



SKIT	Teaching Process	Rev No.: 1.0
Doc Code:	BS-SKIT.Ph5b1.F02	Date: 03-02-2019
Title:	Engineering Chemistry	Page: 1 / 19

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Note : Remove "Table of Content" before including in CP Book

Each Course Plan shall be printed and made into a book with cover page

Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

18CHE12 : ENGINEERING CHEMISTRY

A. COURSE INFORMATION

1. Course Overview

Degree:	BE	Program:	
Year / Semester :	2019/2	Academic Year:	2019-20
Course Title:	Engg chemistry	Course Code:	18CHE12
Credit / L-T-P:	4/3-2-0	SEE Duration:	180 Minutes
Total Contact Hours:	50	SEE Marks:	60 Marks
CIA Marks:	40	Assignment	1 / Module

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Course Plan Author: Dr. Manju	Sign;	Dt:11.02.2019
Checked By: Dr Shankara B S	Sign	Dt:21.02.2019

2. Course Content

Module	Module Content	Teaching Hours	Module Concepts	Blooms Level
1	Electrochemistry and Energy storage systems Use of free energy in chemical equilibrium: Thermodynamic functions: Definitions of free energy and entropy, Cell potential, derivation of Nernst equation for single electrode potential, numerical problems on E, E ₀ , and E _{cell} . Electrochemical Systems: Reference electrodes: Introduction, construction, working and applications of Calomel electrode. Ion-selective electrode – Definition, construction and principle of Glass electrode, and determination of pH using glass electrode. Electrolyte concentration cells, numerical problems.	6hr	Energy storage device	L2 Understanding L3 Applying
2	Energy storage systems: Introduction, classification - primary, secondary and reserve batteries. Construction, working and applications of Ni-MH and Li-ion batteries.	4hr	Batteries	L2 Understanding L3 Applying
3	Corrosion: Introduction, Electrochemical theory of corrosion, Factors affecting the rate of corrosion: ratio of anodic to cathodic areas, nature of metal, nature of corrosion product, nature of medium – pH, conductivity and temperature. Types of corrosion - Differential metal and Differential aeration – pitting and water line). Corrosion control: Anodizing – Anodizing of aluminium, Cathodic protection - sacrificial anode and impressed current methods, Metal coatings - Galvanization.	5hr	Corrosion Engg.	L2 Understanding
4	Metal finishing: Introduction, Technological importance. Electroplating: Introduction, principles governing electroplating-Polarization, decomposition potential and over voltage. Electroplating of chromium (hard and decorative). Electro less plating: Introduction, electroless plating of nickel & copper, distinction between electroplating and electroless plating processes	5hr	Metal Coating techniques	L2 Understanding
5	Energy Systems Chemical Fuels: Introduction, classification, definitions of CV, LCV, and HCV, determination of calorific value of solid/liquid fuel using bomb calorimeter, numerical problems. Knocking of petrol engine – Definition, mechanism, ill effects and prevention. Power alcohol, unleaded petrol and biodiesel. Fuel Cells: Introduction, differences between conventional cell and fuel cell, limitations & advantages. Construction, working & applications of methanol-oxygen fuel cell with H ₂ SO ₄ electrolyte, and solid oxide fuel cell (SOFCs).	6hr	Chemical fuels	L2 Understanding
6	Solar Energy: Photovoltaic cells- introduction, construction and working of a typical PV cell. Preparation of solar grade silicon by Union Carbide Process/Method. Advantages & disadvantages of PV cells.	4hr	Solar cells	L2 Understanding
7	Environmental Pollution and Water Chemistry Environmental Pollution: Air pollutants: Sources, effects and control of primary air pollutants: Carbon monoxide, Oxides of nitrogen and sulphur, hydrocarbons, Particulate matter, Carbon monoxide, Mercury and Lead. Secondary air pollutant: Ozone, Ozone depletion. Waste Management: Solid waste, e-waste & biomedical waste: Sources, characteristics & disposal methods	5hr	Pollutants in air	L2 Understanding L3 Applying



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	(Scientific land filling, composting, recycling and reuse)			
8	Water Chemistry: Introduction, sources and impurities of water; boiler feed water, boiler troubles with disadvantages -scale and sludge formation, boiler corrosion (due to dissolved O ₂ , CO ₂ and MgCl ₂). Sources of water pollution, Sewage, Definitions of Biological oxygen demand (BOD) and Chemical Oxygen Demand (COD), determination of COD, numerical problems on COD. Chemical analysis of water: Sulphates (gravimetry) and Fluorides (colorimetry). Sewage treatment: Primary, secondary (activated sludge) and tertiary methods. Softening of water by ion exchange process. Desalination of sea water by reverse osmosis	5hr	Water Chemistry	L2 Understanding L3 Applying
9	Instrumental methods of analysis and Nanomaterials Instrumental methods of analysis: Theory, Instrumentation and applications of Colorimetry, FlamePhotometry, Atomic Absorption Spectroscopy, Potentio metry, Conductometry (Strong acid with a strong base, weak acid with a strong base, mixture of strong acid and a weak acid with a strong base).	5hr	Qualitative & Quantitative analysis	L2 Understanding
10	Nanomaterials: Introduction, size dependent properties (Surface area, Electrical, Optical, Catalytic and Thermal properties). Synthesis of nanomaterials: Top down and bottom up approaches, Synthesis by Sol-gel, precipitation and chemical vapour deposition, Nanoscale materials: Fullerenes, Carbon nanotubes and graphenes – properties and applications.	5hr	Nano technology	L2 Understanding

