CHEMISTRY

Subject Code : CH102BS
Regulations : R18 - JNTUH
Class : I Year B.Tech II Semester

Department of Science and Humanities

BHARAT INSTITUTE OF ENGINEERING AND TECHNOLOGY

Ibrahimpatnam - 501 510, Hyderabad

Chemistry (CH102BS)
COURSE PLANNER

I. COURSE OVERVIEW:

Concepts in Chemistry are the foundation for any Engineering subject. Hence exposure to the basic concepts of Chemistry is a compulsory aspect to an Engineering graduate.
Introduce the students to atomic, molecular and electronic changes and band theory related to conductivity. As a course outcome they also acquire knowledge on electrochemistry, batteries and their function. The students also gain knowledge on corrosion and waste water treatment methods. As a part of this program further they attain the required concepts about stereochemistry and reaction mechanism of organic molecules. They acquire basic knowledge in spectroscopy and its application to medical and other fields. They are also trained in the synthesis of some drug molecules such as aspirin and paracetamol.
This way the course will build a firm base to students to further understand the engineering concepts efficiently and easily. The lab sessions impart practical exposure to different natural phenomenon in chemistry and to understand them completely.

II. PREREQUISITE(S):

- Students entering advanced engineering chemistry should have a firm grasp of basics of Electrochemistry and Stereochemistry

III. COURSE OBJECTIVES:

- To bring adaptability to new developments in Engineering Chemistry and to acquire the skills required to become a perfect engineer.
- To impart the basic knowledge of atomic molecular and electronic modifications to make the student to understand the technology based on them.
- To understand the basic principles of electrochemistry, corrosion and waste water treatment methods which are essential for the engineers and in industry.
- To acquire the skills pertaining to spectroscopy and to apply them for medical and other fields.
- To accomplish the knowledge of stereochemistry and synthetic aspects useful for understanding reaction pathways.

IV. COURSE OUTCOMES: The student will learn

S. no	Course Outcomes (CO)	Blooms level
CO1	The knowledge of atomic, molecular and electronic changes, band theory related to conductivity.	Theory, Understand, Knowledge
CO2	The required knowledge about importance of water and understanding its treatments methods.	Understand, Remember Theory Knowledge Apply Analyse
CO3	The required principles and concepts of electrochemistry, corrosion.	Theory

		Understand Apply
CO4	The knowledge of configurational and conformational analysis of molecules and reaction mechanisms.	Understand, Analyse Apply
CO5	The required skills to get clear concepts on basic spectroscopy and application to medical and other fields.	Understand, Remember Theory Knowledge Apply Analyse

V. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Level	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems	**1**	LECTURES ASSIGNMENTS SEMINARS CHARTS
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	1	
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	**1**	
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	**1**	
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	**-**	
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	**1**	
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	**2**	
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	**-**	
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	**-**	
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation make effective presentations, and give and receive clear instructions	**-**	
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments	-	
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life long learning in the broadest context of technological change.	-	

VII. SYLLABUS:

UNIT I: Molecular structure and Theories of Bonding: Atomic and Molecular orbitals. Linear Combination of Atomic Orbitals (LCAO), molecular orbitals of diatomic molecules, molecular orbital energy level diagrams of N_2, O_2 and F_2 molecules. Π molecular orbitals of butadiene and benzene.

Crystal Field Theory (CFT): Salient features of CFT- Crystal Field Splitting of transition metal ion d-orbitals in Tetrahedral, Octahedral and square planar geometries. Band Structure of solids and effect of doping on conductance.

UNIT II:

Water and its treatment:

Introduction – hardness of water – causes of hardness – types of hardness: temporary and permanent – expression and units of hardness – Estimation of hardness of water by complexometric method. Numerical problems. Potable water and its specifications- Steps involved in the treatment of potable water - Disinfection of water by chlorination and Ozonization.

Boiler troubles:

Boiler feed water and its treatment– Calgon conditioning – Phosphate conditioning - Colloidal conditioning – External treatment of water by ion- exchange processes. Desalination of water – Reverse osmosis. Numerical problems.

UNIT III: Electrochemistry and Corrosion:

Electrochemistry: Electrochemical cells- **es**lectrode potential, standard electrode potential, types of electrodes – calomel, quinhydrone and glass electrode. Nernst equation. Determination of pH of a solution using quinhydrone and glass electrode. Electrochemical series and its applications. Numerical problems.

