**

Learning Outcomes:

At the end of the topic student should be able to:

Topic Learning Outcomes	COs	BL	CA Code
1. define liquid crystals and describe various types of liquid crystals with examples.	CO6	L1	1.2
2. explain the technique involved in the liquid crystal display.	CO6	L2	1.2
3. explain the phenomenon of fluorescence and phosphorescence and their characteristics.	CO6	L2	1.2
4. explain the meaning, properties and applications of thermoelectric and piezoelectric materials.	CO6	L2	1.2

Lesson Schedule **Class No. - Chunks covered per hour.**
1. Liquid crystals – types of liquid crystals, Liquid Crystal Display and applications
2. Fluorescence and Phosphorescence – Jablonski diagram
3. Thermoelectric and Piezoelectric materials – meaning, properties and applications.

Review Questions

Sr. No - Questions	TLO	BL	PI code
1. Define liquid crystals and explain the classification of liquid crystals with examples.	TLO1	L1	1.2.2
2. Explain the process of liquid crystal display with respect to 201.	TLO2	L2	1.2.2
3. Explain the process of fluorescence and phosphorescence with help of Jablonski diagram.	TLO3	L2	1.2.2
4. What are thermoelectric and piezoelectric materials? Mention their properties and applications.	TLO4	L1	1.2.2

Sr. No.	Post Test Questions	TLOs	BL	PI Code
1	The optical properties of liquid crystals depend on the direction of _____. (a) Air (b) Solid (c) Light (d) Water	TLO1	L1	1.2.2
2	In 7 segment display, how many rows and columns are used? (a) 2 rows and 5 columns (b) 2 rows and 4 columns (c) 4 rows and 2 columns (d) 5 rows and 2 columns	TLO2	L1	1.2.2
3	Which state electron possessed highest stable? (a) Ground state (b) Triplet state (c) Singlet excited state (d) All of the above	TLO3	L1	1.2.2
4	Piezoelectric materials produce electric charges when _____. (a) Voltage is applied (b) Mechanical Stress is applied (c) Electric field is applied (d) Magnetic field is applied	TLO4	L1	1.2.2
5	Operation of thermocouple is governed by _____. (a) Peltier effect (b) Seeback effect (c) Thomson effect (d) All of the mentioned	TLO4	L1	1.2.2

Assignment Questions	TLO	BL	PI code
1. Draw and explain the process of liquid crystal display with respect to 427.	TLO2	L2	1.2.2
2. Explain the process of fluorescence and phosphorescence with help of Jablonski diagram.	TLO3	L2	1.2.2
3. What are thermoelectric and piezoelectric materials? Mention their properties and applications.	TLO4	L2	1.2.2

Chapter-wise Plan

Course Code and Title: : **15ECHB102 / Engineering Chemistry**	
Chapter Number and Title: **07. Instrumental methods of measurement**	Planned Hours: **04 hrs**

Learning Outcomes:

At the end of the topic student should be able to:

Topic Learning Outcomes	COs	BL	CA Code
1. list out the advantages of instrumental methods of analysis over conventional methods.	CO7	L1	1.2
2. explain the estimation of the amount of reducing/oxidizing substance present in the given solution using potentiometer.	CO7	L3	1.2
3. describe the process of determination of amount of metal present in ore using colorimeter.	CO7	L3	1.2
4. explain the instrumentation and applications of UV- Spectrophotometer.	CO7	L2	1.2

Lesson Schedule **Class No. Chunks covered per hour**
1. Advantages of instrumental methods of analysis over conventional methods.
2. Electro analytical methods: Principle, methodology and applications of Potentiometer.
3. Optoanalytical methods: Principle, methodology and applications of colorimeter.
4. Spectral methods of analysis: UV- Spectrophotometer – Instrumentation and applications.