3. Course Material

Module	Details	Available
A	Textbook	
1	P.C Jain & Monica jain "Engineering chemistry" New Delhi(2015-Edition)	In Lib
2	S.S Dara A textbook of "Engineering chemistry" ,10 th Edition ,S Chand & Co New Delhi(2014-Edition)	In Lib
3	Engineering chemistry by Basuchandra (2016-Edition)	In dept
4	Engineering chemistry by Basuchandra (2016-Edition)	In dept
5	Engineering chemistry by Basuchandra (2016-Edition)	In dept
6	Engineering chemistry by Basuchandra (2016-Edition)	In dept
B	Reference books	
1	"Engineering chemistry" by O.G Palanna, Tata McRraw Hill Education Pvt Ltd. New Delhi,4th (2015-Edition)	In dept
2	"Engineering chemistry" by R.V Gadag & A.Nithyanada shetty,New Delhi(2015-Edition)	In dept
3	"Engineering chemistry" by B.Jaipraksh, R. Venugopal, sivakumaraiah & Pushpa iyengar,(2015-Edition)	In dept
C	Concept Videos or Simulation for Understanding	
C1	Electrochemical Systems https://www.frontiersin.org > journals > sections https://www.youtube.com > watch https://www.google.com/url https://www.comsol.com > video > simulating-co...	
C2	Energy storage systems: https://www.mathworks.com > videos > battery https://sam.nrel.gov > battery-storage https://www.youtube.com https://www.youtube.com https://www.youtube.com	



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C3	<p>Corrosion: video > simulating-co">https://www.comsol.com > video > simulating-co ">https://www.youtube.com > watch">https://www.youtube.com > watch watch">https://www.youtube.com > watch watch">https://www.youtube.com > watch ">https://www.youtube.com ></p>	
C4	<p>Metal finishing https://www.youtube.com ">https://www.youtube.com > ">https://www.youtube.com > ">https://www.youtube.com > ">https://www.youtube.com > ">https://www.youtube.com ></p>	

4. Course Prerequisites

SNo	Course Code	Course Name	Module / Topic / Description	Sem	Remarks	Blooms Level
1	18CHE12	Engg Chemistry	1/Electrodes&batteries/in order to understand the entire module student should have the knowledge of Galvanic cells,red-ox reactions & thermodynamic functions.	2	Students have learn t these topics in their previous standards	L2 understanding
2	18CHE12	Engg Chemistry	2/corrosion & metalfinishing/student should have the basic of electrolytic cells, redox reactions .	2	Students have learn t these topics in their previous standards	L2 understanding
3	18CHE12	Engg Chemistry	3/Chemical fuels & solar cells/student should have the basic of calorific value,photoelectric effect ect..	2	Students have learn t these topics in their previous standards	L2 understanding
4	18CHE12	Engg Chemistry	4/air pollutions & water chemistry/student should know about pollutions ,impurities in water & basic parameters of water.	2	Students have learn t these topics in their previous standards	L2 understanding
5	18CHE12	Engg Chemistry	5/instrumental methods of analysis and Nano material/student should have prime knowledge of analysis&nano size.	2	Students have learn t these topics in their previous standards	L2 understanding

Note: If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

B. OBE PARAMETERS

1. Course Outcomes

#	COs	Teach Hours	Concept	Instr Method	Assessmen t Method	Blooms' Level
1	To have knowledge of inter conversion of energy,electro chemistry in energy storage systems	10	Electrochemi stry	Chalk & Talk	Assignment & slip test	L2 Understand
2	To have knowledge Causes & effects of corrosion of metals and control of corrosion .modification of surface	10	Corrosion & metal finishing	Chalk & Talk	Assignment & slip test	L2 Understand

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	properties of metals by metal finishing technique.					
3	To have knowledge Production and consumption of energy by chemical fuels,utilization of solar energy	10	Energy systems	Chalk & Talk	Assignment & slip test	L2 Understand
4	To have knowledge of causes,effects and control of pollutants in air and water,waste management.	10	Environment al pollution & water chemistry	Chalk & Talk	Assignment & slip test	L2 Understand
5	To have knowledge of Different techniques of instrumental method of analysis ,fundamentals and synthesis of nano materials.	10	Intrumental method of analysis & nanomaterials	Chalk & Talk	Assignment & slip test	L2 Understand
-	Total	50	-	-	-	-

Note: Identify a max of 2 Concepts per Module. Write 1 CO per concept.

2. Course Applications

SNo	Application Area	CO	Level
1	Ion selective electrodes are used in analysis of samples.	CO1	L2
2	Batteries are used in electronic devices,computers,medical devices. areo space applications etc...	CO2	L2
3	corrosion control methods like phosphating is used as standard pre treatment of automobiles before painting.	CO3	L2
4	Corrosion effects are used in materials science to check the stability of materials.	CO4	L2
5	Anti knocking agents are used in reducing knocking in an IC engines.	CO5	L3
6	Photovoltaic cells are used in telecommunication equipments, solar home appliance .	CO6	L2
7	COD & BOD parameter is used to check suitability of water in environmental studies.	CO7	L2
8	Reverse osmosis method is used to soften water.	CO8	L3
9	Qualitative Analysis of chemical components	CO9	L3
10	Nano materials are applied in various areas	CO10	L3

Note: Write 1 or 2 applications per CO.

