**Techno India NJR Institute of Technology**



**Course File**

**Session 2021-22**

**Engineering Chemistry(1FY2-03/2FY2-03)**

Yasmin

( Professor)

**Department of Basic Science**

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**Course Overview:**

Student will learn fundamentals of chemistry and how it forms the basis of all engineering and science from this 43-hour course. In this course, student will study the fundamental concepts and application of different chemical phenomenon and their theory.

**Course Outcomes:**

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| **CO. NO.** | **Cognitive Level** | **Course Outcome** |
| 1 | Knowledge | Differentiation between hard and soft water, solve the related numerical problems on water treatment; and its application in industries and daily life |
| 2 | Analysis | Comprehension of various types of fuel, instrumental techniques for analysis and solve the numerical problems related to it |
| 3 | Application | Identification of corrosion and application of its knowledge to protect the metal |
| 4 | Knowledge | Developing basic knowledge of Inorganic Engineering materials viz. cement, glass, lubricants . |
| 5 | Synthesis | Basic knowledge of organic reaction mechanism and introduction of drugs |

**Prerequisites:**

* Aware with the concepts of atomic structure
* Understanding of basic high-school chemistry
* Basic mathematics

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| **Engineering Chemistry Year of study: 2020-21** | | | | | | | | | | | | | | | |
| **Course Outcome** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO11FY203.1** | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 1 | 2 | 0 | 0 | 0 |
| **CO11FY203.2** | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 2 | 2 | 0 | 0 | 0 |
| **CO11FY203.3** | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 3 | 1 | 2 | 0 | 0 | 0 |
| **CO11FY203.4** | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 3 | 1 | 2 | 0 | 0 | 0 |
| **CO11FY203.5** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **C11FY203 (AVG)** | 0.20 | 0.80 | 0.00 | 0.00 | 0.00 | 0.40 | 0.00 | 0.00 | 0.80 | 2.40 | 1.00 | 1.60 | 0.00 | 0.00 | 0.00 |

**Course Coverage Module Wise:**

**Lecture plan based on Unit 1**

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| Lecture Sl. No. | Topic |
| 1 | **Water:** Common impurities, hardness, |
| 2 | determination of hardness by complexometric (EDTA method), Numerical problems based on Hardness, EDTA, |
| 3 | Degree of hardness, Units of hardness |
| 4 | Municipal water supply: Requisite of drinking water, Purification of water; sedimentation, filtration, |
| 5 | Disinfection, breakpoint chlorination. |
| 6 | Boiler troubles: Scale and Sludge formation, Internal treatment methods, |
| 7 | Priming and Foaming, Boiler corrosion and Caustic embrittlement |
| 8 | Water softening; Lime-Soda process, |
| 9 | Numerical problems based on Lime-Soda |
| 10 | Zeolite (Permutit) process, Demineralization process. Numerical problems based on Zeolite Process |
| 11 | Test and practice questions |

**Lecture plan based on Unit 2**

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| Lecture Sl. No. | Topic |
| 9 | Organic Fuels: Solid fuels: Coal, Classification of Coal, Proximate analyses of coal and its significance, Numerical problems based on determination of proximate analysis. |
| 10 | Ultimate analyses of coal and its significance, Numerical problems based on determination of ultimate Analysis of coal. |
| 11 | Gross and Net Calorific value, calorimeter /Junkers Numerical problems based on determination of calorific value using Dulongs formula and combustion of fuel. |
| 12 | Determination of Calorific value of coal by Bomb Calorimeter |
| 13 | Numerical problems based on determination of calorific value using bomb calorimeter. |
| 14 | Metallurgical coke, Carbonization processes; Otto-Hoffmann byproduct oven method |
| 15 | Numerical problems based on determination of combustion of solid fuel. |
| 16 | Liquid fuels : Advantages of liquid fuels, Mining, Refining and Composition of petroleum, |
| 17 | Cracking, |
| 18 | Synthetic petrol, Reforming, |
| 19 | Knocking, Octane number, Anti-knocking agents, Cetane number, Numerical problems based on determination of combustion of liquid fuel. |
| 20 | Gaseous fuels; Advantages, manufacturing, composition and Calorific value of coal gas and oil gas, Determination of calorific value of gaseous fuels by Junker‟s calorimeter |
| 21 | Test and practice questions |

**Lecture plan based on Unit 3**

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| Lecture Sl. No. | Topic |
| 22 | **Corrosion and its control:** Definition and significance of corrosion, Mechanism of chemical (dry) corrosion, |
| 23 | Mechanism of electrochemical (wet) corrosion, |
| 24 | Galvanic corrosion, concentration corrosion and pitting corrosion. |
| 25 | Protection from corrosion; protective coatings-galvanization and tinning, cathodic protection, sacrificial anode and modifications in design. |
| 26 | Test and practice questions |

**Lecture plan based on Unit 4**

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| Lecture Sl. No. | Topic |
| 27 | **Engineering Materials:** Portland Cement; Definition, Manufacturing by Rotary kiln. |
| 28 | Chemistry of setting and hardening of cement. Role of Gypsum. |
| 29 | Glass: Definition, Manufacturing by tank furnaces. significance of annealing |
| 30 | Types and properties of soft glass, hard glass, borosilicate glass, glass wool, safety glass |
| 31 | Lubricants: Classification, |
| 32 | Mechanism of Lubrication. |
| 33 | Properties; Viscosity and viscosity index, |
| 34 | flash and fire point, cloud and pour point. Emulsification and steam emulsion number. |
| 35 | Test and practice questions |