Review Questions

Sr. No - Questions	TLOs	BL	PI code
1. Give the advantages of instrumental methods of analysis over conventional methods.	TLO1	L1	1.2.2
2. Explain the principle and methodology involved in potentiometer.	TLO2	L2	1.2.2
3. In the potentiometric determination of FAS, the equivalence point was found to be 8.2 ml when 100 ml of FAS solution was titrated against 0.4 N $K_2Cr_2O_7$ solution at 25^0C. Calculate the amount of ferrous ammonium sulphate.	TLO2	L3	1.2.1
4. State Lambert – Beer's law. Explain the principle and methodology involved in colorimeter.	TLO3	L2	1.2.2
5. Discuss with neat diagram working of double beam ultraviolet spectrophotometer.	TLO4	L2	1.2.2

6. In the colorimetric estimation of copper, the optical density values for the series of solution of concentrations $1X10^{-2}$, $2X10^{-2}$, $3X10^{-2}$, $4X10^{-2}$, $5X10^{-2}$, $6X10^{-2}$ and $7X10^{-2}$ moles/dm^3 are 0.08, 0.16, 0.25, 0.33, 0.42, 0.50 and 0.58 respectively. Verify Beer-Lamberts law with the graph and calculate the amount of copper present in the supplied solution whose OD is 0.21	TLO3	L3	1.2.1

Sr. No.	Post Test Questions	TLOs	BL	PI Code
1	Basically a potentiometer is a device used for (a) comparing two voltages (b) measuring a current (c) comparing two currents (d) none of the above	TLO2	L2	1.2.2
2	In the potentiometric determination of FAS, the equivalence point was found to be 6.2 ml when 100 ml of FAS solution was titrated against 0.2 N $K_2Cr_2O_7$ solution at 25^0C. What is the concentration of FAS? (a) 0.0124 N (b) 0.124 N (c) 0.02 N (d) 0.2 N	TLO2	L3	1.2.1
3	According to the Beer-Lambert Law, the intensity of light decreases with respect to (a) distance (b) volume (c) concentration (d) composition	TLO3	L2	1.2.2
4	According to the Beer-Lambert Law, on which of the following the absorbance does not depend? (a) distance that the light has travelled through the sample (b) solution concentration (c) Extinction coefficient of the sample (d) colour of the solution	TLO3	L2	1.2.2
5	Which of the following statement is false about double beam absorption instruments? (a) It is similar to single beam instruments except two beams are present (b) Tungsten bulb is used as a source (c) Reference beam must have a higher intensity than sample beam (d) Both the beams after they pass through respective samples are compared	TLO4	L2	1.2.2

Assignment Questions			
Sr. No - Questions	**TLOs**	**BL**	**PI code**
1. Discuss with neat diagram working of double beam ultraviolet spectrophotometer.	TLO4	L2	1.2.2
2. State Lambert – Beer's law. In the colorimetric estimation of copper, the optical density values for the series of solution of concentrations $1X10^{-2}$, $2X10^{-2}$, $3X10^{-2}$, $4X10^{-2}$, $5X10^{-2}$, $6X10^{-2}$ and $7X10^{-2}$ moles/dm^3 are 0.08, 0.16, 0.25, 0.33, 0.42, 0.50 and 0.58 respectively. Verify Beer-Lamberts law with the graph and calculate the amount of copper present in the supplied solution whose OD is 0.30	TLO3	L3	1.2.1

Chapter-wise Plan

Course Code and Title: : **15ECHB102 / Engineering Chemistry**	
Chapter Number and Title: **08. Environmental Chemistry**	Planned Hours: **04 hrs**

Learning Outcomes:

At the end of the topic student should be able to:

Topic Learning Outcomes	COs	BL	CA Code
1. explain the sources and ill effects of fluoride and nitrate in drinking water.	CO8	L2	1.2
2. estimate the hardness of water by EDTA method.	CO8	L2	1.2
3. calculate total hardness of water sample using given data.	CO8	L3	1.2
4. explain the determination of BOD and COD.	CO8	L2	1.2
5. calculate BOD and COD of sewage water using given data.	CO8	L3	1.2

Lesson Schedule **Class No. - Chunks covered per hour**
1. Water: sources and ill effects of water pollutants – fluoride and nitrate;
2. Determination of total hardness of water by EDTA method - numerical problems.
3. Sewage: determination of Biological Oxygen Demand by Winkler's method - numerical problems and
4. Determination of Chemical Oxygen Demand - numerical problems.