Batteries: Primary (Lithium Cell) Secondary batteries (lead- acid storage battery and Lithium ion battery).

Corrosion: Causes and effects of corrosion,Theories of chemical and electrochemical corrosion-Mechanism of electrochemical corrosion, Types of corrosion: Galvanic, Water-line and pitting corrosion. Factors affecting the rate of corrosion, Corrosion control methods-Cathodic protection-Sacrificial anode and impressed current cathodic methods. Surface coatings- metallic coatings-methods of application. Electroless plating of Nickel.

Corrosion control Methods: Cathodic protection-Sacrificial anode and impressed current cathodic methods. Surface coatings-metallic coatings-methods of application. Electroless plating of Nickel.

UNIT IV:

Stereochemistry, Reaction Mechanism and synthesis of drug molecules:

Introduction to representation of 3-dimensional structures, structural and stereoisomers, configurations, symmetry and chirality. Enantiomers, diastereomers, optical activity an Absolute configuration. Conformational analysis of n-butane.

Substitution Reactions: Nucleophilic substitution reactions: Mechanism of S_N1, S_N2 reactions. Electrophilic and nucleophilic addition reactions: Addition of HBr to propene.

Markownikoff and anti Markownikoff's additions. Grignard additions on carbonyl compounds . Elimination reactions: Dehydro halogenations of alkyl halides. Saytzeff rule.

Oxidation Reactions: Oxidation of alcohols using $KMnO_4$ and chromic acid.

Reduction reactions: Reduction of carbonyl compounds using $LiAlH_4$ and $NaBH_4$. Hydroboration of olefins, structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.

UNIT V: Spectroscopic techniques and applications:

Principles of spectroscopy, selection rules and applications of electronic spectroscopy. Vibrational and rotational spectroscopy. Basic concepts of Nuclear Magnetic resonance Spectroscopy, chemical shift. Introduction to Magnetic resonance imaging.

SUGGESTED BOOKS:

TEXT BOOKS:

1. Engineering Chemistry by P.C. Jain and M. Jain, Dhanpatrai Publishing Company, New Delhi (2010)
2. Physical chemistry by P.W. Atkins
3. Fundamentals of Molecular Spectroscopy, by C.N. Banwell
4. Organic chemistry: Structure and Function by K.P.C. Volhardt and N.E. Schore, 5th Edition.
5. University Chemistry by B. M. Mahan, Pearon IV Edition.

REFERENCE BOOKS:

6. Engineering Chemistry by Shikha Agarwal, Cambridge University Press, Delhi (2015)
7. Engineering Chemistry by Shashi Chawla, Dhanpatrai and Company (P) Ltd. Delhi (2011)
8. Engineering Chemistry by Thirumala Chary and Laxminarayana, Scitech Publishers, Chennai (2016).

GATE SYLLABUS: NA

IES SYLLABUS: NA

VIII. COURSE PLAN:

Lecture No.	Week No.	TOPIC	Course learning outcomes	Text books
	UNIT – 1			
1.		Introduction to Atomic and Molecular Orbitals - Bonding in molecules	Theory	1, 2, 7
2.		Linear Combination of Atomic Orbitals (LCAO)	Theory	
3.		Molecular orbitals of diatomic molecules		
4.		Molecular orbital energy level diagrams introduction		
5.	2	Molecular orbital energy level diagrams of N_2, O_2 and F_2 molecules.	Understand, Apply	

