

GOVERNMENT POLYTECHNIC, PUNE
(An Autonomous Institute of Govt. of Maharashtra)

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|-----------------------|---|---|
| Programme | : | Diploma in ET/CE/EE /ME/MT/CM/IT/DDGM |
| Programme Code | : | 01/02/ 03 /04/05/06/07/08/17/21/22/ 23 /24/26 |
| Course | : | Engineering Chemistry |
| Course Code | : | SC184 |

Teaching Scheme:

| | Hours /Week | Total Hours |
|-----------------------------|--------------------|--------------------|
| Theory | 03 | 48 |
| Term Work /Practical | 02 | 32 |

Evaluation:

| | Progressive Assessment | Semester End Examination | | | |
|-----------------|---|---------------------------------|------------------|-------------|------------------|
| | | Theory | Practical | Oral | Term work |
| Duration | Two class tests of 60 minutes duration | 03 Hrs | 02 Hrs | -- | -- |
| Marks | 20 | 80 | 50 | -- | -- |

Course Aim:

Applications of Material Science and Chemical Principles have resulted into the Development of new materials used in modern medicines and automobiles, synthetic fibers polymers, alloys, new energy sources and many other important products and processes.

Hence, Material Science is an important and expanding branch in scientific engineering and economic field of our society. Thus the principles of Material Science have a wide application in all the branches of engineering and technologies. In this syllabus, the coverage of various topics will orient the students to appreciate the principles Material Science in the fields of engineering and Technology.

The topic atomic structure includes the basic structure of matter, which governs the Mechanical, Electrical and Magnetic properties of the matter. Steels, alloys, plastic and Elastomers are included considering their present extensive use in automobiles, chemicals and heavy engineering industries. The contents of this curriculum which provide knowledge of cells and batteries, selection of appropriate materials for engineering applications and methods of protection by metallic and non-metallic coatings. This satisfies the need of the students to cope with the recent use of these materials and processes in their world of work.

Corrosion and methods of prevention will make students realize importance of care and maintenance of machines and equipments. Study of different polymers, insulators, adhesives and their chemical behavior will be useful in their applications in electrical appliances and electronics industries. Study of impurities and hardness in water and methods for water softening will help the students to make proper use of water. The knowledge of environmental pollution and its awareness is helpful to change

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the attitude towards society and development by caring approach.

Nanomaterials are widely used in engineering field. It will help to understand the need of material in different engineering fields.

Course objectives:

The student will be able to

- Develop interest in the fundamental structure of matter, which governs the properties of matter.
- Understand applications of basic concepts in chemistry
- Understand various Chemical Technological processes
- Apply principles and concepts of chemistry, to Engineering situations.
- Identify and formulate the changes and Analyze the chemical changes and effects
- Appreciate effect of chemical changes.
- Aware and Care about the environment

Course Content

| Chapter No. | Name of the Topic | Hours | Marks |
|-------------|--|-------|-------|
| 1 | ATOMIC STRUCTURE AND CHEMICAL BONDING 1.1 Atomic Structure : Definition of atom, structure of modern atom, Characteristics of fundamental particles of an atom, definition of atomic number, atomic mass number and their difference, Orbits: Bohr's energy levels, sub-energy levels, s, p, d, f orbital, shapes and description of s and p orbital. Definition and significance of quantum numbers:, Aufbau's principle, Hund's rule, orbital electronic configurations (s, p, d, f) of elements having atomic number 1 to 30, 1.2 Chemical Bonding : • Definitions of valence electrons, valency. • Definition of electrovalency, positive and negative electrovalency, formation of Electrovalent compounds- $NaCl, AlCl_3$ Definition of covalency, single, double and triple covalent bonds, formation of Covalent compounds H_2O, CO_2, N_2 | 04 | 08 |

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| 2 | <p>Electrochemistry</p> <p>2.1 Introduction Definition of an electrolyte, electrolysis, ionization, Assumptions of Arrhenius theory of electrolytic dissociation degree of ionization, factors affecting degree of ionization, Difference between atom and ion, Activity series, Mechanism of electrolysis of $i)CuSO_4$ solution by using platinum, Cu rods.</p> <p>2.2 Faraday's law of electrolysis. Statements, explanation Numerical examples based on Faraday's laws of electrolysis.</p> <p>2.3 Cell and cell reactions Concept of electrode potential, standard electrode potential (E^0), significance of oxidation-reduction potential, type of electrodes, reference electrode and indicator electrode. Construction and working of hydrogen electrode and calomel electrode. EMF series and its application, constructions and working reactions of lead acid cell, Daniel cell with porous vessel and salt bridge. Applications of Electrolysis Electroplating and Electrorefining</p> | 08 | 12 |
| 3 | <p>METAL AND ALLOYS</p> <p>3.1 Metal Occurrence of metals, definitions of mineral, ore, flux, matrix, slag and metallurgy, mechanical properties of metal, flow chart showing different processes in metallurgy, classification, properties and application of carbon steel, heat treatment (definition, purposes and methods)</p> <p>3.2 Alloys Definition of alloy, purposes of making alloys with examples, classification of alloys (ferrous and non-ferrous), effects of alloying elements on the properties of steel (Ni, Co, Si, Mn, V, W) composition, properties and uses of heat resisting steel, magnetic steel, shock resistance steel, stainless steel, high speed steel, spring steel, tool steel, duralumin, woods metal, brass and monel metal.</p> | 06 | 08 |
| 4 | <p>4.1 PLASTIC AND RUBBER (POLYMER AND ELASTOMER) Definition of monomer and polymer, types of polymer (Addition, and Condensation) Definition example- (formation of Polythene, PVC, Teflon, Bakelite) Thermo softening and thermosetting (definition and comparison), applications of Plastic based on its properties. Definition and applications of Conductive polymer, Definition of elastomer, isoprene unit. Natural rubber-drawbacks, vulcanization, properties of rubber and applications based on its properties. Difference between synthetic and natural rubber.</p> <p>4.2 Engg. Materials - Definition Properties and Applications of- 1) Cement and lime 2) Ceramics and composites 3) Glass and Insulating materials 4) Paint and adhesives.</p> | 05 | 10 |