Review Questions

Sr. No	Questions	TLOs	BL	PI code
1.	Discuss the sources and ill effects of fluoride and nitrate in drinking water.	TLO1	L2	1.2.2
2.	Explain the determination of total hardness of water by EDTA method.	TLO2	L2	1.2.2
3.	Calculate the temporary hardness and permanent hardness of water sample which contains 16.2 mg/liter of $Ca(HCO_3)_2$, 14.6 mg/liter of $Mg(HCO_3)_2$, 22.2 mg/liter of $CaCl_2$, 18.0 mg/liter of $MgSO_4$ and 55.0 mg/liter of NaCl.	TLO3	L3	1.2.1
4.	50 ml of water sample requires 10 ml of 0.01 N EDTA when titrated using buffer solution whose pH is 10 to attain the end point. Calculate the total hardness of water sample in terms of ppm equivalent of $CaCO_3$ per liter.	TLO3	L3	1.2.1

5. Describe the process of BOD determination of a sewage sample by Winkler's method.	TLO4	L2	1.2.2
6. Describe the determination of COD of a sewage sample.	TLO4	L2	1.2.2
7. 25 ml of waste water was diluted to 500 ml and equal volumes are filled in two BOD bottles. In the blank titration 100 ml of diluted waste water when titrated immediately required 6.1 ml of 0.02 N thiosulphate solution. 100 ml of the incubated sample after 5 days required 3.6 ml of 0.02 N thiosulphate solution. Calculate BOD of the waste water.	TLO5	L3	1.2.1
8. 20 ml of sewage sample for COD is reacted with 25 ml of $K_2Cr_2O_7$ and the un-reacted $K_2Cr_2O_7$ requires 9.0 ml of 0.25 N FAS solution. Under similar conditions, in blank titration, 15.0 ml of FAS is used up. Calculate the COD of the sewage sample.	TLO5	L3	1.2.1
9. Define BOD and COD. In COD experiment, 30 ml of an effluent sample required 9.8 ml of 0.01 N $K_2Cr_2O_7$ solution for oxidation. Calculate the COD of sewage sample	TLO5	L3	1.2.1

Sr. No.	Post Test Questions	TLOs	BL	PI Code
1	The disease that may be caused due to excess nitrate concentration in water is _____. (a) dental fluorosis (b) Methemoglobinemia (c) cancer (d) None of these	TLO1	L1	1.2.2
2	Permanent hardness of water is due to the presence of soluble salts of _____ (a) nitrates of calcium and magnesium (b) chlorides of calcium and magnesium (c) sulphates of calcium and magnesium (d) All of these	TLO2	L1	1.2.2
3	Calculate the temporary hardness of water sample which contains 32.4 mg/liter of $Ca(HCO_3)_2$, 14.6 mg/liter of $Mg(HCO_3)_2$. (a) 10 ppm (b) 20 ppm (c) 30 ppm (d) 40 ppm	TLO3	L3	1.2.1

4	The amount of dissolved oxygen available in waste water is determined before and after 5 days of incubation period by _____. (a) Iodometric titration (b) complexometric titration (c) acid-base titration (d) None of these.	TLO4	L1	1.2.2
5	Give the name of the indicator that is used in the determination of chemical oxygen demand (a) ferroin (b) starch (c) EBT (d) phenolphthalein	TLO4	L1	1.2.2

Assignment Questions	**TLOs**	**BL**	**PI code**
1. Define hardness of water. Describe the determination of total hardness present in supplied sample of water by Na_2EDTA method.	TLO2	L2	1.2.2
2. Define BOD. Describe the process of DO determination of a sewage sample by Winkler's method	TLO4	L2	1.2.2
3. Define COD. In COD experiment, 25ml of an effluent sample required 10 ml of 0.01M $K_2Cr_2O_7$ solution for oxidation. Calculate the COD of sewage sample	TLO5	L3	1.2.1