6.		Pi molecular orbtals of butadiene and benzene	Remember	
7.		Introduction to Crystal Field theory (CFT)- Salient features of CFT	Theory	
8.		Crystal field splitting of d orbitals in Tetrahedral, Octahedral and Square Planar geometries	Understand	
9.	3	Band structure of solids	Theory	
10.		Effect of doping on conductance.	Understand	
11.		Revision of unit-1		
12.		***Mock Test – I***		
	UNIT – 2			
13.	4	Hardness of water, Causes, Expression ,Units, Types of Hardness: temporary and permanent	Understand, Remember	1,6,7
14.		Estimation of Hardness by complexometric method (EDTA), Numerical Problems.	Apply, Apply	
15.		Potable water- Its Specifications, steps involved in Treatment of potable water	Understand, Remember	
16.		Disinfection of Potable water by Chlorination & Ozonization.	Understand, Apply	
		Bridge Class # 1		
17.	5	Boiler feed water and its treatment	Theory and Apply	
18.		calgon, phosphate & colloidal conditioning	Apply	
19.		External treatment of water ion exchange process.	Understand	
20.		Desalination of water-reverse osmosis.	Theory	
		Numerical problems	Understand	
21.	6	Revision of Unit-II		
	UNIT III			
22.	6	Electrochemical cells-electrode potential, standard electrode potential	Theory	1, 6,7
23.		Types of electrodes-calomel,Quinhydrone and glass electrode.	Theory	
24.		Nernst equation. Determination of pH of a solution using quinhydrone and glass electrode.	Understand, Derive	
		Bridge Class # 3		
25.	7	Electrochemical series and its applications. Potentiometric titrations.	Understand	
26.		Batteries primary (Lithium cell) and secondary batteries (lead acid storage battery	Theory, Remember	
27.		Lithium ion batteries	Apply	
28.		Numerical problems.	Apply	
		Bridge Class # 4		
29.	8	Causes And effects of Corrosion-theories of chemical and electrochemical corrosion-mechanism of electrochemical corrosion.	Understand	
30.		Types of Corrosion:Galvanic, water-line and pitting	Theory	

		corrosion, Factors affecting rate of corrosion.		
31.		Corrosion control methods-Cathodic protection-Sacrificial anode and impressed current cathodic methods.	Apply	
32.		Surface coatings-metallic coatings-methods of application. Electroless plating of Nickel.	Apply	
		Bridge Class # 5		
	I Mid Examinations			
	UNIT – IV			
33.	9	Introduction to representation of 3- dimensional structures, structural and stereoisomers.	Understand	4
34.		Configurations, symmetry and chirality.	Understand	
35.		Enantiomers and diastereomers.	Remember	
36.		Optical activity and Absolute configuration	Understand	
		Bridge Class # 6		
	UNIT – IV contd.			
37.	10	Conformational analysis of n-butane.	Apply	4
38.		Substitution reactions: Nucleophilic substitution reactions	Understand	
39.		Mechanism of SN_1 and Mechanism of SN_2 reaction.	Understand	
40.		Electrophilic and nucleophilic addition reactions	Understand	
		Bridge Class # 7		
41.	11	Addition of HBr to propene. Markownikoff and anti Markownikoff's additions.	Understand, Remember	
42.		Grignard additions on carbonyl compounds.	Apply	
43.		Elimination reactions: Dehydro halogenations of alkyl halides. Saytzeff rule.	Understand	
44.		Oxidation of alcohols using $KMnO_4$ and chromic acid.Reduction of carbonyl compounds using $LiAlH_4$ and $NaBH_4$.	Apply	
		Bridge Class # 8		
45.	12	Hydroboration of olefins.	Understand	
46.		Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.	Apply, Understand	
47.		Revision		
48.		Revision		
		Mock Test – II		
	UNIT –V			
49.	13	Principles of spectroscopy	Theory	3
50.		selection rules and its applications	Understand	
51.		Vibrational spectroscopy	Theory	
52.		Rotational spectroscopy	Theory	
		Bridge Class # 9		
53.	14	Basic concepts of Nuclear Magnetic Resonance	Understand	

		spectroscopy		
54.		Chemical Shift	Analyze	
55.		Introduction to Magnetic resonance imaging	create	
56.		Revision		
		Bridge Class # 10		
57.		Revision		
58.		Revision		
59.	15	Revision		
60.		Revision		
		Bridge Class # 11		
61.		Mock test – 1		
62.		Paper discussion and revision		
63.	16	Mock test – 2		
64.		Paper discussion and Revision		
		Bridge Class # 12		
	II Mid Examinations			

IX. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CO's	Program Outcomes (PO's)											
	PO 1	**PO2**	**PO3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	1	-	-		-	-	-	-	-	-	-	-
CO2	1	1	1	1	-	1	2	-	-	-	-	-
CO3	1	1	1	1	-	1	2	-	-	-	-	-
CO4	1		1	1	-	1	-	-	-	-	-	-
CO5	1		-	1	-	-	-	-	-	-	-	-
Average (Rounded)	1	0.4	0.6	0.8	-	0.6	0.8	-	-	-	-	-

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)** **- : None**

X. QUESTION BANK: (JNTUH)

Definitions of the different levels of cognitive skills in Bloom's taxonomy marked in descriptive questions (where the highest level in question bits is only marked) are as follows:

