SYLLABUS

1.4 APPLIED CHEMISTRY

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RATIONALE

The use of various chemical and chemical products in diverse technical and engineering field have repeatedly proved the importance of applied chemistry, which enhances its role to a new peak. On the other hand, ever increasing use of such materials will compel engineers, technocrats to acquire essential applied chemistry knowledge in order to select engineering material, which not only suit them but also provide more environmental compatibility. This situation demands principles of applied chemistry in diploma-engineering courses. Principles of Applied Chemistry will enable budding engineers and technocrats to develop scientific temper and appreciate physical, chemical and engineering properties of materials. Hence the subject of applied chemistry.

LEARNING OUTCOMES

After undergoing this subject, the students will able to:

- Classify matter based on state of aggregation.
- Calculate percentage composition of chemical compounds.
- Substantiate the laws and principles on which structure of atom is established.
- Prepared solution of required concentration.
- Understand pH and Prepare buffer solution and understand their significance in industrial processes such as electrolysis, electrochemical machining of materials etc.
- Explain various characteristics of water.
- Explain cause and facture factors which adversely affecting natural water quality and remedial measure available for water purification to achieve water quality standards required for domestic, agriculture and industrial applications .
- Explain chemistry and technology of industrial metal extraction processes.
- Explain chemistry of fuel and relative advantages.
- Select most efficient fuel for engine and engineering applications.
- Explain mechanism of lubrication and their advantages.
- Explain the chemistry of various polymers and plastics.
- Verify suitability and select polymer/ plastic material for engineering applications.

Detail Content

1. Some Basic Concepts in Chemistry (8 Hrs)
   - 1.1 General introduction: Importance and scope of chemistry.
   - 1.2 Classification of matter:
     - a) Physical classification: Solid, Liquid and Gases (only definition with examples).
     - b) Chemical Classification: elements, compounds and mixture (Definition and examples Types of mixture excluded).
   - 1.3 Definition of atom, molecule, symbol and significance of symbol.
   - 1.4 Molecular Formula, Writing the formula of compounds containing CI^-, OH^-, HCO_3^-, SO_4^{2-},CO_3^{2-} and NH_4^+, Na^+, K^+, Ca^{2+}, Mg^{2+}, Fe^{2+}, Zn^{2+}, Fe^{3+}, Al^{3+} ions
   - 1.5 Calculation of molecular mass (Atomic mass of constituents should be provided), Calculation of mass percentage composition of elements in compound (Atomic masses of elements should be provided)

2. Structure of Atom (8 Hrs)
   - 2.1 Fundamental particles of atom: electron, proton and neutron, charge and mass of electron, proton and neutron.
   - 2.2 Bohr's model of atom (postulates only) i,e concept of orbit or shell.
   - 2.3 Atomic number (Z), mass number (A), calculation of protons, electrons and neutrons in $^{A}_{z}X$.
   - 2.4 Isotopes, isobars and isotones (definition with examples).
   - 2.5 Concept of orbital (wave nature of electron), difference between orbit and orbital.
   - 2.6 Principles of filling electrons in various orbital: a) Aufbau principle b) Hund's Rule of maximum multiplicity c) Pauli's exclusion principle.
   - 2.7 Electronic configuration of atoms (upto Z=30)

3. Chemical Bonding (5 Hrs)
   - 3.1 Valence electrons, Lewis symbol.
   - 3.2 Octet rule (Limitation excluded).
   - 3.3 Chemical bond (definition) and its type.
   - 3.4 Electrovalent or Ionic Bond with example of NaCI,
   - 3.5 Covalent Bonding in H_2, O_2

4. Solution (8 Hrs)
   - 4.1 Definition of solution, Binary solution, aqueous solution.
   - 4.2 Definition of solute, solvent.
   - 4.3 Definition of acid and base and salt.
   - 4.4 Definition of acidity and basicity.

4.5 Concentration of solution

4.6 Modes of expressing concentration of solution

a) Strength

b) Molarity (M)

c) Normality (N) and d) simple numerical problems based on (a) and (b)

4.7 Definition of pH and industrial application of pH. (Numericals excluded)

5. Electrochemistry. (8 Hrs)

5.1 Electronic concept of oxidation, reduction

5.1 Definition of terms electrolyte, non electrolyte with example

5.2 Types of electrolytes: strong and weak with examples

5.3 Definition of electrolysis.

5.4 Faradays laws of electrolysis

5.5 Industrial applications of electrolysis: Electroplating, electrolytic refining, electrometallurgy.

6 General Principles of extraction of metals (8 Hrs)

6.1 Metals and Non-metals (definition)

6.1 Definition of Mineral, Chief ores of iron, aluminum and copper.

6.2 Definition of metallurgy, types of metallurgy

6.4 General Steps of metallurgy

a) Crushing

b) Pulverization of ore

c) Concentration or purification of ore:

i) Gravity separation method ii) froth flotation method.

