Program : **Diploma in Engineering and Technology**	
Course Code : **1004**	Course Title: **Applied Chemistry**
Semester : **1**	Credits: **3**
Course Category: **Basic Science**	
Periods per week: **3 (L: 3 T: 0 P: 0)**	Periods per semester: **45**

Course Objectives:

- To impart an overall knowledge in atomic structure, chemical bonding, water treatment, engineering materials and Electrochemistry.
- To provide solutions to real world domestic and industrial applications.
- To equip the student in selecting appropriate materials for engineering applications.

Course Prerequisites:

Topic	Program / Course Name
Basic knowledge of Chemistry	Secondary School

Course Outcomes:

On completion of the course, the student will be able to:

COn	Description	Duration (Hours)	Cognitive Level
CO1	Explain atomic structure and chemical bonding	8	Understanding
CO2	Apply the fundamentals of analytical chemistry to solve the engineering problems and understand appropriate water treatment methods.	14	Applying
CO3	Explain various engineering materials for domestic and industrial applications	9	Understanding
CO4	Apply the concept of Electrochemistry and corrosion to solve engineering problems.	12	Applying
	Series Test	2	

CO – PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1							
CO2	3						
CO3			1				
CO4	3						

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

Course Outline:

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO1	**Explain atomic structure and chemical bonding**		
M1.01	Illustrate the structure of atoms.	4	Understanding
M1.02	Explain the basic theoretical concepts of orbitals and facts related to it and extend the skill of writing electronic configuration of atoms.	2	Understanding
M1.03	Explain the different types of bonds in various molecules with suitable examples.	2	Understanding
Contents : Introduction to atomic structure, Bohr's atom model –Postulates, merits and demerits (expression of energy and radius to be omitted), dual nature of matter- de Broglie's equation, Heisenberg's uncertainty principle, simple problems based on de Broglie's equation and Heisenberg's uncertainty principle. Orbital concept, Quantum numbers, Pauli exclusion principle, Hund's rule of maximum multiplicity, Aufbau rule, electronic configuration of first 20 elements. Concept of chemical bonding – octet rule, types of bonds: Ionic bond (eg: NaCl), Covalent bond (eg: H_2, HF), Co-ordinate bond in NH_4^+ ions, anomalous behaviour of H_2O due to hydrogen bonding.			
CO2	**Apply the fundamentals of analytical chemistry to solve the engineering problems and understand appropriate water treatment methods.**		
M2.01	Make use of the knowledge of concentration of solutions and volumetric analysis as a quantitative analysis in the field of science, engineering and technology	6	Applying

M2.02	Apply the physical concepts related to pH and develop the skill of solving problems	3	Applying
M2.03	Explain different types of hardness of water and methods of removal of hardness	3	Understanding
M2.04	Explain various steps involved in municipal water treatment	2	Understanding
	Series Test - I	1	

Contents :

Solution – idea of solute, solvent and solution, methods to express the concentration of solution- molarity, normality and ppm. Simple problems based on molarity and normality. Ionic Product of water – pH and pOH scale Definition – relation between pH and pOH – Simple problems based on pH - Applications of pH, Buffer solution – acidic, basic buffer, one example each. Volumetric analysis – Titration – end point – indicators – choice of indicators in titration – Principle of Volumetric analysis (Normality equation only). Simple problems based on normality equation.

Soft and hard water, salts causing water hardness. Cause of poor lathering of soap in hard water. Problems caused by the use of hard water in boiler (scale and corrosion) Water softening techniques – soda lime process and ion exchange method.

Potable water and its characteristics, Municipal water treatment (in brief only) – sedimentation, coagulation, filtration, sterilization- chlorination, bleaching, UV radiation. Flow chart for municipal supply of potable water.

CO3	**Explain various engineering materials for domestic and industrial applications**		
M3.01	Introduce appropriate materials in various engineering applications.	3	Understanding
M3.02	Classify the types of polymers and its applications in daily life.	3	Understanding
M3.03	Explain the terms nano materials, nanotechnology and its applications.	3	Understanding

Contents :

Alloys – purposes of alloying, application of alloys like Brass, Bronze and Solder. Glasses- types and application (sodium silicate, borosilicate, safety glass and insulating glass) , Refractory materials – any two examples - characteristics and application.