BLOOMS LEVEL	COGNITIVE SKILL	DEFINITION
Level–1 (L1) : REMEMBER	Knowledge	Recalling/Retrieving relevant terminology, specific facts, or different procedures related to information and/or course topics. (At this level, student remembers something, but may not really understand it fully.)
Level–2 (L2) : UNDERSTAND	Comprehension	Determining the meaning of instructional messages (facts, definitions, concepts, graphics etc.)
Level–3 (L3) : APPLY	Application	Carrying out or use previously learned information in another familiar situations or in problem solving

Level–4 (L4) : ANALYZE	Analysis	Breaking information into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose. Analysis refers to the process of examining information in order to make conclusions regarding cause and effect, interpreting motives, making inferences, or finding evidence to support statements/arguments
Level–5 (L5) : EVALUATE	Evaluation	Making judgment's based on criteria and standards, personal values or opinions
Level–6 (L6) : CREATE	Synthesis	Create or uniquely apply prior knowledge and/or skills to form a novel, coherent whole or original product or produce new and original thoughts, ideas, processes,...

DESCRIPTIVE QUESTIONS: (WITH BLOOMS PHRASES)

UNIT I

S.no	Short Answer Questions	Blooms taxonomy Level	Course out come
1	What are atomic and molecular orbital?	Remember	1
2	Calculate the bond order in molecules of O_2, O_2^-, O_2^{2-}	Apply	1
3	Define bond order. Explain the factors affecting it	Remember	1
4	Write notes on Linear combination of atomic orbitals	Remember	1
5	What is meant by doping, and how it affects on conduction?	Understand	1
6	Calculate the bond order in molecules of N_2^+, N_2^-	Apply	1
7	What is the reason for crystal field splitting	Apply	1
8	What are the factors effecting the magnitude of crystal field splitting	Understand	1
9	Explain the effect of doping on conductance	Apply	1
10	What are the differences between atomic and molecular orbitals	Remember	1

S. No	Long Answer Question	Blooms taxonomy Level	Course out come
1	Draw the molecular orbital energy level diagrams of N_2, O_2	understand	1
2	What is the reason for crystal field splitting and what are the factors affecting crystal field splitting?	Apply	1
3	Explain the important postulates of Molecular orbital theory Explain the CFT splitting in octahedral and tetrahedral geometries?	Understand	1
5	Write salient features of CFT?	Remember	1
6	Draw the molecular orbital energy level diagrams of F_2 and explain its bond order	Remember	1
7	Write a note on LCAO	Remember	1
8	Write an account on molecular orbital theory	Understand	1
9	Explain about crystal field theory	Understand	1
10	Mention the different between bonding orbitals and anti bonding orbitals	Remember	1

UNIT – II

S.	Short Answer Questions	Blooms	Course

No		taxonomy Level	out come
1	Why are NH_4Cl and NH_4OH buffer added during the determination of hardness?	Apply	2
2	What is the indicator used in EDTA method?	Remember	2
3	A sample of hard water contains 14.6 g of $Mg(HCO_3)_2$ and 9.5 g of $MgCl_2$ and 13.6 g of $CaSO_4$. What is the temporary, permanent and total hardness of the water sample?	Apply	2
4	Explain the role of anion exchange resin.	Understand	2
5	How is caustic embrittlement avoided?	Understand	2
6	What is carbonate hardness? How can you remove carbonate hardness?	Remember	2
7	Explain why hard water consumes a lot of soap?	Apply	2
8	What is the advantage of break-point chlorination?	Remember	2
9	What is the phosphate conditioning?	Understand	2
10	Give the specifications of potable water.	Remember	2

S. no	Long Answer Questions	Blooms taxonomy Level	Course out come
1	Distinguish between temporary and permanent hardness of water.	Understand	2
2	Write a note on complexometric titrations used for estimation of hardness of water by EDTA method	Understand	2
3	Why is hard water harmful to boilers? Discuss the causes and harmful effects of scale formation.	Understand	2
4	What are the factors that lead to caustic embrittlement in boilers? How can it be prevented?	Remember	2
5	Explain the softening of water by Ion exchange process.	Remember	2
6	Define Potable water and give an account of disinfection of water by chlorination and ozonisation.	Apply	2
7	Define Desalination and explain the methods of desalination.	Understand	2
8	Write a brief account on internal conditional methods of treatment of water.	Apply	2
9	Explain the difference between scale and sludge	Understand	2
10	Write note on specification of potable water and its treatment	Apply	2

