

Government Polytechnic, Pune

'180 OBE' – Scheme
I – Semester Course Curriculum

Course Title: **Applied Chemistry**
(Course Code: (SC1106)

Diploma programme in which this course is offered	Semester in which offered
CE/ME/MT Engineering	I
01/04/05	

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. Steels, alloys, plastic and elastomers are included considering their present extensive use in automobiles, chemicals and heavy engineering industries.

Corrosion and methods of prevention will make students realize importance of care and maintenance of machines and equipments. Study of impurities and hardness in water and methods for water softening will help the students to make proper use of water.

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. Select metals and non metals for given applications.
3. Use corrosion preventive measures in industry.
4. Use relevant water treatment process to solve industrial problems.
5. Select relevant fuel and lubricant in relevant applications.

3. TEACHING AND EXAMINATION SCHEME

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

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, AlCl ₃ , H ₂ O, CO ₂ , N ₂	1	4
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 the percentage of iron in given steel sample by redox titration.	2	4
6	Preparation of phenol formaldehyde resin.	3	2
7	Determine the rate of corrosion of Aluminium in acidic medium.	4	2
8	Determination of hardness of given water sample by EDTA method.	5	2
9	Determine the coefficient of viscosity using Ostwald's viscometer.	6	2
10	Determine moisture content from given coal sample.	7	2
11	Determine thinner content in oil paint.	8	4
Total			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 practical, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PRO. No.
1	Digital Hot Air Oven GR Lab temperature range 100 to 250 °C	7, 8

S. No.	Equipment Name with Broad Specifications	PRO. No.
2	Electronic balance with the scale range of 0.001 gm to 500 gm	All

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	<ol style="list-style-type: none"> 1. Explain the characteristics of fundamental particles 2. Distinguish between atomic number and atomic mass number 3. Distinguish between orbit and orbital. 4. Describe significance of quantum numbers. 5. Explain the formation of molecules. 6. Draw orbital electronic configurations (s, p, d, f) of elements. 7. Define metallic bond with example. 	<ol style="list-style-type: none"> 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, valency, types of valencies, definition of metallic bond. Definition of electrovalency, positive and negative electrovalency. 1.5 Formation of Electrovalent compounds-NaCl, AlCl₃ Definition of covalency, single, double and triple covalent bonds, formation of Covalent compounds H₂O, CO₂, N₂

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit 2: METAL AND ALLOYS	<ol style="list-style-type: none"> 1. Draw the flow chart showing different processes in metallurgy. 2. Classify carbon steel giving properties and application of each type. 3. Define heat treatment and state the purposes of hardening method. 4. Describe purposes of making alloys. 5. Explain effects of alloying elements on the properties of steel. 6. State the composition, properties and uses of heat given alloy. 	<p>2.1 Occurrence of metals, definitions of mineral, ore, flux, matrix, slag and metallurgy, mechanical properties of metal.</p> <p>2.2 Flow chart showing different processes in metallurgy, classification, properties and application of carbon steel, heat treatment(definition, purposes and methods)</p> <p>2.3 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)</p> <p>2.4 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>
Unit 3: PLASTIC AND RUBBER	<ol style="list-style-type: none"> 1. Describe the formation of given polymer. 2. Distinguish between thermo softening and thermosetting plastics. 3. List the applications of Plastic based on its properties. 4. Explain vulcanization process of natural rubber. 5. Distinguish between synthetic and natural rubber. 6. Describe preparation reaction of given synthetic rubber. 	<p>3.1 Definition of monomer and polymer, polymerization, classification of plastic on the basis of monomer, on basis of thermal behavior, on basis of monomer structure,</p> <p>3.2 types of polymerization (Addition, and Condensation) applications of Plastic based on its properties.</p> <p>3.3 synthesis, properties and applications of- polythene, PVC, Teflon, Bakelite, polystyrene.</p> <p>3.4 Types of rubber, processing of natural rubber, properties of rubber, drawbacks of natural rubber, vulcanization of rubber.</p> <p>3.5 synthetic rubber – preparation, properties and application of BUNA-S,</p>