d) Oxidation of ore:

i) Roasting ii) Calcination

e) Reduction:

i) Smelting (Pyrometallurgy) and ii) Electrolytic reduction

f) Refining of Metal:

i) Electrolytic refining

6.3 Definition of alloy, types of alloys and purpose of alloying.

7 Fuel (8Hrs)

7.1 Definition of fuel, classification of fuel a) on the basis of physical state b) on the basis of source.

7.1 Definition of calorific value

7.2 Characteristics of good fuel, advantages of gaseous fuel over solid fuels.

7.3 Coal- Proximate analysis of coal and its importance.

7.4 Fuel quality rating- octane number and cetane number (definition only)

7.5 Gaseous fuel: Composition, calorific value and application of CNG, LPG and biogas.

8 Water (8 Hrs)

8.1 Type of water: Soft and hard water.

8.2 Types of hardness of water

8.3 Units of hardness of water: ppm, mg/L (with simple numericals).

8.4 Disadvantages of using hard water in boiler. a) Scale and sludge formation b) Boiler Corrosion c) Caustic embrittlement

8.5 Qualities of drinking (potable) water

9 Lubricants (5Hrs)

9.1 lubricant and lubrication.

9.2 Functions of lubricants.

9.3 Classification of lubricants: solid, semisolid and liquid lubricants with examples.

9.4 Type of lubrications – hydrodynamic and boundary lubrication with illustrative diagrams.

9.5 Properties of lubricants

a) Physical properties- viscosity, viscosity index, cloud point, pour point, flash point, fire point, oiliness

b) Chemical properties- TAN or TAV (Total acid number), emulsification, aniline point and iodine value.

10 Polymer and Plastic (5 Hrs)

10.1 Definition of polymer, Monomer, Degree of Polymerization

10.2 Monomer and uses of PE, PVC, PS, Teflon, Nylon-66, Bakelite

10.3 Brief introduction to addition and condensation polymers with suitable examples (PE, PVC, PS, Teflon, Nylon-66, Bakelite).

10.4 Definition of plastics, thermoplastic and thermosetting polymer with example, difference between thermoplastic and thermosetting polymers.

10.5 Uses of polymer and plastic in daily life and in industries.

LIST OF PRACTICALS:

1. Volumetric analysis and apparatus used their in.
2. To prepare standard solution of oxalic acid (N/20).

3. To determine the strength of given sodium hydroxide solution by titrating against standard oxalic acid (N/10) solution using phenolphthalein as indicator.
4. Gravimetric analysis and apparatus used their in.
5. To determine the percentage of moisture in given sample of coal.
6. To determine the percentage of ash in given sample of coal.
7. To determine the percentage of volatile and non volatile substance in given mixture.
8. To determine the viscosity of lubricant by using Redwood viscometer.
9. To determine total acid number (TAN) or Total acid value of given lubricant (liquid).
10. Detection of iron metal in the given solution of rust.

INSTRUCTIONAL STRATEGY

Teachers may take help of various models and charts while imparting instructions to make the concept clear. Awareness of the contents should be done through examples using you-tubes and subsequent discussions. More emphasis should be laid on discussing and explaining practical applications of various chemical process and reactions. In addition, students should be encouraged or motivated to study those processes in more details, which may find practical application in their future professional career.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, exercises and viva-voce

RECOMMENDED BOOKS

1. Chemistry in Engineering by J.C. Kuricose& J. Rajaram, Tata McGraw Hill, Publishing Company Limited, New Delhi.
2. Engineering Chemistry by P.C. Jain & Monika Jain, DhanapatRai Publishing Company, New Delhi.
3. Eagle's Applied Chemistry - I by S. C. Ahuja & G. H. Hugar, Eagle Prakashan, Jalandhar.
4. Engineering Chemistry – A Text Book by H. K. Chopra & A. Parmar, Narosa Publishing House, New Delhi.
5. Engineering Chemistry by Dr.Himanshu Pandey, Goel Publishing House, Meerut, India.
6. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

Distribution of Syllabus For Assessments & Distribution Of Marks

Section	Assessment	Units to be covered		Distribution of marks
A	1st Internal	1.	Some basic concepts in chemistry	08
		2.	Structure of atom	12
B	2nd INTERNAL	3.	Chemical bonding	08
		4.	General principals of extraction of metal	12
C	Final	5.	Solution	11
		6.	Electrochemistry	10
		7.	Fuel	10
		8.	Water	12
		9.	Lubricants	10
		10.	Polymers and plastics	07