UNIT – III

S. No	Short answer type questions	Blooms taxonomy Level	Course out come
1	Write the Nernst equation in terms of reduction potential.	Understand	3
2	What is reference electrode?	Remember	3
3	What do you mean by a salt bridge? Why is it used?	Understand	3

4	What is a secondary reference electrode?	Apply	3
5	Why is coating of zinc on iron called sacrificial anode	Analyse	3
6	What is the difference between primary and secondary cell	Understand	3
7	Lead acid battery is not completely sealed – Explain	Analyse	3
8	What is an anode material in a lithium ion battery	Understand	3
9	Why non aqueous solvent is used in a Lithium ion battery	Understand	3
10	What is Dry corrosion?	Remember	3

S.No	**Long Answer Questions**	**Blooms taxonomy Level**	**Course out come**
1	What do you mean by sacrificial anodic protection explain with suitable example	Understand	3
2	Explain the construction and working of Lead acid battery.	Apply	3
3	How can you determine the PH of an unknown solution by using Quinone-Hydrone electrode	Remember	3
4	Explain Calomel electrode. Mention its advantages.	Remember	3
5	Design a cell to determine the PH of an aqueous acid unknown solution by using a Calomel electrode	Understand	3
6	What is a Glass electrode? Explain how can you determine the PH of an unknown solution by using glass electrode	Understand	3
7	Explain the mechanism involved in Electro chemical corrosion with reactions	Apply	3
8	Write an account of lithium ion battery	Understand	3
9	Explain the chemical reaction involved in electrochemical corrosion	Remember	3
10	Iron corrodes faster than aluminium? explain	Apply	3

UNIT – IV

S.No	Short answer questions	**Blooms taxonomy Level**	**Course out come**
1	What are stereoisomers?	Understand	4
2	What do you mean by specific rotation?	Remember	4
3	Differentiate between diasteromers and enantiomers	Remember	4
4	What is Markownikoff rule	Understand	4
5	Allenes do not contain any chiral centre but still exhibit optical activity. Explain	Understand	4
6	Why proxide effect is only confined to addition of only HBr	Apply	4
7	State and explain Saytzeff rule?	Remember	4
8	Why Markownikoff's rule fails in the addition of HBr to	Apply	4

	propene in presence of H_2O_2.		
9	Why is rate of SN^1 reaction much faster in polar solvents than in a non-polar solvent.	Apply	4
10	How can it be decided whether the following reactions proceeds by $SN^1$and SN^2 mechanism	Apply	4

S.No	**Long answer questions**	**Blooms taxonomy Level**	**Course out come**
1	What are SN^1 and SN^2 reactions. Write the mechanism with suitable examples and their stereochemistry.	Understand	4
2	Explain different conformations of butane with the potential energy diagram	Understand	4
3	What are elimination reactions? Explain dehydrohalogenations of alkyl halide with suitable examples.	Apply	4
4	What is isomerism? How it is classified? Explain with suitable examples?	Remember	4
5	Explain β elimination reaction with a suitable example?	Understand	4
6	State and explain Markownikoff rule with a suitable example?	Remember	4
7	What are addition reactions? Explain the possible mechanism for addition reactions with an example each.	Apply	4
8	Write synthesis and uses of paracetamol	Apply	4
9	Write synthesis and uses of Aspirin.	Apply	4
10	Explain how competing E2 and SN2 reactions are affected by the following factors a) structure of substrate b) reagentc) solvent	Apply	4

UNIT – V

S.No	**Short answer questions**	**Blooms taxonomy Level**	**Course out come**
1	With the help of IR how will you distinguish between o-nitro phenol and p- nitrophenol	Understand	5
2	Define the term Red shift and blue shift. Increased conjugation will cause which shift?	Remember	5
3	Find the number of fundamental modes of vibration/ vibrational degrees of freedom in linear and non linear molecules such as C_6H_6, CO_2, H_2O, SO_2, N_2O, HCN	Understand	5

4	What is meant by the term chemical shift explain	Understand	5
5	Why C_{12},O_{16}, O_{18} and S_{32} do not exhibit NMR Spectrum	Remember	5
6	What is the necessary condition for a molecule to absorb IR radiation?	Understand	5
7	What is selection rule	Remember	5
8	How will you distinguish between propanaldehyde and propanone	Understand	5
9	Explain the effect of polar solvents on both n to π^* and π to π^*	Apply	5
10	CO2 is IR active. Explain	Apply	5