3. Articulation Matrix

(CO – PO MAPPING)

#	Course Outcomes COs	Program Outcomes												Level	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		
1	To have the knowledge of electro chemistry, electrodes and measurement of electrode potential.	3	1	1	-	-	-	-	-	-	-	-	-	-	L3
2	To have knowledge of inter conversion of energy, energy storage systems	2	1	1	-	-	-	-	-	-	-	-	-	-	L2
3	To have knowledge Causes & effects of corrosion of metals and control of corrosion	2	1	1	-	-	-	1	-	-	-	-	-	-	L2
4	To have knowledge modification	2	1	1	-	-	-	-	-	-	-	-	-	-	L2



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	of surface properties of metals by metal finishing technique.													
5	To have knowledge of Production and consumption of energy by using chemical fuels	2	1	1	-	-	-	-	-	-	-	-	-	L2
6	To have knowledge utilization of solar energy	2	1	1	-	-	-	-	-	-	-	-	-	L2
7	To have knowledge of causes, effects and control of pollutants in air and water, waste management.	2	1	1	-	-	-	1	-	-	-	-	-	L3
8	To have knowledge of analysis and purification water treatment	2	1	1	-	-	-	1	-	-	-	-	-	L2
9	To have knowledge of Different techniques of instrumental method of analysis	2	1	1	-	-	-	-	-	-	-	-	-	L2
10	To have knowledge of fundamentals and synthesis of nano materials.	2	1	1	-	-	-	-	-	-	-	-	-	L2
18CHE12.	Average	2.2	1	1	-	-	-	1	-	-	-	-	-	L2

Note: Mention the mapping strength as 1, 2, or 3

4. Mapping Justification

Mapping		Justification	Mapping Level
CO	PO	-	-
CO1	PO1	Apply the knowledge of anode and cathode to understand the electrochemical cells	L2
	PO2	Formulate nernst equation and solve the problems	L3
	PO3	Design the electrochemical cell by system of electrode components	L2
CO2	PO1	Apply the knowledge of galvanic cells to understated the concept of batteries	L2
	PO2	Identify the different types of batteries	L2
	PO3	Design the various batteries the processes that specified needs with appropriate for the public acceptance	L2
CO3	PO1	Apply the knowledge of redox reaction to understated corrosion processes	L2
	PO2	Analyze the problems due to corrosion of metals and alloys	L2
	PO3	Corrosion control processes that consideration for the safety of metals	L2
	PO7	Corrosion control impact of the professional engineering solution in societal and environmental sustainability.	
CO4	PO1	To apply the engineering knowledge of coating technique of metal structures	L2
	PO2	Identify the metal coatings techniques	L2
	PO3	Processes of electroplating and electro less plating needs appropriate consideration for the safety of metals	L2
CO5	PO1	Apply the basic knowledge of renewable and non renewable energy sources to understand the production of energy	L2
	PO2	Formulate calorific value of solid fuel using bomb calorimeter and solve the problems	L2 & L3
	PO3	Design the IC engine to control the knocking properties of petrol	



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CO	PO	Learning Outcome	Level
CO6	PO1	Apply the knowledge of renewable energy sources of making of solar cell	L2
	PO2	Using mathematical equation to calculate calorific values	L3
	PO3	Design and development of solar cell that processes meet the specified needs with appropriate environmental considerations.	L2
CO7	PO1	Apply the knowledge of air pollutants to discuss cause and control of pollutants air	L2
	PO2	Identify cause and control of primary and secondary air pollutants	L2
	PO7	Understand the impact of cause of air pollutant in society and environmental contexts	L2
CO8	PO1	Understand and analyze important parameter of water through analysis	L2
	PO2	Identify different parameters of water through analysis and solve the problems	L2 & L3
	PO3	The processes softening of water by ion exchange and desalination of sea water by reverse osmosis.	L2
	PO7	Understand the impact of cause of water pollutant in society and environmental contexts and demonstrate the knowledge of environmental sustainability of water.	L2
CO9	PO1	Apply the knowledge of science and mathematics to analyze sample qualitatively	L2
	PO2	Formulate the equation of some experimental methods of analysis	L2
	PO3	Design solution for complex engineering problem solve through Instrumental methods of analysis	L2
CO10	PO1	Apply the basic knowledge of size of the particles for synthesis and properties of nano materials	L2
	PO2	Analyze the application of nano materials from various field	L2
	PO3	Design and development of nano materials through various tech	L2

Note: Write justification for each CO-PO mapping.

5. Curricular Gap and Content

SNo	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					
2					
3					
4					
5					

Note: Write Gap topics from A.4 and add others also.

6. Content Beyond Syllabus

SNo	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					
2					
3					
4					
5					
6					
7					
8					

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9					
10					

Note: Anything not covered above is included here.

C. COURSE ASSESSMENT

1. Course Coverage

Module #	Title	Teaching Hours	No. of question in Exam						CO	Levels
			CIA-1	CIA-2	CIA-3	Asg	Extra Asg	SEE		
1	Electrochemistry and Energy storage systems	10	2	-	-	1	1	2	CO1, CO2	L1, L2 & L3
2	Corrosion Science and Metal finishing	10	2	-	-	1	1	2	CO3, CO4	L1, L2
3	Energy Systems	10	-	2	-	1	1	2	CO5, CO6	L1, L2 & L3
4	Environmental pollution and water Chemistry	10	-	2	-	1	1	2	CO7, CO8	L1, L2 & L3
5	Instrumental Methods of Analysis & Nanomaterials	10	-	-	4	1	1	2	CO9, CO10	L1, L2
-	Total	50	4	4	4	5	5	10	-	-

Note: Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

2. Continuous Internal Assessment (CIA)

Evaluation	Weightage in Marks	CO	Levels
CIA Exam - 1	30	CO1, CO2, CO3, CO4	L1, L2, L3
CIA Exam - 2	30	CO5, CO6, CO7, CO8	L1, L2, L3
CIA Exam - 3	30	CO9, CO10	L1, L2
			L1, L2, L3
Assignment - 1	10	CO1, CO2	L1, L2, L3
Assignment - 2	10	CO3, CO4	L1, L2, L3
Assignment - 3	10	CO5, CO6	L1, L2, L3
Assignment - 4	10	CO7, CO8	L1, L2, L3
Assignment - 5	10	CO9, CO10	L1, L2, L3
Seminar - 1			
Seminar - 2			
Seminar - 3			
Other Activities - define - Slip test			
Final CIA Marks	40	-	-

Note : Blooms Level in last column shall match with A.2 above.

