**Course Name : 03 Years Diploma in Mining Engineering**

**Year : First**

**Subject Title : Engineering Chemistry**

**Subject Code : M104/M108**

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|
| L | T | P | Full Marks. | External Exam Marks | Internal Exam Marks | External Pas Marks | Total Pass Marks | Duration of External Exams |
| 02 | | | 100 | 80 | 20 | 26 | 40 | 3 Hrs |
| Practical | | 2 | 50 | 40 | 10 | 13 | 20 | 4 Hrs |

**NOTE:**

**Internal marks will be allotted on the basis of two snap tests and 2 assignment of equal marks to be conducted by the faculty teaching the subject.**

**Subject Objective :**

This subject is classified under the category of Basic science. It is intends to teach students the chemical properties of materials, selection of materials, and applications in various engineering field. This will provide the input for better understanding of other core technology and Technology subjects.

## Contents: Theory

| Chapter | Name of the Topic | Marks | Hours |
|---|---|---|---|
| **1.** | **ATOMIC STRUCTURE**<br>1.1) Introduction of Atom<br>1.2) Fundamental Practicles of Atom-protons, neutrons, electrons,<br>1.3) Their mass, charge location<br>1.4) Definition of Atomic number, atomic mass, simple numerical problems based on atomic number and atomic mass number, Isotopes and Isobars definition, distinction and suitable examples<br>1.5) Bohr's theory of hydrogen atom.<br>1.6) Modern atomic structure<br>1.7) Orbits and orbitals, sub energy levels.<br>1.8) Pauli's exclusion principle<br>1.9) Hunds rule<br>1.10) Filling of electron in Sub-shells by Aufbau Principle (Z=1 -30).<br>1.11) Concept of variable valency with examples of ous' & 'ic' compounds<br>1.12) Nuclear stability<br>1.13) Mass defect and binding energy –numerical problems. | **05** | **04** |
| **2.** | Electronic Theory of Valency<br>Duplet and Octet rule.<br>2.2) Valance electrons and Valency of the Element.<br>2.3) Electro positive electro negative and inert nature of elements.<br>2.4) Electro valency and co-valency.<br>2.6) Formation of electro valent and covalent compounds. | **05** | **04** |

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| **3.** | Electro Chemistry<br>3.1) Arrhenius theories of Ionization. Degree of Ionization, Strong and Weak electrolytes.<br>3.2) Electrochemical series and their applications.<br>3.3) Electrolysis of $CuSO_4$ solution using platinum electrodes, and copper electrodes.<br>3.4) Applications of electrolysis, such as electroplating & electro refining.<br>3.5) Faraday's laws of electrolysis and numerical problems based on these laws.<br>3.6) Conductivity of an electrolyte.<br>3.7) Solubility product and common ion effect<br>3.8) Specific conductivity | **08** | **06** |
| **4.** | **Water**<br>4.1) Sources & their physical and Chemical Characteristic of water.<br>4.2) Purification of drinking water, Sedimentation , Coagulation , Filtration, Sterilization, (chlorination , Ozonization, ultra – violet rays, Boiling & Aeration)<br>4.3) Hard and soft water and causes of hardness.<br>4.4) Types of hardness, degree of hardness in ppm of $CaCO_3$ Equivalent.<br>4.5) Effect of hard water in Domestic and Industrial application. Effect of hard water n steam generation, boiler scales and sludge formation.<br>4.6) Removal of hardness of water by<br>a) Lime – soda process,<br>b) Permutite process<br>c) Ion exchange method.<br>d) PH & POH value of water and its application in domestic & industrial purposes. | **08** | **06** |
| **5.** | **Material**<br>5.1) Occurrence of metals, definition of metallurgy, ore and mineral.<br>5.2) Processing of ore –stages of extraction of metal from it's ore.<br>5.3) Extraction of Iron in the form of Pig iron in blast furnace. Reactions in the blast Furnace.<br>5.4) Types of carbon steel, based on the percentage of carbon. Heat treatment to steel such as hardening, tempering, annealing & normalizing.<br>5.5) Physical properties and applications of some commonly used metals such as – Fe, Cu, Al, Cr, Ni, Sn, Pb, Zn, Co, Ag, W.<br>5.6) Chemical properties of metals and their compounds. | **08** | **06** |
| **6.** | Alloys<br>Definition of Alloys, types and purpose.<br>6.2)Preparation of binary alloy by fusion method and compression method.<br>6.4)A. Alloy, steel and their Applications:- effect of addition of C, Mn, V,W, Ni, Cr, Co, and Si. On steel<br>6.5) Ferrous & Non – ferrous alloys. | **05** | **04** |
| **7.** | **Corrosion**<br>7.1) Definition of corrosion.<br>7.2) Types of corrosion.<br>7.3) Atmospheric corrosion.<br>7.4) Mechanism of atmospheric corrosion.<br>7.5) Types of oxide films.<br>7.6) Factors affecting rate of atmospheric corrosion. | **05** | **04** |