S.No	**Long answer questions**	**Blooms taxonomy Level**	**Course out come**
1	Describe briefly the theory of NMR spectroscopy? What information can be obtained from NMR absorption peaks?	Apply	5
2	Explain the terms chromophore and auxochrome with suitable examples. Write any 5 applications of UV spectroscopy.	Understand	5
3	Write any 5 applications of IR spectroscopy	Understand	5
4	Write any 5 applications of NMR spectroscopy	Remember	5
5	Write the basic principles of IR spectroscopy. Describe various molecular vibrations in the technique.	Understand	5
6	Schematically represent and discuss various types of electronic transitions and hence show that n to π^* transition is the lowest energy demanding among all of them	Understand	5
7	How would you analyze a sample by spectrophotometer method?	Apply	5
8	What is Beer-Lambert law? Show the absorption is linearly proportional to concentration of the solution.	Remember	5
9	Describe various absorption laws involved in UV-Visible spectral method. Derive Lambert-Beer's law.	Understand	5
10	Explain briefly about MRI imaging technique.	Apply	5

XI. OBJECTIVE QUESTIONS: JNTUH

UNIT: I

1. The bond order of N_2 molecule is _____.
   a) 2.0 b) 3.0 c) 2.5 d) 1.0

2. The bond order of a molecule can be calculated using MOT as_____

3. The electron density of Pi Molecular Orbital along internuclear axis is_____.

4. The magnetic nature of O_2 molecule is_____.

5. The bond energy of N_2 is _____than that of O_2.

6. Ligands remove the degeneracy of _____of the metal ion.

7. The most stable amongst the following: O_2, O_2^+, O_2^-, O_2^{-2} is_____.

8. The bond order of F_2 molecule is_____.

9. Bond order = _____.

10. What is the bond order of O_2 molecule_____.

11. The bond order is _____ proportional to its bond length.
    a) directly b) Inversely c) no relation

12. Which of the following molecular orbitals have lowest energy?
    a) $\sigma 2p_z$ b) $\sigma^* 2p_z$ c) $\pi 2px$ d) $\pi^* 2px$
13. In O_2 molecule, the empty molecular orbital is_____
    a) $\sigma 2S$ b) $\sigma^* 2S$ c) $\sigma^* 2P_z$ d) $\sigma 2P_z$
14. Which of the following is paramagnetic_____
    a) O_2^- b) CN^- c) CO d) NO^+
15. Which among the following will have the highest bond length?
    a) O_2 b) O_2^+ c) O_2^- d) O_2^{-2}
16. The bond order of O_2^+ molecule is__
    a) 1 b) 2 c) 2.5 d) 3
17. Which of the following is diamagnetic
    a) O_2 b) O_2^+ c) O_2^- d) O_2^{-2}
18. Molecular orbitals are classified as
    a) σ b) π c) n d) bonding & anti-bonding
19. Any p-orbital can accommodate upto
    a) 4 electrons b) 6 electrons c) 2 electrons d) 8 electrons
20. In an octahedral crystal field, eg., orbitals are
    a) raised the energy by 0.4 $\Delta 0$ b) lowered the energy by 0.6 $\Delta 0$
    c) lowered the energy by 0.4 $\Delta 0$ d) raised the energy by 0.6 $\Delta 0$

UNIT-II

1. Cation exchange resin contains _____ mobile ions.
2. Hardness of water is expressed in terms of _____.
3. The amount of chlorine required to kill bacteria and to remove organic matter is called_____.
4. $CaSO_4$ causes _____hardness to water.
5. Addition of chlorine to water produces_____acid which acts as powerful germicide.
6. Hardness that can be easily removed by boiling and filtration is known as_____ hardness.
7. _____is used calgon conditioning.
8. Process of removing salts from water is called as_____.
9. Exhausted anion exchangers are regenerated by using_____.

