Government Polytechnic, Pune

'180 OBE' – Scheme

Course Title: **Engineering Chemistry**
(Course Code: (SC1105)

Diploma programme in which this course is offered	Semester in which offered
EE/ET Engineering	II

1. RATIONALE

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.

Material Science is an important and expanding branch in scientific engineering and economic field of our society..

The topic atomic structure includes the basic structure of matter, which governs the Mechanical, Electrical and Magnetic properties of the matter.

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.

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

2. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1. Distinguish materials on the basis of atomic structure.
2. Solve the problems based on Faraday's laws.
3. Select metals and nonmetals for given applications.
4. Use corrosion preventive measures in industry.

3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	150
3	-	2	5	80	20	25	25	

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to

4. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency**:**

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
1	Write the electronic configuration of atoms from Z=1 to Z=30	1	2
2	Write the formation of compounds NaCl, AlCl3, H2O, CO2, N2	1	2
3	Determine acidic and basic radical from unknown solution (solution 1)	1	4
4	Determine acidic and basic radical from unknown solution (solution 2)	1	4
5	Determine electrochemical equivalent of copper metal using Faraday's first law and Faraday's second law.	2	2
6	Use Hygrometer for testing Battery	3	2
7	Measure the voltage developed due to chemical reactions by setting up of Daniel cell.	3	2
8	Determine the percentage of iron in given steel sample by redox titration.	4	4
9	Prepare phenol formaldehyde resin.	5	2
10	Determine acid value of given resin	5	2
11	Determine electrode potential of various metals to study their tendency to corrosion.	6	2
12	Determine the rate of corrosion of Aluminium in acidic and basic medium.	**6**	4
			32

S.No.	Performance Indicators	Weightage in %
a.	Prepare experimental set up	20
b.	Handling of instruments during performing practical.	30
c.	Follow Safety measures	10
d.	Accuracy in calculation	10
e.	Answers to questions related with performed practices.	10
f.	Submit journal report on time	10
g.	Follow Housekeeping	5
h.	Attendance and punctuality	5
Total		**100**

5. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned**.**

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Electronic balance with the scale range of 0.001 gm to 500 gm	all
2	Hygrometer	6

6. THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Units 1 : Atomic Structure	1. Explain the characteristics of fundamental particles of an atom. 2. Distinguish between atomic number and atomic mass number 3. Distinguish between orbit and orbital. 4. Explain the significance of quantum numbers. 5. Explain the formation of given molecule.	1.1 Definition of atom, structure of atom, Characteristics of fundamental particles of an atom, definition of atomic number, atomic mass number and their difference 1.2 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 1.3 Aufbau's principle, Hund's rule, orbital electronic configurations (s, p, d, f) of elements having atomic number 1 to 30. 1.4 Definitions of valence electrons,

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	6. State Aufbau's principle and Hund's rule. 7. Define metallic bond with example. 8. Draw orbital electronic configurations (s, p, d, f) of elements.	valenc, types of valencies, 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*
Unit 2: Electrochemistry:	1. Differentiate between atom and ion. 2. Explain the assumptions of Arrhenius theory of electrolytic dissociation. 3. Describe the process of electroplating taking suitable example. 4. Explain the mechanism of electrolysis for the given electrolyte. 5. Calculate CE, ECE, weight of substance deposited or liberated, time.	2.1 Definition of electrolyte, electrolysis, ionization, Arrhenius theory, Difference between atom and ion 2.2 Activity series, mechanism of electrolysis of CuSO4 using Pt electrode and Cu electrode 2.3 Applications of electrolysis: electroplating, electro refining, 2.4 Faraday's laws of electrolysis and numerical.
Unit 3: Cells and batteries:	1. Distinguish between : metallic conductor, electrolytic conductors 2. Describe the construction and working of cells. 3. Explain the reactions taking place in given cells. 4. Explain applications of cells. 5. Explain the care and maintenance of battery.	3.1 **Types of conductors**: metallic conductor, electrolytic conductors(definition and difference) 3.2 Conductance in metals, conductance in electrolyte, Factors affecting conductance: nature of solute, nature of solvent, temperature, concentration of solution. 3.3 **Primary and secondary cell:** Difference between primary cell and secondary cell, Construction, working and applications of Daniel cell (porous vessel and salt bridge), Dry cell, lead acid cell, Ni-Cd cell, Lithium ion battery

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		3.4 Maintenance of battery.
Unit 4:Metals and alloys	1. Draw the flow chart showing different processes in metallurgy. 2. Classify carbon steel giving properties and application of each type. 3. Explain the purposes of heat treatment methods. 4. Explain purposes of making alloys. 5. classify alloys with suitable examples of each. 6. Write the composition, properties and uses of alloys.	4.1 Occurrence of metals, definitions of mineral, ore, flux, matrix, slag and metallurgy, mechanical properties of metal. 4.2 Flow chart showing different processes in metallurgy, classification, properties and application of carbon steel, heat treatment(definition, purposes and methods) 4.3 Definition of alloy, purposes of making alloys with examples, classification of alloys(ferrous and non-ferrous), 4.4 Composition, properties application of copper zinc alloy, cadmium copper alloy, chromium copper alloy, brass, bronze, duralumin, wood's metal, babbit metal.
Unit 5: Insulating materials:	1. Describe the formation of given polymer. 2. Distinguish between thermo softening and thermosetting plastics. 3. Explain the applications of Plastic based on its properties. 4. Explain vulcanization process of natural rubber.	**Plastic** 5.1 Definition of monomer and polymer, polymerization, classification of plastic on the basis of monomer, on basis of thermal behavior, on basis of monomer structure, 5.2 types of polymerization (Addition, and Condensation) applications of Plastic based on its properties. 5.3 synthesis, properties and applications of- polythene, PVC, Teflon, Bakelite, polystyrene. **Rubber** 5.4 Types of rubber, processing of natural