| | | | |
|---|---|---|---|
| | 7.7) Electro – chemical corrosion.<br>7.8) Mechanism of electro-chemical corrosion.<br>7.9) Galvanic cell corrosion, concentration cell, Oxidation Concentration cell, Corrosion.<br>7.10) Factors affecting rate of electro – chemical corrosion.<br>7.11) Protection of metals from corrosion.<br>7.12) Processes of protection, cathodic protection, organic coating, Inorganic coating, and metallic coating.<br>Metallic coating – hot, Dipping – Galvanizing, Tinning, cementation, Sherardizing, metal- cladding, spraying. | | |
| **8.** | **Paints & Varnishes**<br>8.1) Principle constituents of paint, such as pigments, Vehicle, thinner. Drier, Extender, Plasticizer.<br>8.2) Methods of application of paint such as brushing, spraying, dipping, roller, coating.<br>8.3) Failure of paint film<br>8.4) Characteristics of good varnishes<br>Introduction of Enamels | **05** | **04** |
| **9.** | **Lubricants**<br>Function of lubricants & types of lubricants, solid, Semisolid, and liquid.<br>9.2) Characteristics and properties of lubricant.<br>9.3) Selection of lubricant for machines working under different conditions. | **04** | **03** |
| **10.** | **Fuels**<br>Fuel, their types & characteristics.<br>10.2) Carbon, its bond formation, and types of hydrocarbon. Coalification, Analysis of coal. Proximate analysis and its importance<br>10.3) Liquid fuel – crude petroleum and its refining by fractional distillation. Alcohol and power alcohol, Important products of petroleum and their applications.<br>10.4) Gaseous fuel – Introduction of bio- gas. and petro- chemical gas (LPG), water gas and producer gas. | **09** | **06** |
| **11.** | **Non-Matallic Materials**<br>Plastics: Formation of plastics (polymer) by addition such as polythene, polystyrene, PVC and Teflon and condensation such as Nylon & Bakelite.<br>11.2) Types of plastics. Thermosoftening and Thermosetting. Compounding of plastics by fillers, plasticizers, accelerators, pigments. Properties of plastics and their engineering applications.<br>11.3) Rubber :<br>a. Types of rubber. Natural & Synthetic rubber<br>b. Limitations of natural rubber.<br>c. Vulcanization of rubber.<br>d. Properties and engineering applications of synthetic rubber.<br>11.4) Insulating Materials: Characteristics of good insulating materials.<br>11.5) Glass, types and applications of glass – wool thermo Cole, asbestos.<br>11.6) Cement , their chemical composition and properties. | **10** | **08** |
| **12.** | Pollution & its control<br>12.1Pollution, types, its causes, impact and preventions.<br>12.2) Air pollution, water pollution and land pollutions.<br>**12.3)**Environmental Impact and their assessment. | **08** | **05** |
| | Total | **80** | **60** |

List of Experiments:

**EXPERIMENT NO.1**

Determination of neutralization point of a weak acid and weak base using conductivity meter.

**EXPERIMENT NO. 2**

To determine the electrochemical equivalent of copper, by electrolysis of $CuSO_4$ solution, using Copper plates as an electrodes.

**EXPERIMENT NO.3**

Purification of NaCl by dissolving impure NaCl in water and then recrystalization

**EXPERIMENT NO.4**

Precipitation titration of $BaCl_2$ with $H_2SO_4$ using conductivity meter

**EXPERIMENT NO. 5**

Determination of Chloride content in given sample of water.

**EXPERIMENT NO.6**

Determination of alkalinity
of given sample water i.e. volumetric determination of $OH^-$, $CO_3^{-2}$, $HCO_3^-$

**EXPERIMENT NO.7**

Determination of degree of hardness, in terms of ppm of $CaCO_3$, of given sample of water, by EDTA method.

**EXPERIMENT NO.8**

Determination of pH value by Digital pH meter

**EXPERIMENT NO.9**

Qualitative analysis of seven solutions containing one acidic and one basic radical from following radicals.
[$Pb^{++}$,$Cu^{++}$, $AI^{+++}$, $Fe^{+++}$, $Cr^{+++}$, $Zn^{++}$, $Ni^{++}$, $Mn^{++}$, $Ca^{++}$,$Ba^{++}$,$Mg^{++}$
$NH_4^+$, $Na^+$, $K^+$, $CI^-$,$Br^-$,$I^-$,
$(SO_4)^{--}$,$(NO_3)^-$, $(CO_3)^{--}$

**EXPERIMENT NO. 10**

Determination of percentage of Iron in given ferrous alloy by
( $KMnO_4$ )
(Redox titration method)

**EXPERIMENT NO.11**

To determine the viscosity of oil lubricant.

**EXPERIMENT NO. 12**

To determine the acid value of oil lubricant by neutralizing with standard KOH Solution

**EXPERIMENT NO. 13**

Estimation of ash content in coal.

**EXPERIMENT NO . 14**

Estimation of moisture content in coal.

**EXPERIMENT NO.15**

Laboratory preparation of Bakelite by Phenol and Formaldehyde.

EXPERIMENT NO. 16

To determine CO and $CO_2$ content in emission from petrol vehicle by using Auto exhaust analyzer.

**REFERENCES :**

| Author | Title | Year Of Publication & Publisher | Place Of Publication |
|---|---|---|---|
| M. N. Uppal | A Text - book of engineering Chemistry | | |
| V. P. Mehta | A Text - book of polytechnic Chemistry | | |
| Banswal, Mahajan and Mehta | A Text - book of Applied Chemistry | | |
| Jain & Jain | Engineering Chemistry | Dhanpat Rai and Sons | |