10. Agar-Agar is used in _____water conditioning.

11. The indicator used for the estimation of total hardness of a given water sample by EDTA method is.
    a) Starch b) EBT c) Ferroin d) Methyl orange
12. Temporary hardness of water is caused due to the presence of.
    a) Calcium carbonate b) Calcium chloride c) Magnesium bicarbonate d) None
13. The method used for desalination of water is.
    a) zeolite process b) Lime soda process c) Ion exchange process d) Distillation
14. The soft, loose and slimy precipitate formed within the boiler is called.
    a) Scale b) Sludge c) embrittlement d) Coagulation
15. Permanent hardness of water is caused due to the presence of.
    a) Calcium carbonate b) Calcium chloride c) Magnesium bicarbonate d) None
16. Tannin, Lignin are used for
    a) Phosphate conditioning b) Carbonate conditioning
    c) Colloidal conditioning d) Calgon conditioning
17. Caustic embrittlement is caused due to presence of
    a) NaCl b) NaOH c) $MgCO_3$ d) KNO_3
18. Hard water after passing through cation exchanger is
    a) alkaline b) acidic c) neutral d) slightly alkaline
19. Hard water + buffer (pH 10) + indicator (EBT) develops_____colour
    a) orange b) blue c) pink d) wine-red
20. Which of the following water sample has maximum hardness containing?
    a) 10 mg/L $CaSO_4$ b) 10 mg/L $MgCl_2$ c) 10 mg/L $MgSO_4$ d) 10 mg/L $CaCl_2$

UNIT – III

1. _____electrode is the one which produces stable and reproducible potential.
2. In Daniel cell_____is used as an anode, _____is used as a cathode.
3. Tinning is _____coating.
4. Lead acid battery is a _____type of battery.
5. _____batteries cannot be recharged and reused.
6. In lead acid battery, _____is used a cathode.
7. The emf of the cell Zn/Zn^{+2} (1 M) // Cu^{+2}/Cu is _____volts.
8. Oxidation corrosion in absence of moisture is _____corrosion.
9. Galvanizing is a process of coating _____on iron.
10. _____coating is a most preferable than the cathodic coating.
11. Which of the following cell converts chemical energy into electrical energy.
    a) Galvanic cell b) Daniel cell c) Dry cell d) all
12. In the anodic chamber which reaction takes place.
    a) Oxidation b) Reduction c) Addition d) Substitution
13. In the cathodic chamber which reaction takes place.
    a) Oxidation b) Reduction c) Addition d) Substitution
14. Origin of electrode potential is explained in __.
    a) Nernst theory b) Helmholtz double layer theory

c) Galvanic theory d) Electrochemical theory

15. In two half cells, the one which is having high negative value acts as ___.
    a) anode b) Cathode c) Dry cell d) None
16. Rusting of iron is an example for _____.
    a) Dry corrosion b) electrochemical corrosion c) acid corrosion d) None
17. Coating used for the iron container used for food package coated with _____.
    a) Zn b) Sn c) Pb d) Al
18. The potentials of the two electrodes used in a cell are 0.24 V and 0.6 V. The emf of the cell formed by the two electrodes are
    a) 0.36 V b) -0.36 V c) 0.84 V d) -0.84 V
19. One of the common sacrificial anodic metal is
    a) Zinc b) Magnesium c) Copper d) Titanium
20. During discharging operation in lead-acid cell, the concentration of H_2SO_4__
    a) decreases b) not affected c) increased d) H_2SO_4 is not used

UNIT - IV

1. A molecule that can't be superimposed on its mirror image is called _____
2. The _____confirmation of n-butane is its most stable confirmation.
3. _____states that in dehydrohalogenation, the more stable alkene, faster is formed.
4. A compound is said to be _____, when it rotates the plan polarised light.
5. Polar protic solvents favour _____reaction mechanism.
6. HBr addition to propene in presence of peroxides gives _____as a major product.
7. In SN^2 mechanism, the stereochemistry of the compound _____.
8. Write the structure of aspirin_____.
9. Write the structure of paracetamol _____.
10. Electrophilic reagents are _____charged and electron _____compounds.
11. The number of stereo isomers present in tartaric acid
    a) 1 b) 2 c) 3 d) 4
12. The correct reactivity order of A) 1^0 alkyl halide, B) 2^0 alkyl halide C) 3^0 alkyl halide toward SN^1 reaction
    a) A>B>C b) B>C>A c) C>A>B d) C>B>A
13. The number of optically active isomers in glucose
    a) 4 b) 8 c) 16 d) 2
14. The correct reactivity order of A) 1^0 alkyl halide, B) 2^0 alkyl halide C) 3^0 alkyl halide towards SN^2 reaction
    a) A >B >C b) B > C >A c) C > A >B d) C > B >A
15. The major product in the addition of HBr to propene in presence of benzoyl peroxide
    a) 1-bromopropane b) 2- bromopropane c) 1,2 ibromopropane d) n-propane
16. The major product in the addition of HBr to propene
    b) 1-bromopropane b) 2- bromopropane c) 1,2 ibromopropane d) n-propane
17. Which among the following will show highest reactivity in nucleophilic substitution reaction
    a) CH_3F b) CH_3Br c) CH_3Cl d) CH_3I
18. SN^1 mechanism for the hydrolysis of an alkyl halide involves the formation of intermediate