**Lecture plan based on Unit 5**

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| Lecture Sl. No. | Topic |
| 36 | **Organic reaction mechanism and introduction of drugs**: Organic reaction mechanism: Substitution; SN1, SN2, |
| 37 | Elecrophilic aromatic substitution in benzene, free radical halogenations of alkanes, |
| 38 | Elimination; elimination in alkyl halides, dehydration of alcohols, |
| 39 | Addition: electrophilic and free radical addition in alkenes, |
| 40 | nucleophilic addition in aldehyde and ketones, |
| 41 | Rearrangement; Carbocation and free radical rearrangements |
| 42 | Drugs : Introduction, Synthesis, properties and uses of Aspirin, Paracetamol |
| 43 | Test and practice questions |

**TEXT/REFERENCE BOOKS**

1. The Chemistry and Technology of Coal, by J G Speigh, CRC Press

2. The Chemistry and Technology of Petroleum, by J G Speigh, CRC Press

3. Text book of Engineering Chemistry by Suresh C. Ameta, Yasmin, Himanshu Publications.

4. Text Book of Engineering Chemistry by S.S. Dara, S.Chand Publications.

5. Lubricants and Lubrications, Theo Mang, Wilfeied, Wiley-VCH

6. Organic Reactions and Their Mechanisms by P.S. Kalsi, New Age Internationals.

**Teaching and Learning resources:**

**Unit 1**

<https://www.youtube.com/watch?v=6u9L0nVUYPY>

**Unit 2**

<https://nptel.ac.in/courses/103/105/103105110/>

**Unit 3**

<https://nptel.ac.in/courses/113/101/113101098/>

**Unit 4**

<https://www.youtube.com/watch?v=dgjZEI9PXCs>

**Unit 5**

<https://nptel.ac.in/courses/104/101/104101115/>

**Assessment Methodology:**

1. Online quiz after every module completion.
2. Practical exam in lab where they have to perform experiments. (Once in a week)
3. Assignments one from each unit.
4. Midterm subjective paper (Twice during the semester)
5. Final paper at the end of the semester subjective.

**ENGINEERING CHEMISTRY QUESTION BANK**

**Unit 1**

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| What is the principle of EDTA method? Describe the estimation of hardness of water by soap titration method. |
| A sample of water on analysis has been found to contain following in ppm:  Ca(HCO 3 ) 2 = 4.86; Mg(HCO 3 ) 2 = 5.84; CaSO 4 = 6.8; MgSO 4 =8.4.  Calculate the temporary and permanent hardness of the water. |
| Write short notes on:  (i) Break point chlorination (ii) Scale and sludge formation in boiler  (iii) Carry over (iv) Lime soda process (chemical reactions only)  (a) Describe zeolite process for the removal of hardness of water.  (b) Calculate the amount of lime and soda required per litre for the chemical treatment of water containing: Ca 2+ = 80 ppm; Mg 2+ = 36 ppm; K + =39 ppm; HCO 3 - = 244 ppm; FeSO 4 .7H 2 O added as coagulant = 69.5 ppm. |

**Unit 2**

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| What is carbonization of coal? Describe manufacture of metallurgical coke by Otto- Hoffmann’s by-product oven process.  Explain Fischer Tropsch process for synthetic petrol. |
| What is cracking ? Explain fixed bed catalytic cracking process for gasoline. |
| Write short Notes on (any two):- |
| (i) Coal gas. (ii) Reforming of gasoline. (iii) Knocking and Octane Number (iv) Refining of petroleum.  A sample of coal was found to have the following % composition by weight:  C=75%, H=5.2%, O=12.1%, N= 3.2%, S= 2.5% and ash =2.0%. Calculate:  (i) The minimum amount of O 2 and air by weight necessary for the complete combustion of 1  kg of coal.  (ii) Percentage composition of dry product by Weight if 30% excess air is supplied. |

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| **Unit 3**  Define corrosion of metals. Explain the electrochemical theory of wet corrosion. |
| What is corrosion? Describe the mechanism of dry chemical corrosion.  Give reasons of the following:  (a) Impure metal corrodes faster than the pure metal under identical conditions.  (b) Corrosion of water filled steel tanks occurs below the water line.  (c ) Rusting of iron is quicker in saline water than in ordinary water.  (d) Silver and copper do not undergo much corrosion like iron in moist atmosphere.  Explain impressed current cathodic protection. |

**Unit 4**

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| What is glass? Describe the manufacturing process of glass by pot furnace method. |
| Describe with neat diagram how Portland cement is manufactured by rotary kiln method |

What is setting and hardening of cement? Explain with chemical reactions.

What is lubricants? Explain boundary film and extreme pressure lubrication

mechanisms of lubricant.

**Unit 5**

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| What is an addition reaction? Explain its reaction mechanism with an example.  What is an elimination reaction? Explain its reaction mechanism with an example.  How do bulky groups affect SN1 reaction?   1. Comment on the stability of carbocations. 2. Comment on elimination versus substitution.   What are different intermediate organic species? Discuss in detail their stabilities.  Why are haloalkane more reactive than haloarenes? |
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