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		BUNA-N, neoprene, Thiokol.
Unit 4: CORROSION	<ol style="list-style-type: none"> 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. 	<p>4.1 Definition, causes of corrosion types of corrosion-definition (atmospheric and electro chemical) Types of oxide films</p> <p>4.2 Mechanism of atmospheric and electrochemical corrosion (evolution of hydrogen, absorption of oxygen).</p> <p>4.3 Factors affecting rate of atmospheric corrosion and electrochemical corrosion.</p> <p>4.4 Protection Methods- Galvanization and tinning processes, sherardizing, metal spraying , metal cladding.</p>
Unit 5: WATER	<ol style="list-style-type: none"> 1. Explain the bad effects of hard water in paper and textile industries. 2. Describe the method of removal of hardness by zeolite process. 3. Explain reverse osmosis process of water. 4. Explain sewage treatment of water. 5. Calculate the pH and pOH having $[H^+] = 5.5 \times 10^{-5}$ 	<p>5.1 Definition of hard water and soft water, causes of hardness, types of hardness.</p> <p>5.2 Bad effect of hard water in industries (paper, textile, dye, sugar)</p> <p>5.3 Removal of hardness by lime soda method, zeolite, ion exchange method, reverse osmosis.</p> <p>5.4 reverse osmosis, sewage treatment-</p> <p>5.5 pH scale, applications of pH in engineering. Numerical based on pH.</p>
Unit 6: LUBRICANT	<ol style="list-style-type: none"> 1. Explain the mechanism of fluid film lubrication. 2. Classify lubricant and list the examples of each type. 3. Describe given physical and chemical properties of lubricant. 	<p>6.1 Definition and functions of lubricant, mechanism of lubrication(fluid film, boundary, extreme pressure lubrication)</p> <p>6.2 Classification of lubricant, properties of lubricating oils(physical and chemical)</p> <p>6.3 Selection of lubricant for light</p>

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	4. Select proper lubricant for light machines, I.C.E., gears, cutting tools, high pressure.	machines, I.C.E., gears, cutting tools, high pressure and low speed machines, transformers, spindles in textile industry, for refrigeration system.
Unit 7: FUELS	<ol style="list-style-type: none"> 1. Describe the characteristics of good fuel. 2. Compare solid, liquid and gaseous fuel on the basis of ignition point, calorific value, ash content and mode of supply. 3. Explain proximate analysis of coal. 4. Draw the diagram of refining of crude petroleum. 	<ol style="list-style-type: none"> 7.1 Definition, classification of fuels, characteristics of good fuel. 7.2 Comparison between solid, liquid and gaseous fuel, types of coal, analysis of coal by proximate and ultimate analysis 7.3 Refining of crude petroleum. 7.4 Fractions obtained by distillation of crude oil, gasoline, kerosene, diesel as a fuel(properties and uses)
Unit 8: MATERIALS	<ol style="list-style-type: none"> 1. Describe the different constituents of paint. 2. Distinguish between varnish and paint. 3. Describe the preparation and properties of given insulator. 4. Explain the function of different constituent of cement. 	<p>8.1 Paints: Definition, purpose of applying paints, characteristics of paint, constituents of paint, function and examples of each constituent.</p> <p>8.2 Varnish: Definition, types, difference between varnish and paint.</p> <p>8.3 Insulators: Definition, characteristics, preparation, properties and application of glass wool and thermocole.</p> <p>8.4 Cement: Definition, classification of cement, chemical composition of Portland cement, function of constituent in cement.</p>

7. 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
I	Atomic structure	06	02	08	00	10
II	Metals and alloys	08	02	04	06	12
III	Polymer and elastomer	06	02	02	06	10
IV	corrosion	06	00	02	06	08
V	Water	06	02	02	06	10
VI	lubricant	04	02	00	06	08
VII	fuel	06	02	04	04	10
VIII	Materials	06	02	04	06	12
Total		48	14	26	40	80

8. 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:

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

9. 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:

- Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- 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).
- With respect to item No.8, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- Use Flash/Animations to explain various components, operation and
- Teacher should ask the students to go through instruction and Technical manuals

10. 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.

11. SUGGESTED LEARNING RESOURCES

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

12. SOFTWARE/LEARNING WEBSITES

- www.chemistrytesching.com
- www.visionlearning.com
- www.chem1.com
- www.onlinelibrary.wiley.com
- www.rsc.org
- www.chemcollective.org
- www.wqa.org

13. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	-	-	-	-	1
CO2	3	2	-	-	-	1	1
CO3	3	-	-	-	-	-	1
CO4	3	3	-	2	2	1	1
CO5	3	2	-	2	1	1	1
	3	1.33	-	0.66	1	0.66	1

	PSO1			PSO2			PSO3		
	1	4	5	1	4	5	1	4	5
CO1		-			-				
CO2		-			1				
CO3		-			1				
CO4		-			1				
CO5		-			1				

14. Prepared by:

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