D1. TEACHING PLAN - 1

Module - 1

Title:	Electro chemistry and Energy storage systems	Appr Time:	13 Hrs
a	Course Outcomes	-	Blooms
-	The student should be able to:	-	Level

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1	Describe Electrochemical energy systems through Redox reactions		L2
2	Explain construction, working & Applications of Batteries		L3
b	Course Schedule	-	-
Class No	Module Content Covered	CO1	Level
1	Use of free energy in chemical equilibria: Thermodynamic functions: Definitions of free energy and entropy. Cell potential, derivation of Nernst equation for single electrode potential,		L1, L2
2	Numerical on E, E ⁰ , and E _{cell} .		L3
3	Electrochemical Systems: Reference electrodes: Introduction, construction, working and applications of Calomel electrode.		L2
4	Ion-selective electrode – Definition, construction and principle of Glass electrode and determination of pH using glass electrode.		L2
5	Electrolyte concentration cells, numerical problems.		L2, L3
6	Energy storage systems: Introduction, classification - primary, secondary and reserve batteries		L1
7	Construction, working and applications of Ni-MH		L2
8	Construction, working and applications of Li-ion batteries.		L2
c	Application Areas	CO1	Level
1	Measurement of PH is used in medical electronics to analyze samples		L3
2	Batteries are used in electronic devices, computer devices, auto mobiles etc		L4
d	Review Questions		-
1	Define Free energy, enthalpy and entropy.		L1
2	Derive Nernst equation for single electrode potential.		L2
3	What is Reference electrode?		L1
4	Explain construction & working of calomel electrode with its application.		L2
5	Define Ion Selective electrode?		L1
6	Describe construction & principles of glass electrode		L2
8	Explain determination of pH of unknown solution using glass electrode.		L2
9	What is electrolyte concentration cells.		L1
10	Explain the construction, working & EMF determination of electrolyte concentration cells.		L1
11	What is batteries? Explain the Classification batteries with suitable examples		L1
12	Describe the construction, working & Application of Ni-MH battery		L2
13	Explain 1 st law and 2 nd law of thermodynamics.		L2
14	Define single and standard electrode potential		L2
14	What are the advantages of Lithium batteries.		L2
15	Explain construction, working & Application for Li-ion battery.		L2
e	Experiences	-	-
1			
2			
3			
4			
5			

Module – 2

Title:	Corrosion and Metal finishing	Appr Time:	10 Hrs
a	Course Outcomes	-	Blooms Level
	The student should be able to:	-	Level

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1	Describe Electrochemical energy systems through Redox reactions		L2
2	Explain construction, working & Applications of Batteries		L2
		-	Level
b	Course Schedule	-	-
Class No	Module Content Covered	CO2	Level
1	Introduction to Subject, course objectives and outcomes		L2
2	Corrosion: Introduction, Electrochemical theory of corrosion,		L2
3	Factors affecting the rate of corrosion: ratio of anodic to cathodic areas, nature of metal, nature of corrosion product,		L2
4	nature of medium – pH, conductivity and temperature. Types of corrosion - Differential metal and		L2
5	Differential aeration – pitting and water line). Corrosion control: Anodizing – Anodizing of aluminium, Cathodic protection -sacrificial anode and impressed current methods,		L2
6	Corrosion control: Anodizing, Metal coatings – Galvanization.		L2
7	Metal finishing: Introduction, Technological importance.		L2
8	Electroplating: Introduction, principles governing electroplating-Polarization,		L2
9	decomposition potential and over voltage. Electroplating of chromium (hard and decorative).		L2
10	Electro less plating: Introduction, electroless plating of nickel & copper, distinction between electroplating and electroless plating processes		L2
c	Application Areas	CO2	Level
1	Prevention of iron buried in soil by connecting with Zn metal (oil pipe lines, Water pipelines and Gas pipelines).		L3
2	Electroless plating of copper is used in making PCB'S in electronics.		L4
d	Review Questions	-	-
1	Explain electrochemical theory of corrosion by taking Fe as an example		L2
2	How does the following factors affect the rate of corrosion ratio of cathodic ares to anodic area,pH,conductivity & temperature.		L2
3	What is cathodic protection? Explain sacrificial anodic method & impressed current/Voltage method		L2
4	What is Anodizing? Explain the anodizing of Al.		L1 & L2
5	Write a note on differential metal corrosion.		L2
6	Explain waterline corrosion & pitting corrosion.		L2
7	What is differential aeration corrosion. Explain with example.		L2
8	Explain Galvanizing of iron		L2
9	Explain why nut & bolt should be made up of same metal		L2
10	Explain why ship moving in water corrodes below water level.		L2
11	What is metal finishing? Give the technological importance of metal finishing.		L1& L2
12	Discuss polarization and over voltage which govern the electroplating.		L2
13	Discuss the electroplating of Chromium.		L2
14	Discuss the electroplating of Ni using Watts bath.		L2
15	What is electrolessplating? Differentiate between electroplating & electrolessplating .		L2
16	Explain electrolessplating of Copper.		L2
17	Explain electrolessplating of Copper in PCBs and their applications.		L2
18	Explain the following factors affect the rate of corrosion: Ratio of cathodic ares to anodic area, nature of the corrosion product,		L2



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	Nature of the metals		
e	Experiences	-	-
1			
2			
3			
4			
5			