Model Question Paper for In Semester Assessment - I (ISA-I)						
Course: Engineering Chemistry		**Course Code: 15ECHB102**				
Duration: 75 Minutes.		**Max. Marks:40**				
Note: ***Answer any two full questions***						
Q. No	**Questions**	**Marks**	**CO**	**BL**	**PO**	**PI Code**
1 a.	Explain the salient features of Valence Bond Theory.	7	1	L2	1	1.2.2
b.	Explain with neat diagram construction, working and applications of lead-acid battery.	7	2	L2	1	1.2.2
c.	A polymer sample contains 10, 20, 30 & 40 molecules having molecular weights 10 $X10^3$, 20 X 10^3, 30 X 10^3 and 40 X 10^3 respectively. Calculate the number average and weight average molecular weight of the polymer.	6	3	L3	1	1.2.1
2 a.	What is meant by single electrode potential? Derive Nernst equation for electrode potential of an electrode.	7	2	L2	1	1.2.2
b.	Explain the synthesis, properties and applications of Epoxy resin.	7	3	L2	1	1.2.2
c.	What is dipole moment? Dipole moment of HCl molecule is 1.03D for complete transfer of electrons (100% ionic) and the charge on H^+ & Cl^- ions would be equal to 4.8 x 10^{-10}esu. The length of HCl bond is 1.275 x 10^{-8}cm. Calculate % of ionic character.	6	1	L3	1	1.2.1
3 a.	What is polymerization? Explain the free radical mechanism of addition polymerization by taking ethylene as an example.	7	3	L2	1	1.2.2
b.	Discuss the following battery characteristics: (i) capacity (ii) voltage and (iii) energy efficiency and (iv) cycle life.	7	2	L2	1	1.2.2
c.	A cell is formed by dipping Ni rod in 0.1 M Ni^{2+} solution and Pb rod in 0.5 M Pb^{2+} solution. The standard electrode potentials of Nickel and Lead are -0.24 V and -0.13 V respectively. Write the cell representation, cell reactions and calculate EMF of the cell.	6	2	L3	1	1.2.1

Model Question Paper for In Semester Assessment - II (ISA-II)						
Course: Engineering Chemistry			**Course Code: 15ECHB102**			
Duration: 75 Minutes.			**Max. Marks: 40**			
Note: *Answer any two full questions*						
Q. No	**Questions**	**Marks**	**CO**	**BL**	**PO**	**PI Code**
1 a.	Explain with neat diagram the process of diffusion for the development of silicon wafers of known dopant concentration.	7	5	L2	1	1.2.2
b.	Explain with neat diagram, the manufacture of electronic grade silicon by CVD process.	7	5	L2	1	1.2.2
c.	What is throwing power? The throwing power of an electrolyte in a Haring Blum cell is 85%. During an experiment, 70 mg of the metal was deposited at the nearest cathode kept at a distance of 5.5 cm from the cathode. At what distance must the cathode at the longer distance be kept if the metal deposited on it is 65 mg?	6	4	L3	1	1.2.1
2 a.	Describe the production of electronic grade silicon by Czhochralski crystal pulling technique.	7	5	L2	1	1.2.2
b.	Explain the process of liquid crystal display with respect to 463.	7	6	L2	1	1.2.2
c.	Phosphorus is implanted in an n-type silicon sample with a uniform doping concentration of 5 x 10^{16} atoms/cm^3. If the beam current density is 2.5 μA/cm^2 and the implantation time is 8 minutes, calculate the implantation dose.	6	5	L3	1	1.2.1
3 a.	Describe the electroless plating process of copper in the preparation of PCB.	7	4	L2	1	1.2.2
b.	Explain with neat diagram a typical vapour phase epitaxial growth system.	7	5	L2	1	1.2.2
c.	Explain the phenomenon of fluorescence and phosphorescence and mention their characteristics.	6	6	L2	1	1.2.2