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	5. Distinguish between synthetic and natural rubber. 6. Distinguish between natural and synthetic rubber. 7. Explain the preparation, properties and application reaction of given synthetic rubber 8. Explain he properties and application of thermal insulators. 9. Explain the properties and application of electrical insulators.	rubber, properties of rubber, drawbacks of natural rubber, vulcanization of rubber. 5.5synthetic rubber – preparation, properties and application of BUNA-S, BUNA-N, neoprene, Thiokol. **Thermal insulators:** 5.6 properties and application of thermocole and glasswool. **Electrical insulators:** 5.7 Properties and applications of Ceramics , silicon fluid, nitrogen gas.
Unit 6: Corrosion	1. Explain different types of oxide films. 2. Explain the mechanism of electrochemical corrosion. 3. Explain the factors affecting rate of atmospheric corrosion and electrochemical corrosion. 4. Describe the galvanization process of protection of metal from corrosion. 5. Distinguish between galvanization and tinning. 6. Describe the given process of protection of metal from corrosion.	6.1 Definition, causes of corrosion types of corrosion-definition (atmospheric and electro chemical) Types of oxide films 6.2 Mechanism of atmospheric and electrochemical corrosion (evolution of hydrogen, absorption of oxygen). 6.3 Factors affecting rate of atmospheric corrosion and electrochemical corrosion. 6.4Protection Methods-anoidic and cathodic protection, Galvanization and tinning processes, sherardizing.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit 7: Engineering materials	1. Explain the properties and application of nano materials. 2. Explain the properties and application of magnetic materials. 3. Distinguish between diamagnetic and paramagnetic materials. 4. Explain the applications of Semiconducting materials. 5. Difference between N-type and P- type semiconductors. 6. Describe the properties of three groups of resistor materials. 7. Explain the properties and applications of resistor materials.	7.1**Nano materials-** properties and application of fullerene, grapheme. **7.2 Magnetic Material:** properties and applications of – diamagnetic materials, paramagnetic material and ferromagnetic materials. **7.3 Semiconducting materials:** Definition, Applications of Semiconducting materials, Examples of Semiconductors commonly used, Intrinsic and extrinsic semiconductors, N-type and P- type semiconductors, Difference between N-type and P- type semiconductors, 7.4 **Resistor material:** Defination, Properties of three groups of resistor materials, Properties and applications of resistor materials: Tungsten, Carbon, Nichrome, Manganin, Eureka, Platinum.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
01	Atomic structure	05	02	04	04	10
02	Electrochemistry	06	02	04	04	10
03	Cells and batteries	06	02	02	08	12
04	Metals and alloys	07	02	02	06	10
05	Insulating materials	10	04	08	04	16
06	Corrosion	06	04	00	04	08
07	Engineering Materials	08	04	06	04	14
Total		**48**	**20**	**26**	**34**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various

outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal based on practical performed in Chemistry laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Use Flash/Animations to explain various components, operation and
e. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS
(Only for Class Declaration Courses)

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

N.A.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication/ISBN
1	Polytechnic Chemistry	V.P.Mehta, Jain brothers, New Delhi.	818360093X
2	Applied chemistry	P.C.Jain and Monica Jain, DhanpatRai and sons, New Delhi.	9352160002

S. No.	Title of Book	Author	Publication/ISBN
3	Engineering Chemistry	Dara S.S. Umare S.S.	S. Chand and Co publication, New Delhi, 201, ISBN: 8121997658
4	Engineering Chemistry	Jain and Jain	Dhanpat Rai and Sons, New Delhi,2015, ISBN: 9352160002
5	Engineering Chemistry	Vairam. S	Wiley Indian Pvt. Ltd, New Delhi, 2013 ISBN: 9788126543342
6	Chemistry of Engineers	Agnihotri,Rajesh	Wiley Indian Ptd.Ltd, New Delhi, 2014, ISBN: 9788126550784
7	Engineering Chemistry	Agrawal Shikha	Cambridge University press, New Delhi, 2015 ISBN: 97811074764

13. SOFTWARE/LEARNING WEBSITES

a. www.chemistrytesching.com
b. www.visionlearning.com
c. www.chem1.com
d. www.onlinelibrary.wiley.com
e. www.rsc.org
f. www.chemcollective.org
g. www.wqa.org

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3		-	-	1		1
CO2	3	2	-	1		1	1
CO3	3		-	1		1	1
CO4	3		1	1	1	1	1
	3	0.5	0.2	0.75	0.5	0.75	1

15. CO- PSO MAPPING

	ELECTRICAL				ELECTRONICS AND TELECOMMUNICATION		
	PSO1	PSO2	PSO3	PSO4	PSO1	PSO2	PSO3
CO1	-	1		1	1	-	-
CO2	-		1	1	-	-	-

CO3	1	1		-	1	1	1
CO4	1				-	-	-
	0.5	0.5	0.25	0.5	0.5	0.25	0.25

16. Prepared by:

Signature of Course Expert Name of Course Expert	Signature of Head of Department Name of Head of Department
Signature of Programme Head Name of Programme Head	Signature of CDC In-Charge Name of CDC In-Charge