Polymers – monomer, polymerization, classification- homo and copolymers, addition and condensation polymer, common polymers – polythene, PVC, Nylon-66 and Bakelite - monomers and uses, thermoplastics and thermosetting plastics- with one example each. Natural rubber, vulcanization of rubber, properties of vulcanized rubber. Synthetic rubber- Buna S, Buna-N – Monomers.

Definition of nano materials and nano technology –Classification of nanomaterials based on dimension with one example each 0D, 1D and 2D. Carbon nanotubes (SWCNT, MWCNT), fullerenes, grapheme - (basic concept only, no classification required) Applications of nano materials.

CO4	**Apply the concept of Electrochemistry and corrosion to solve engineering problems.**		
M4.01	Recall the electronic concept of oxidation and reduction	3	Understanding
M4.02	Solve problems based on Faraday's laws of electrolysis	2	Applying
M4.03	Explain electrolysis in the field of electroplating and electrolytic refining.	2	Understanding
M4.04	Explain Daniel cell.	2	Understanding
M4.05	Explain the methods to prevent different types of corrosion.	3	Understanding
	Series Test – II	1	

Contents :

Electronic concept of oxidation, reduction and redox reactions, examples. Definition of terms: Conductors (metallic and electrolytic), insulators, electrolytes – strong and weak electrolytes, non-electrolytes with suitable examples, electrolysis, electrolytic cell - Faraday's laws of electrolysis, simple problems based on Faraday's laws.

Industrial Application of Electrolysis – Electroplating (electroplating of Nickel on mild steel) and Electrolytic refining (electrolytic refining of copper).

Electrochemical cells and classification –Primary cell, Secondary cell and fuel cell -one example each. Application of redox reaction in electrochemical cells taking Daniel cell as an example.

Electrochemical series and calculation of emf. Introduction to corrosion of metals – definition, factors affecting rate of corrosion. External corrosion preventive measures:

a) Barrier protection-metal (anodic, cathodic) coatings, non-metallic (anodising and anti rust solution)

b) Cathodic protection- sacrificial anode method.

Text / Reference

T/R	**Book Title / Author**
R1	Text Book of Chemistry for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi, 2017-18
R2	Agarwal, & Shikha, Engineering Chemistry, Cambridge University Press; New Delhi, 2015.

R3	C.N. R. Rao, Understanding Chemistry, Universities Press (India) Pvt. Ltd., 2011.
R4	Dara, S. S. &Dr.S.S.Umare, Engineering Chemistry, S.Chand. Publication, New Delhi, New Delhi, 2015.
R5	Jain & Jain, Engineering Chemistry, Dhanpat Rai and Sons; New Delhi, 2015.
R6	Dr. Vairam, S., Engineering Chemistry, Wiley India Pvt.Ltd., New Delhi, 2013.
R7	Dr. G. H. Hugar& Prof A. N. Pathak, Applied Chemistry Laboratory Practices, Vol. I and Vol. II, NITTTR, Chandigarh, Publications, 2013-14.
R8	Agnihotri, Rajesh, Chemistry for Engineers, Wiley India Pvt.Ltd., 2014.

Online Resources

Sl. No	Website Link
1	www.chemguide.co.uk/atommenu.html (Atomic structure and chemical bonding)
2	www.visionlearning.com (Atomic structure and chemical bonding)
3	www.chem1.com (Atomic structure and chemical bonding)
4	https://www.wastewaterelearning.com/elearning/ (Water Treatment)
5	www.capital-refractories.com (Metals, Alloys, Cement, and Refractory Materials)
6	www.em-ea.org/guide%20books/book-2/2.1%20fuels%20and%20combustion.pdf (Fuel and Combustion)
7	www.chemcollective.org (Metals, Alloys)
8	www.wqa.org(Water Treatment)