

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

Programme : Diploma in CE/EE/MT
 Programme Code : 01 /02 / 05/15/16/19
 Name of Course : Engineering Chemistry
 Course Code : SC156
 Teaching Scheme:

	Hours /Week	Total Hours
Theory	03	48
Practical	02	32

Evaluation Scheme:

	Progressive Assessment	Semester End Examination			
		Theory	Practical	Oral	Term work
Duration	Two class tests , each of 60 Min. duration	03 Hrs.	03 Hrs.	---	---
Marks	20	80	50	---	---

Course Rationale:

Material Science is the science that investigates the composition and structure of matter, the changes that matter undergoes, the amount and kind of energy necessary for these changes, and the law that govern the changes.

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 microstructure includes the basic structure of matter, which governs the Mechanical, Electrical and Magnetic properties of the matter. Steels, alloys, plastic resins and Elastometers are included in the syllabus considering their present extensive use in automobiles, chemicals and heavy engineering industries.

GOVERNMENT POLYTECHNIC, PUNE
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Course Objectives:

After studying this course, the student will be able to

- Develop interest in the fundamental structure of matter, which governs properties of matter.
- Apply principles of chemistry, to Engineering situations.
- Understand applications of basic concepts in chemistry.
- Appreciate effect of chemical changes.
- Understand various Chemical Technology processes.

Course Content:

Chapter No.	Name of Topic/Sub topic	Hrs
1.	Introduction to Material Science	
	1.1 Atomic Structure and Chemical bonding – Fundamental particles, Electronic configuration, Atomic Orbital, Main and sub energy levels, Quantum Numbers and their significance, formation of molecules, electrovalent and ionic Bonds, Covalent Bonds, Nuclear stability, mass defect Nuclear fusion, fission.	04
	1.2 Introduction to crystal structure- Unit cell, , seven systems, closed packed structures, hexagonal closed packed structure, cubic close packed structure, body-centered cubic structure and explanation of metallic properties based on these Structure. Inter Atomic Distances and Ionic Radii Correlation between Crystal structure and properties.	

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

Electrochemistry

2.1	Introduction Mechanism of electrolysis Activity series Electrolysis of H_2SO_4 , KCl with platinum electrodes. $NaCl$ fused and $NaCl$ (aq) $CuSO_4$ solution with Pt electrodes and Cu electrodes.		
2.2	Faraday's law of electrolysis. Statements, Numerical examples based on Faraday's laws of electrolysis.		
2.3	Some electrochemical cells and cell reaction such as – i) Voltaic cells, chemical cell, concentration cell, reversible and irreversible cells. ii) Daniel cell with porous vessel and salt bridge. Concept of electrode potential, standard electrode potential (E^0), significance of oxidation –reduction potential, type of electrodes, active electrodes. EMF series and its application, constructions, working and reaction of lead accumulators, Nickel Cadmium cell. Applications of Electolysis Electroplating and Electrefining.	07	10
3.	Corrosion		
3.1	Definition, Types of corrosion		
3.2	Atmospheric Corrosion, Factors affecting atmospheric corrosion, Corrosion by oxidation Mechanism of Oxidation corrosion Types of oxide films formed	07	12

GOVERNMENT POLYTECHNIC, PUNE
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3.3	<p>Electrochemical Corrosion, its mechanism, electrochemical series, Galvanic corrosion, concentration cell corrosion- Metal ion concentration, oxidation concentration.</p> <p>Factors affecting Electro-chemical corrosion Protection of metal from corrosion-</p> <ul style="list-style-type: none"> i) Purification of metal and alloy formation. i) ii) Cathodic Protection. ii) Inorganic coating. iii) Metallic coating- Anodic and Cathodic coating, Electroplating, Hot dipping galvanizing and tinning, Cementation- Sherardizing, Metal cladding, Spraying 	
4.	Lubricant	
4.1	<p>Definition of lubricant, functions of lubricant, Properties of lubricant Physical viscosity, viscosity index, oiliness, Flash and fire point, cloud and pour point Emulsification, Volatility, Thermal stability.</p>	04
4.2	<p>Chemical properties – Acid value, specification number, Oxidation properties types of lubricants Synthetic lubricant, solid, semisolid, liquid, selection of proper lubricant for a machine under different working conditions.</p>	
5.	Water	
5.1	<p>Hard and soft water, causes of hardness, types of hardness, degree of hardness of water scales, sludges, Treatment of water to remove hardness..</p> <ul style="list-style-type: none"> i) Lime Soda process, Zeolite or permutite process and ii) Ion exchange process, Hydrogen ion concentration and pH, pH scales, measurement of pH, Applications of PH Measurements in engineering (Effluents ,corrosion, city water supply ,electroplating).numerical problems on PH. 	06