D2. TEACHING PLAN - 2

Module – 3

Title:	Energy systems & photo voltaic cell	Appr Time:	10 Hrs
a	Course Outcomes	-	Blooms Level
-	The student should be able to:	-	
1	Understand production & consumption of energy using energy systems		L2
2	Describe purpose of renewable energy in making solar cells		L2
b	Course Schedule		
Class No	Module Content Covered	CO3	Level
1	Energy System:Chemical Fuels: Introduction, classification, definitions of CV, LCV, and HCV,	CO3	L2
2	Determination of calorific value of solid/liquid fuel using bomb calorimeter.		L2
3	Numerical problems on calorific value.		L2
4	Knocking of petrol engine - Definition, mechanism, ill effects and prevention.		L2
5	Power alcohol, unleaded petrol and biodiesel.		L2
6	Fuel Cells: Introduction, differences between conventional cell & fuel cell imitations & advantages.,		L2
7	Construction, working & applications of methanol-oxygen fuel cell with H ₂ SO ₄ electrolyte,		L2
8	Construction, working & applications of solid oxide fuel cell (SOFCs).		L2
9	Solar Energy: Photo voltaic cells- introduction, construction and working of a typical PV cell.		L2
10	Preparation of solar grade silicon by Union Carbide Process/Method. Advantages & disadvantages of PV cells.		L2
c	Application Areas	CO3	Level
1	Anti knocking agents like tetraethyl lead are used in IC engines to reduce knocking.		L2
2	Photovoltaic cells are used in telecommunication equipments, solar home appliance etc.		L2
d	Review Questions		L2
1	What are chemical fuels?		
2	Define Calorific Value? Describe determination of Calorific value of solid fuel using bomb Calorimeter.		
3	What is Knocking? Explain mechanism of petrol Knocking		
4	Write note on biodiesel, power alcohol & unleaded petrol.		
5	What are PV Cells? Give the importance of PV Cells.		L2
6	Explain the construction and working of PV Cells		
7	Explain the utilization of PV Cells		



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8	Explain the production of Solar grade silicon by union carbide process.		
e	Experiences	-	-
1			
2			
3			
4			
5			

Module – 4

Title:	Air pollution and Water chemistry	Appr Time:	16 Hrs
a	Course Outcomes	-	Blooms Level
-	The student should be able to:	-	
1	Understand important parameters of water through analysis.		L2
2	Conclude experimental method to analyze sample qualitatively.		L2
b	Course Schedule		
Class No	Module Content Covered	CO4	Level
1	Environmental Pollution: Air pollutants: Sources, effects and control of primary air pollutants: Carbon monoxide, Oxides of nitrogen		L2
2	sulphur, hydrocarbons, Particulate matter, Carbon monoxide,		L2
3	Mercury and Lead. Secondary air pollutant: Ozone, Ozone depletion.		L2
4	Waste Management: Solid waste, e-waste & biomedical waste: Sources, characteristics & disposal methods (Scientific land filling, composting, recycling and reuse)		L2
5	Water Chemistry: Introduction, sources and impurities of water		L2
6	boiler feed water, boiler troubles with disadvantages -scale and sludge formation, boiler corrosion (due to dissolved O ₂ , CO ₂ and MgCl ₂).		L2
7	Sources of water pollution, Sewage, Definitions of Biological oxygen demand (BOD) and Chemical Oxygen Demand (COD),		L2
8	determination of COD, numerical problems on COD. Chemical analysis of water: Sulphates (gravimetry) and Fluorides (colorimetry).		L2
9	Sewage treatment: Primary, secondary (activated sludge), tertiary methods.		L2
10	Softening of water by ion exchange process. Desalination of sea water by reverse osmosis		L2
c	Application Areas	CO4	Level
1	COD & BOD parameter is used to check suitability of water in environmental studies.		L3
2	Reverse osmosis method is used to soften water.		L4
d	Review Questions		-
1	Describe effects & control of any two primary air pollutants.		L1
2	Discuss effects & control of any secondary air pollutants.		L3
3	Explain characteristic & disposal methods of e-waste & biomedical waste.		L2
4	Write a note on sources of air pollutants.		L4
5	What is boiler feed water? Explain boiler troubles & disadvantages of scale and sludge formation,		L2
6	Discuss boiler corrosion due to dissolved O ₂ , CO ₂ and MgCl ₂		L5
7	What is COD? Explain determination of COD.		L2
8	Explain activated sludge method of sewage treatment.		L3
9	Write a note on primary & tertiary treatment of sewage.		L4
10	Explain how Softening of water can be done by ion exchange process.		L1
11	What is desalination of sea water? explain reverse osmosis method.		L4
e	Experiences	-	-

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1		L2
2		
3		
4		L3
5		

D3. TEACHING PLAN - 3

Module – 5

Title:	Instrumental methods of analysis and Nanomaterials	Appr Time:	16 Hrs
a	Course Outcomes	-	Blooms Level
-	The student should be able to:	-	Level
1	Conclude experimental methods to analyze the sample Qualitatively		L2
2	Describe the synthesis, properties and applications of Nanomaterial		L2
b	Course Schedule		
Class No	Module Content Covered	CO5	Level
1	Instrumental methods of analysis: Theory, Instrumentation and applications of Colorimetry & Flame Photometry,		L2
2	Theory, Instrumentation and applications of Atomic Absorption Spectroscopy & Potentiometry.		L2
3	Theory, Instrumentation and applications of Conductometry (Strong acid with a strong base, weak acid with a strong base, mixture of strong acid and a weak acid with a strong base).		L2
4	Nanomaterials: Introduction, size dependent properties (Surface area, Electrical, Optical, Catalytic and Thermal properties).		L2
5	Synthesis of nanomaterials: Top down and bottom up approaches,		L2
6	Synthesis of nanomaterials Synthesis by Sol-gel,		L2
7	Synthesis of nanomaterials precipitation and chemical vapour deposition,		L2
8	Nanoscale materials: Fullerenes, Carbon nanotubes and graphenes – properties and applications.		L2
c	Application Areas	CO5	Level
1	Measurement of optical density is used for analysis of unknown samples in medical electronics.		L3
2	Fullerenes are used in super conductors, micro electronic device, non linear optic devices etc.		L4
3	CNT'S are used in nano-electronics ,optics, analyte sensing electrodes etc		
d	Review Questions		-
1	Explain Theory, Instrumentation and applications of Colorimetry.		L2
2	Explain Theory, Instrumentation and applications of Flame Photometry.		L2
3	Discuss how conductometers are used for analysis of samples.		L2
4	Describe Theory, Instrumentation and applications of Atomic Absorption Spectroscopy.& Potentiometry.		L2
5	Describe Theory, Instrumentation and applications of Potentiometry.		L2
6			L2
7	What are nano materials? Explain the synthesis of nano material by solgel & precipitation methods		L2
8	Explain the size dependent properties of Nanomaterials		L2
9	Explain synthesis of nano materials by chemical vapour condensation method		L2
10	Explain the properties and application of Fullerenes.		L2
11	Explain the properties and application of carbon Nano tubes.		L2
12	Describe the properties and application of graphenes.		L2
e	Experiences		-