Model Question Paper for End Semester Assessment (ESA)						
Course : Engineering Chemistry			**Course Code: 15ECHB102**			
Duration: 3 Hours			**Max. Marks: 100**			
Note: Solve any two full questions from unit I, two full questions from Unit II and one full question from Unit III.						
	Unit I					
Q. No	**Questions**	**Marks**	**CO**	**BL**	**PO**	**PI Code**
1 a.	Explain the salient features of Molecular Orbital Theory and draw the MO diagram of H_2 molecule & calculate its bond order.	7	1	L2	1	1.2.2
b.	What are polymers? Explain the synthesis, properties and applications of Plexi glass and Polystyrene.	7	3	L2	1	1.2.2
c.	The E^0 values of Li/Li^+, Zn/Zn^{++}, Cu/Cu^{++}, and Ag/Ag+ are -3.0V, -0.77V, +0.33V and +0.80V respectively. Which combination of the electrodes you use to construct a cell of highest *emf* if the ionic concentrations are 0.1M, 1.0M, 10M and 0.01M in the same order. Justify your answer.	6	2	L3	1	1.2.1
2 a.	Explain the construction, working and applications of lead - acid battery	7	2	L2	1	1.2.2
b.	Explain the free radical mechanism of addition polymerization by taking ethylene as an example.	7	3	L2	1	1.2.2
c.	The dipole moment of HF is 1.98D. When HF forms H^+ and F^- ions by complete transfer of electrons, the charge on the ion is 4.8×10^{-10} esu and bond length is 0.98×10^{-8}cm. Calculate the percentage of ionic character in HF.	6	1	L3	1	1.2.1
3 a.	Define single electrode potential? Derive Nernst equation for single electrode potential of an electrode.	7	2	L2	1	1.2.2
b.	What are fuel cells? Describe the construction, working and applications of methanol-oxygen fuel cell	7	2	L2	1	1.2.2
c.	A polymer of polypropylene is found to have the following composition. (i) R -[CH_2-CH(CH_3) -] $_{400}$ R 30% (ii) R -[CH_2-CH(CH_3) -] $_{500}$ R 30% (iii) R -[CH_2-CH(CH_3) -] $_{600}$ R 40% Calculate the number average and weight average molecular masses of the polymer (atomic mass of C = 12, H = 1 and neglect the molecular mass of R).	6	3	L3	1	1.2.1

	Unit II					
4 a.	Discuss the electroplating process of gold and mention its applications.	7	4	L2	1	1.2.2
b.	Explain the process of liquid crystal display with respect to 274.	7	6	L2	1	1.2.2
c.	Boron is implanted in a p-type silicon sample with a uniform doping concentration of 2 x 10^{15} atoms/cm^3. If the beam current density is 1mA/cm^2, calculate the time required to realize the implantation dose of 5 x10^{15} per cm^2.	6	5	L3	1	1.2.1
5 a.	Discuss in detail the process of Czhochralski crystal pulling technique in the production of single crystal silicon.	7	5	L2	1	1.2.2
b.	What is throwing power? Explain the determination of throwing power using Haring - Blum cell.	7	4	L2	1	1.2.2
c.	A Silicon crystal is to be pulled from the melt and doped with phosphorous . If silicon weighs 7 kg, how many grams of phosphorous should be introduced to achieve a donor concentration of 2 x 10^{15}/cm^3 during initial growth. Given: K_0 for P in Silicon is 0.32, atomic weight of P is 30.97 g/mole and density of Si is 2.33 g/cm^3.	6	5	L3	1	1.2.1
6 a.	Explain with neat diagram the process of diffusion for the development of silicon wafers of known dopant concentration.	7	5	L2	1	1.2.2
b.	Describe the process of thermal oxidation with relevant reactions?	7	5	L2	1	1.2.2
c.	Explain the process of fluorescence and phosphorescence with help of Jablonski diagram.	6	6	L2	1	1.2.2
	Unit III					
7 a.	Discuss with neat diagram the working of double beam UV-spectrophotometer.	7	7	L2	1	1.2.2
b.	Explain the principle and methodology involved in potentiometry with respect to FAS.	7	7	L2	1	1.2.2
c.	In the colorimetric estimation of copper, the OD values for the series of solution of concentrations 1X10^{-3}, 2X10^{-3}, 3X10^{-3}, 4X10^{-3}, 5X10^{-3}, 6X10^{-3} and 7X10^{-3} moles / dm^3 are 0.08, 0.16, 0.25, 0.33, 0.42, 0.50 and 0.58 respectively. Verify Beer-Lamberts law with the graph and calculate the amount of copper present in the supplied solution whose OD is 0.30.	6	7	L3	1	1.2.1

8 a.	Define hardness. Discuss the determination of total hardness of sample of water by EDTA method.	7	8	L2	1	1.2.2
b.	Describe the process of BOD determination of a sewage sample by Winkler's method.	7	8	L2	1	1.2.2
c.	Define BOD and COD. In COD experiment, 30 ml of an effluent sample required 9.8ml of 0.01 N $K_2Cr_2O_7$ solution for oxidation. Calculate the COD of sewage sample.	6	8	L3	1	1.2.1