GOVERNMENT POLYTECHNIC, PUNE
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Fuels			
6.1	Definition – Types of fuels Characteristics of good fuel, Merits and Demerits of solid, liquid, gaseous fuels, Refining of crude petroleum by fractional distillation. Product obtained during refining, their properties and applications. Conventional and Non conventional fuels.CNG Biogas,(calorific value composition ,uses)	04	06
Polymer			
7.1	Plastic i) Introduction ii) Definition of polymerization iii) Types of polymerization – Addition and Condensation iv) Structure of polymer v) Types of plastic – Thermosoft and thermoset, vi) Their structure and properties vii) Study of polymers such as cellulose, acetate, PVC, polythene, polystyrene Nylon, Teflon(Thermosoft) Bakelite, silicon (Thermoset plastic) Compounding of plastic, Properties and related applications in industries.	04	06
7.2	Elastometers- Natural Rubber drawback of natural rubber, polymerization and. Vulcanization of rubber, properties (tack rebound, elasticity, abrasion resistance) and application of rubber.		
8.	Metal and Alloy		
8.1	Definition of metal, mineral, ore , properties and applications of different metals (Fe, Cu ,Al ,Cr ,Ni,Sn,Pb,Zn,Co,W,Ag)		
8.2	Definition of alloy ,formation of alloy, purposes of making alloy, classification (ferrous and nonferrous alloy) composition, properties and uses of heat resisting steel, magnetic steel ,shock resistance steel, stainless steel ,high speed steel spring steel, tool steel, and bronze brass monel metal babbitt metal duralumin.	05	08

GOVERNMENT POLYTECHNIC, PUNE
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9.	Engineering Materials	
	9.1	Definition, properties, application of Composite material
	9.2	Insulating materials
	9.3	Ceramics AND Asbestos, Paint, Adhesives,
10.	Environmental Effects (Awareness Level)	
	10.1	Definition, types of pollution, air, water, soil, sound. (causes, control method, effect) deforestation, ozone depletion, green house effect, preventative environmental management activities.
		Total

List of Practicals/Experiments/Assignments:

Sr. No.	Name of Practical/Experiment/Assignment
1.	Drawing of Electronic configuration of items from Z = 1 to Z = 20 Drawing of Molecular structures of electrovalent and covalent compounds and +ve and -ve ions
2.	Qualitative Analysis of salts of metals such as Hg, Pb, Cu, Sn, Fe, Cr, Ni, Zn, Mn, Ca, Ba, Mg, NH ₄ , K, Na (Any two)
3.	To find the electrochemical equivalent of copper by electrolysis and verify Faraday's 1 st law of Electrolysis.
4.	Determine conductivity of different electrolytes by using conductometer.
5.	Study of Mechanism of electrochemical Corrosion due to evolution of H ₂ And absorption of O ₂
6.	To find Acid value/neutralization number of given lubricant.
7.	To determine the viscosity of oil lubricant using by using Ostwald's viscometer.
8.	Determination of pH value of unknown solutions and better mixtures.
9.	To estimate the chloride content, I n given water sample.
10.	To determine the degree of hardness in terms of ppm of CaCO ₃ , given water sample by EDTA method.
11.	Estimation of calorific value of given liquid fuel OR proximate analysis of coal.
12.	Formation of phenol formaldehyde resin.

GOVERNMENT POLYTECHNIC, PUNE
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to estimate percentage of pure iron in iron alloy or impure iron by redox titration method.	02
preparation of chart of composition, properties, uses of metal and alloys.	02
to determine co content in emission from petrol vehicle	02
Total	32

Instructional Strategy:

Topic	Instructional Strategy
1. Introduction to material science	Class room Teaching, Demonstration, Models, Charts
2. Electrochemistry	Class room Teaching
3. Corrosion	Class room Teaching, Demonstration, Models
4. Lubricant	Class room Teaching, Demonstration
5. Water	Class room Teaching, Demonstration
6. Fuels	Class room Teaching
7. Polymers	Class room Teaching
8. Metal and alloy	Class room Teaching
9. Engineering Materials	Class room Teaching
10. Environmental effects	Class room Teaching

Text Books:

Sr. No	Author	Title	Publication
1.	S.N.Narkhede	Chemistry of Engineering Materials	Nirali Publication

Reference Books:

Sr. No	Author	Title	Publication
1.	V. P. Mehta	Polytechnic Chemistry	Jain Brothers, New Delhi.
2.	P.C. Jain and Monica Jain	Applied Chemistry	Dharpat Rai and sons, New Delhi
3.	M.M. Uppal	Engineering Chemistry	Khanna Publisher, Delhi.
4.	S.N. Narkhede, M.M. Thatte	Applied Chemistry	Nirali Prakashan, Pune.