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1			L2
2			
3			
4			L3
5			

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs Code	18CHE22	Sem:	2	Marks:	30	Time:	75 minutes	
Course:	Engineering Chemistry							
-	-	Note: Answer any 3 questions, each carry equal marks.				Marks	CO	Level
1	a	Derive Nernst equation for single electrode potential.				5	CO1	L2
	b	Discuss classification of batteries with example.				5	CO2	L2
	c	What is reference electrode? Discuss the construction and working of Standard Calomel electrode.				5	CO1	L2
		OR						L2
2	a	What is Ion selective electrode? Explain measurement of pH using Glass electrode.				5	CO1	L2
	b	What is concentration cell? The cell potential of concentration cell of copper was measured 0.0592V. The concentrations of the anode is 0.001M CuSO ₄ solution, Cathode is X M. Mention cell representation, cell reaction & calculate the value of X.				5	CO1	L2
	c	Discuss the construction, working & applications of nickel-metal hydride battery.				5	CO1	L2
								L2
3	a	Define Corrosion? Explain the electrochemical theory of corrosion by taking iron as an example.				5	CO2	L2
	b	What is fuel cell? Discuss the construction, working & applications of methanol-oxygen fuel cell.				5	CO2	L2
	c	Explain the following terms : i. Polarization ii. Decomposition Potential iii. Over voltage				5	CO2	L2
		OR						L2
4	a	What is differential aeration corrosion? Explain waterline corrosion & pitting corrosion with example.				5	CO2	L2
	b	What is Electroplating? Explain Electroplating of Chromium.				5	CO2	L2
	c	What is electroless plating? Explain Electroless plating of Copper with relevant reactions.				5	CO2	L2

b. Assignment -1

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions								
Crs Code:	18CHE22	Sem:	2	Marks:	10	Time:	90 – 120 minutes	
Course:	Engineering Chemistry							
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.								
SNo	USN	Assignment Description				Marks	CO	Level
1		Define Free energy and entropy.					CO1	L2
2		Derive Nernst equation for single electrode potential.					CO1	L2
3		What is Reference electrode?					CO1	L2
4		Explain construction & working of calomel electrode with its application.					CO1	L2
5		Define Ion Selective electrode?					CO1	L2
6		Describe construction & working of glass electrode					CO1	L2
7		Explain determination of pH of unknown solution using glass electrode.					CO1	L2
8		What is electrolyte concentration cells.					CO1	L2
9		Explain the construction, working & EMF determination of electrolyte concentration cells.					CO1	L2

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10		What is batteries? Explain the Classification batteries with suitable examples		CO1	L2
11		Describe the construction, working & Application of Ni-MH battery		CO1	L2
12		Explain construction, working & Application for Li-ion battery.		CO1	L2
13		Explain electrochemical theory of corrosion by taking Fe as an example		CO2	L2
14		How does the following factors affect the rate of corrosion ratio of cathodic area to anodic area, pH, conductivity & temperature.		CO2	L2
15		What is cathodic protection? Explain sacrificial anodic method & impressed current/Voltage method		CO2	L2
16		What is Anodizing? Explain the anodizing of AL.		CO2	L2
17		Write a note on differential metal corrosion.		CO2	L2
18		Explain waterline corrosion & pitting corrosion.		CO2	L2
19		What is differential aeration corrosion. Explain with example.		CO2	L2
20		Explain Galvanization		CO2	L2
21		Explain why nut & bolt should be made up of same metal		CO2	L2
22		Explain why ship moving in water corrodes below water level.		CO2	L2
23		What is metal finishing? Give the technological importance of metal finishing.		CO2	L2
24		Discuss polarization and over voltage which govern the electroplating.		CO2	L2
25		Discuss the electroplating of Chromium.		CO2	L2
26		Discuss the electroplating of Ni using Watts bath.		CO2	L2
27		What is electroless plating? Differentiate between electroplating & electroless plating .		CO2	L2
28		Explain electroless plating of Copper.		CO2	L2

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs Code:	18CHE22	Sem:	2	Marks:	30	Time:	75 minutes	
Course:								
-	-	Note: Answer any 2 questions, each carry equal marks.				Marks	CO	Level
1	a	Define Calorific Value? Describe determination of Calorific value of solid fuel using bomb Calorimeter.		5	CO3	L2		
	b	What is Knocking? Explain mechanism of petrol Knocking		5	CO3	L2		
	c	Explain the construction and working of PV Cells		5	CO3	L2		
					CO3			
2	a	Explain the utilization of PV Cells .		5	CO3	L2		
	b	Explain the production of Solar grade silicon by union carbide process.		5	CO3	L2		
	c	Discuss Construction, working & applications of methanol-oxygen fuel cell with H ₂ SO ₄ electrolyte.		5	CO3	L2		
3	a	Discuss effects & control of any secondary air pollutants.		5	CO4	L2		
	b	Explain characteristic & disposal methods of e-waste & biomedical waste.		5	CO4	L2		
	c	What is COD? Explain determination of COD.		5	CO4	L2		
4	a	Explain how Softening of water can be done by ion exchange process.		5	CO4	L2		
	b	Write a note on primary & tertiary treatment of sewage.		5	CO4	L2		
	c	Explain characteristic & disposal methods of e-waste & biomedical waste		5	CO4	L2		