a) carbocation b) carbanion c) free radical d) carbene

19. Which of the following is an electrophile
    a) NH_3 b) H_2O c) SO_3 d) ROH
20. Which of the following will undergo homolytic fission.
    a) Br_2 b) HBr c) H_2O d) HCl

UNIT - V

1. Number of vibrational degrees of freedom in HCN _____
2. A molecule can absorb IR radiation only when its absorption cause a change in _____.
3. A set of protons with same chemical environment are called as _____ protons.
4. The finger print region is between _____ and _____.
5. The splitting of NMR signal lines in the spectrum into two or more components is called _____.
6. _____ is used as reference standard for measurement of chemical shifts in NMR spectroscopy.
7. In UV-Visible spectroscopy, shift of absorption maxima (λ_{max}) to shorter wavelength is called _____
8. The functional group responsible for absorption in UV-visible region is called _____
9. In NMR spectroscopy, the radiation used for nuclear excitation is called _____
10. In IR spectroscopy, no. of fundamental modes of vibrations for H_2O is _____.
11. Which of the following compounds have most deshielded protons
    a) CH_3I b) CH_3Br c) CH_3Cl d) CH_4
12. How many signals would the following molecule show in its ^1H NMR spectrum? of benzene
    a) 5 b)1 c) 6 d) 8
13. In NMR spectroscopy, the radiation used for nuclear excitation is
    a) microwaves b) IR c) Radio wave d) UV
14. A quartet has intensity ratio
    a) 1:3:2:1 b)1:2:3:1 c)1:3:3:1 d)1:1:2:3
15. Increasing order of wavelength is
    a) x-ray, UV, IR, microwave b) microwave, x-ray, UV, IR, c) x-ray,IR, microwave, UV d) UV, IR, microwave, x-ray
16. Number of vibrational degrees of freedom for CO2 is
    a) 2 b)3 c)4 d)1
17. The value of TMS protons in δ scale is
    a) 10 b)0 c)not predictable d)-10
18. Radiation source for UV-Visible spectrophotometer is
    a) Tungsten filament lamp b) Nernst glower
    c) xenon discharge tube d) Heated nichrome wire
19. When there are n-protons adjacent to a given proton, the multiplying of its NMR peak is given by
    a) 2n+1 b)n+1 c) 2n-1 d) n2
20. Which of the following molecules will not give rotational spectra?
    a) CO b) HCl c) HBr d) N_2

XII. GATE QUESTIONS: NA

XIII. WEBSITES:

1. http://nptel.ac.in/courses/104103019/40
2. http://nptel.ac.in/courses/104105039/
3. http://pubs.acs.org/doi/abs/10.1021/ed059p724
4. ocw.mit.edu › Courses
5. online.stanford.edu/course/introduction-chemical-engineering-self-study-resource
6. Engineering chemistry (NPTEL web-book), by B.L. Tembe, Kamaluddin and M.S. Krishnan.

XIV. EXPERT DETAILS:

1. Dr Y. Bharathi Kumari, Retd Professor, Department of Chemistry, JNTU, Hyderabad
2. Dr. B. Rama Devi, Department of Chemistry, JNTU, Hyderabad

XV. JOURNALS: Journal of Industrial and Engineering Chemistry: Elsevier

XVI. LIST OF TOPICS FOR STUDENT SEMINARS:

1. Batteries
2. Waste water Treatment methods
3. stereochemistry
4. Crystal Field theory
5. NMR applications in medical field

XVII. CASE STUDIES / SMALL PROJECTS:

1. Estimation of Hardness of water
2. Preparation of Drugs
3. Optical activity measurements of some R and S drugs
4. NMR spectra interpretation of some compounds
5. Applications of MRI in diagnosis of diseases