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| 5 | WATER Definition of hard water and soft water, causes of hardness, types of hardness, analysis of degree of hardness in calcium carbonate equivalent(numerical), bad effect of hard water in industries (paper, textile, dye, sugar), removal of hardness by lime soda method, zeolite, ion exchange method, reverse osmosis, PH scale, applications of PH in engineering. Numerical based on PH and hardness. | 05 | 08 |
| 6 | CORROSION Definition, causes of corrosion types of corrosion-definition (atmospheric and electro chemical) Types of oxide films , mechanism of atmospheric and electrochemical corrosion (evolution of hydrogen, absorption of oxygen), factors affecting rate of atmospheric corrosion and electrochemical corrosion. Protection Methods- Galvanization and tinning processes, sherardizing, metal spraying , metal cladding. | 05 | 08 |
| 7 | LUBRICANT Definition and functions of lubricant, mechanism of lubrication(fluid film, boundary, extreme pressure lubrication), classification of lubricant, properties of lubricating oils(physical and chemical), selection of lubricant for light machines, I.C.E., gears, cutting tools, high pressure and low speed machines, transformers, spindles in textile industry, for refrigeration system. | 04 | 08 |
| 8. | FUELS Definition, classification of fuels, characteristics of good fuel, comparison between solid, liquid and gaseous fuel, types of coal, analysis of coal by proximate and ultimate analysis, refining of crude petroleum, fractions obtained by distillation of crude oil, gasoline, kerosene, diesel as a fuel(properties and uses) | 04 | 08 |
| 9. | MATERIAL SCIENCE AND ENGINEERING Definition of material science, terminology and scales, properties of materials, (mechanical, electrical, magnetic, optical, thermal with example) structure depended properties (example of hardness versus structure of steel.)Types of materials- metals, semiconductor, polymer ceramic and composites (examples and properties and applications).Engineering nanomaterial and its applications. | 04 | 04 |
| 10 | ENVORNMENTAL EFFECT (Awareness Level) Definition, types of pollution, air, water, soil, sound, nuclear pollution. (Causes, effect, control method), E-waste (origin effect control) deforestation, ozone depletion, greenhouse effect, preventative environmental management activities. | 03 | 06 |

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List of experiments:

| SR NO. | NAME OF THE EXPERIMENT | Hours |
|--------|---|-------|
| 1. | Write the electronic configuration of atoms (atomic no.1-30) Write the formation of compounds NaCl, AlCl ₃ , H ₂ O, CO ₂ , N ₂ . | 04 |
| 2. | Determine acidic and basic radical from unknown solution (any two) | 04 |
| 3. | Measure the voltage developed due to chemical reactions by setting up Daniel cell. | 02 |
| 4. | To determine the percentage of iron in given steel sample by redox titration. | 02 |
| 5. | To determine total hardness of sample of water by EDTA method. | 02 |
| 6. | To determine chloride content in given sample of water by Mohr's method | 02 |
| | Revision / Repetition (Expts.1 to 6) | 02 |
| 7. | To determine the percentage of Ca content in cement. | 02 |
| 8. | To determine electrode potential of various metals to study their tendency to corrosion | 02 |
| 9. | To determine the acid value of lubricant by using KOH | 02 |
| 10. | To determine coefficient of viscosity by using Ostwald's viscometer. | 02 |
| 11. | To determine percentage of ash or moisture in a given coal sample by proximate analysis. | 02 |
| 12. | To determine the strength of hydrochloric acid by titrating against sodium hydroxide solution by using PH meter. | 02 |
| | Revision / Repetition (Expts.7 to12) | 02 |

Learning Resources:

| Author | Title | Publisher |
|-------------------------------|-----------------------|----------------------------------|
| V. P. Mehta | Polytechnic Chemistry | Jain Brothers, New Delhi. |
| P.C. Jain and Monica Jain | Applied Chemistry | Dhanpat Rai and sons, New Del hi |
| M.M. Uppal | Engineering Chemistry | Khanna Publisher, Delhi. |
| S.N. Narkhede, M.M. Thatte | Applied Chemistry | Nirali Prakashan, Pune. |




Internet, You tube ,Videos etc.

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Specification Table:

| Sr. No. | Topic | Cognitive Levels | | | Total |
|---------|--|------------------|---------------|-------------|-----------|
| | | Knowledge | Comprehension | Application | |
| 1 | Atomic structure and chemical bonding. | 04 | 02 | 02 | 08 |
| | Electrochemistry | 04 | 06 | 02 | 12 |
| 3 | Metal and alloys | 04 | 02 | 02 | 08 |
| 4 | Polymer ,Elastomer and Engg materials | 04 | 02 | 04 | 10 |
| 5 | Water | 02 | 03 | 03 | 08 |
| 6 | Corrosion | 04 | 02 | 02 | 08 |
| 7 | Lubricant | 03 | 03 | 02 | 08 |
| 8 | Fuel | 03 | 03 | 02 | 08 |
| 9 | Material science and Engineering. | 00 | 02 | 02 | 04 |
| 10 | Environmental effects | 02 | 02 | 02 | 06 |
| | Total | 30 | 27 | 23 | 80 |

Prepared by :

| | | |
|---|---|--|
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| Lecturer in Chemistry | Member Secretary PBOS | Chairman PBOS |