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b. Assignment – 2

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions								
Crs Code:	18CHE22	Sem:	2	Marks:	5 / 10	Time:	90 – 120 minutes	
Course:	Engineering chemistry							
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.								
SNo	USN	Assignment Description				Marks	CO	Level
1		Describe effects & control of any two primary air pollutants.				5	CO4	L2
2		Discuss effects & control of any secondary air pollutants.				5	CO4	L2
3		Explain characteristic & disposal methods of e-waste & biomedical waste.					CO4	L2
4		Write a note on sources of air pollutants.				5	CO4	L2
5		What is boiler feed water? Explain boiler troubles & disadvantages of scale and sludge formation,				5	CO4	L2
6		Discuss boiler corrosion due to dissolved O ₂ , CO ₂ and MgCl ₂				5	CO4	L2
7		What is COD? Explain determination of COD.				5	CO4	L2
8		Explain activated sludge method of sewage treatment.				5	CO4	L2
9		Write a note on primary & tertiary treatment of sewage.				5	CO4	L2
10		Explain how Softening of water can be done by ion exchange process.				5	CO4	L2
11		What is desalination of sea water? explain reverse osmosis method.				5	CO4	L2

E3. CIA EXAM – 3

a. Model Question Paper - 3

Crs Code:	18CHE22	Sem:	2	Marks:	30	Time:	75 minutes	
Course:	Engineering chemistry							
-	-	Note: Answer any 2 questions, each carry equal marks.				Marks	CO	Level
1	a	Explain Theory, Instrumentation and applications of Colorimetry.				5	CO5	L2
	b	Discuss how conducto meters are used for analysis of samples.				5	CO5	L2
	c	Describe Theory, Instrumentation and applications of Potentiometry.				5	CO5	L2
		or					CO5	
2	a	Explain Theory, Instrumentation and applications of Flame Photometry.				5	CO5	L2
	b	Describe Theory, Instrumentation and applications of Atomic Absorption Spectroscopy.				5	CO5	L2
	c	Explain Theory, Instrumentation and applications of conductometer .				5	CO5	L2
3	a	What are nano materials? Explain the synthesis of nano material by solgel method.				5	CO5	L2
	b	Explain the size dependent properties of Nanomaterials				5	CO5	L2
	c	Explain synthesis of nano materials by chemical vapour condensation method				5	CO5	L2
		or					CO5	
4	a	Explain the properties and application of carbon Nano tubes.				5	CO5	L2
	b	Describe the properties and application of graphenes.				5	CO5	L2
	c	Explain the synthesis of nano material by precipitation method.				5	CO5	L2

b. Assignment – 3

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions								
Crs Code:	18CHE22	Sem:	2	Marks:	5 / 10	Time:	90 – 120 minutes	
Course:	Engineering chemistry							
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.								
SNo	USN	Assignment Description				Marks	CO	Level

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1	Explain Theory, Instrumentation and applications of Colorimetry.	5	CO5	L2
2	Explain Theory, Instrumentation and applications of Flame Photometry.	5	CO5	L2
3	Discuss how conductometers are used for analysis of samples.	5	CO5	L2
4	Describe Theory, Instrumentation and applications of Atomic Absorption Spectroscopy.	5	CO5	L2
5	Describe Theory, Instrumentation and applications of Potentiometry.	5	CO5	L2
6	What are nano materials? Explain the synthesis of nano material by solgel & precipitation methods	5	CO5	L2
7	Explain the size dependent properties of Nanomaterials	5	CO5	L2
8	Explain synthesis of nano materials by chemical vapour condensation method	5	CO5	L2
9	Explain the properties and application of Fullerenes.	5	CO5	L2
10	Explain the properties and application of carbon Nano tubes.	5	CO5	L2
11	Describe the properties and application of graphenes.	5	CO5	L2

F. EXAM PREPARATION

1. University Model Question Paper

Course:					Month / Year	Feb / 2019		
Crs Code:	18CHE22	Sem:	2	Marks:	100	Time:	180 minutes	
-	Note	Answer all FIVE full questions. All questions carry equal marks.				Marks	CO	Level
1	a	Derive Nernst's equation for single electrode potential.				5	CO1	L2
	b	Define electrolyte concentration cell. Calculate the e.m.f of the given concentration cell at 298 K $\text{Ag} / \text{Ag} / \text{NO}_3(0.02 \text{ M}) \parallel \text{AgNO}_3(2 \text{ M}) / \text{Ag}$				5	CO1	L3
	c	Describe construction and working of Ni-MH battery. Mention its application.				5	CO1	L2
	d	What is batteries? Explain the Classification batteries with suitable examples				5	CO1	L2
		OR						
-	a	Define reference electrode. Describe construction, working & Application of Calomel electrode				5	CO1	L2
	b	Describe construction and working of Li-ion battery. Mention its application.				5	CO1	L2
	c	Explain determination of pH of unknown solution using glass electrode.				5	CO1	L2
	d	An electrochemical cell consist of a Nickel electrode dipped in 0.05M NiSO ₄ & lead electrode dipped in 0.5M PbSO ₄ solution at 298K. Given that the standard electrode potential of Ni & Pb electrode are -0.24V & -0.13V respectively. Write the cell representation, cell reaction and calculate EMF of the cell.				5	CO1	L3
		OR						
2	a	Explain electrochemical theory of corrosion with its mechanism taking Iron as an example.				5	C02	L2
	b	Describe the following factors which affects the rate of corrosion: (i) Ratio of Anodic to cathodic area (ii) pH of the medium.				5	C02	L2
	c	Describe electroplating of Chromium. Mention its applications.				5	C02	L2
	d	Define Metal finishing. Describe the technological importance of metal finishing.				5	C02	L2
		OR						
-	a	Describe electroless plating of copper on PCB's with plating reaction. Mention its application.				5	C02	L2
	b	Explain polarization & over voltage.				5	C02	L2

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	c	What is anodizing? Explain the anodizing of aluminum.	5	CO2	L2
	d	Explain Differential Aeration Corrosion with an example.	5	CO2	L2
3	a	Describe Bomb calorimetric method for determination of calorific value of a solid fuel.	5	CO3	L2
	b	What is Knocking of petrol engine? Explain the Knocking mechanism and ill effects.	5	CO3	L2
	c	What is Fuel cell? Give the difference between conventional cell and fuel cell.	5	CO3	L2
	d	Explain the construction, working and application of methanol-oxygen fuel cell.	5	CO3	L2
		OR		CO3	
-	a	What is P.V cell? Explain the construction and working of P.V Cell.	5	CO3	L2
	b	Explain the production of solar grade silicon by Union carbide method.	5	CO3	L2
	c	0.75g of coal saple (carbon-90%, hydrogen-6% and ash -4%) was subjected to combustion in a bomb calorimeter. Mass of water taken in the calorimeter was 3500g and the water equivalent of calorimeter was 750g. The rise in temperature was found to be 3.2°C. Calculate the gross and net calorific values of a Sample (Specific heat of water=4.187kJ/Kg/°C: Latent heat of stam = 2454kJ/Kg).	6	CO3	L3
	d	Explain Followings: (i)Power alcohol (ii)Biodiesel	4	CO3	L2
				CO3	
4	a	What is boiler feed water? Explain boiler troubles & disadvantages of scale and sludge formation,	5	CO4	L2
	b	Describe effects & control of any two primary air pollutants.	5	CO4	L2
	c	What is COD?Explain determination of COD of west water .	5	CO4	L2
	d	Explain characteristic & disposal methods of e-waste & biomedical waste.	5	CO4	L2
		OR		CO4	
-	a	Explain activated sludge method of sewage treatment.	5	CO4	L2
	b	Explain how Softening of water can be done by ion exchange proc	5	CO4	L2
	c	What is desalination of sea water? explian reverse osmosis method.	5	CO4	L2
	d	Calculate COD of 25CC of an effluent sample which requires 8.3cm ³ of 0.001MK ₂ Cr ₂ O ₇ , for its complete oxidation.	5	CO4	L3
5	a	Explain the theory, Instrumentation and application of Colorimetry.	5	CO5	L2
	b	Describe the theory, Instrumentation and application of Flame Photometry	5	CO5	L2
	c	Explain synthesis of nano materials by chemical vapour condensation method	5	CO5	L2
	d	What are nano materials? Explain the synthesis of nano material by solgel Method.	5	CO5	L2
		OR		CO5	
	a	Describe the theory, Instrumentation and application of Colorimetry.	5	CO5	L2
	b	What are the application of Conductometry by Strong acid with a strong base, weak acid with a strong base, mixture of strong acid and a weak acid with a strong base.	5	CO5	L2
	c	Explain the properties and application of Fullerenes.	5	CO5	L2
	d	Explain the properties and application of carbon Nano tubes and graphenes.	5	CO5	L2

2. SEE Important Questions

Course:	Engineering chemistry	Month / Year	Feb /2019
Crs Code:	18CHE22	Sem:	2
	Marks:	100	Time:
			180 minutes
	Note	Answer all FIVE full questions. All questions carry equal marks.	
		-	-
Module	Qno.	Important Question	Marks
			CO
			Year

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1	1	Derive Nernst equation for single electrode potential.	20	CO1	2019
	2	Discuss classification of batteries with example.		CO1	2019
	3	What is reference electrode? Discuss the construction and working of Standard Calomel electrode.		CO1	2019
	4	What is Ion selective electrode? Explain measurement of pH using Glass electrode.		CO1	2019
	5	What is concentration cell? The cell potential of concentration cell of copper was measured 0.0592V. The concentrations of the anode is 0.001M CuSO ₄ solution, Cathode is X M. Mention cell representation, cell reaction & calculate the value of X.		CO1	2019
					2019
2	1	Explain electrochemical theory of corrosion taking rusting of iron as example.	20	CO2	2019
	2	How does the following factors affect the rate of corrosion ratio of cathodic area to anodic area, pH, conductivity & temperature.		CO2	2019
	3	What is cathodic protection? Explain sacrificial anodic method & impressed current/Voltage method		CO2	2019
	4	Discuss the electroplating of Ni using Watts bath.		CO2	2019
	5	What is electroless plating? Differentiate between electroplating & electroless plating.		CO2	2019
					2019
3	1	Define Calorific Value? Describe determination of Calorific value of solid fuel using bomb Calorimeter.	20	CO3	2019
	2	What is Knocking? Explain mechanism of petrol Knocking		CO3	2019
	3	Explain the construction and working of PV Cells		CO3	2019
	4	Explain the production of Solar grade silicon by union carbide process.		CO3	2019
	5	Write note on biodiesel, power alcohol & unleaded petrol.		CO3	2019
					2019
4	1	Discuss effects & control of any secondary air pollutants.	20	CO4	2019
	2	Explain characteristic & disposal methods of e-waste & biomedical waste.		CO4	2019
	3	Explain activated sludge method of sewage treatment.		CO4	2019
	4	Discuss boiler corrosion due to dissolved O ₂ , CO ₂ and MgCl ₂		CO4	2019
	5	What is COD? Explain determination of COD.		CO4	2019
					2019
5	1	Explain conductometric estimation of strong acid with strong base.	20	CO5	2019
	2	Describe Theory, Instrumentation and applications of Atomic Absorption Spectroscopy.		CO5	2019
	3	Describe Theory, Instrumentation and applications of Potentiometry.		CO5	2019
	4	What are nano materials? Explain the synthesis of nano material by solgel & precipitation methods		CO5	2019
	5	Explain the size dependent properties of Nanomaterials		CO5	2019