

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

**COURSE CURRICULUM
COURSE TITLE: CORROSION OF METALS
(COURSE CODE: 3352102)**

Diploma Programme in which this course is offered	Semester in which offered
Metallurgy Engineering	5 th Semester

1 RATIONALE

Billions of rupees are lost due to corrosion. Since a metallurgist is responsible for extraction of metals, s/he is also the right person to suggest prevention methods to corrosion. This course is designed so that the diploma metallurgical engineer is able to acquire the basic skills in all the domains of learning so that s/he can take measures to prevent and minimize different types of corrosion in various metals.

2 LIST OF COMPETENCY

The course content should be taught and implemented with the aim to develop required skills in the students so that they are able to acquire following competency:

- **Take measures to prevent and minimise corrosion of different types of materials.**

3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes:

- Distinguish between corrosion from other phenomena
- Apply the theories of corrosion to minimise the corrosion
- Identify the mechanisms to prevent different types of corrosion.
- Measure the rate of corrosion in different situations
- Select the relevant mechanism for preventing corrosion in the material under consideration.

4. 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	
3	0	4	7	70	30	40	60	200

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit; ESE - End Semester Examination; PA - Progressive Assessment

5. COURSE CONTENT DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Corrosion	1a. Differentiate between erosion and corrosion and wet and dry corrosion 1b. Explain factors affecting corrosion. 1c. Measure rate of corrosion by weight loss method 1d. Describe the cost factors due to corrosion	1.1 corrosion: Erosion and corrosion, wet corrosion and dry corrosion, Factors affecting corrosion 1.2 Measure rate of corrosion by weight loss method 1.3 Cost factors involved in corrosion of metals.
Unit – II Theories of corrosion	2a. Explain electrochemical reaction 2b. Explain redox reactions in corrosion 2c. Describe construction of the electrochemical cell 2d. Differentiate between EMF and Galvanic series	2.1 Electrochemical corrosion. 2.2 Oxidation-reduction reactions involved in corrosion. 2.3 Electrochemical cell, standard electrode potential. electromotive force (EMF) 2.4 EMF series and Galvanic series.
Unit – III Forms of corrosion	3a. Explain mechanisms for preventing Uniform corrosion, Galvanic, Crevice, Pitting, Inter granular, Stress, Erosion, Filiform corrosion and Selective leaching and Hydrogen damage	3.1 Mechanism and prevention of : Uniform corrosion, Galvanic, Crevice, Pitting, Inter granular, Stress, Erosion, Filiform corrosion and Selective leaching and Hydrogen damage.
Unit – IV Corrosion Prevention Techniques	4a. Describe corrosion prevention techniques. 4b. Suggest best suitable material for particular environment. 4c. Distinguish between cathodic and anodic protection. 4d. Select coating for particular application.	4.1 Material selection and design. 4.2 Control of environment. 4.3 Coatings as a method of corrosion prevention (Tinning, Galvanizing, Painting Electroplating, Anodising). 4.4 Cathodic protection and Anodic protection. 4.5 Corrosion resistant materials.

6. SUGGESTED SPECIFICATION TABLE WITH HOURS and MARKS (Theory)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Corrosion	08	06	02	02	10
II	Theories of corrosion	10	06	06	02	14
III	Forms of corrosion	12	04	08	08	20
IV	Corrosion prevention techniques	12	04	06	16	26
Total		42	20	22	28	70

Legends: R = Remember U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

7. SUGGESTED EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

*Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.*

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes

S. No.	Unit No.	Practical/Exercise (Outcomes in Psychomotor Domain)	Approx. Hrs. Required
1.	I	Demonstrate the electrochemical nature of corrosion by observing effect of acid on different metals. Displacement of metal in aq. solution (Fe-CuSO ₄)	02
2.	I	Measure of corrosion rate by weight loss method of MS, Cu, Al, Brass, C.I., in various corrosive environment like acid, alkali.	04
3.	I	Measure rate of corrosion of MS in 3.5% NaCl solution by potentiostat/galvanostat	04
4.	II	Find standard electrode potential of given metal (Pure Copper) as per IS code.	02
5.	II	Interpret the effect of passivity on steel by observing effect of Nitric acid (Dilute, Conc.)	02
6.	III	Demonstrate the galvanic effect as a method of cathodic protection using silver coating.	04
7.	III	Interpret the micro specimen /specimen for identification of intergranular corrosion stress corrosion cracking etc.	04
8.	IV	Perform electroplating for corrosion prevention as per IS code.	04
9.	IV	Demonstrate anodic protection and cathodic protection as a method of corrosion prevention.	04
10.	IV	Interpret the AC impedance curve for different metals and alloy	02
11.	IV	Prepare report corrosion prevention techniques being used in an Industrial visit	06
		Total (Perform any practical for total 28 hours so that most units are covered)	38

8. SUGGESTED LIST OF STUDENT ACTIVITIES

- i. Students may be given different metals and alloys to find rate of corrosion in different environment
- ii. Students may be given sample to identify the different forms of corrosion.
- iii. Students will prepare file of activities carried out and get it checked from concerned faculty.

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

- i. Arrange visits to polluted industrial area and demonstrate different type of corrosions and their causes to students. Ask students to prepare reports on these corrosions and suggest remedial measures for each type of corrosion.
- ii. Show video/animation films/photographs depicting different types of corrosion, their causes and remedial measures.

10. SUGGESTED LEARNING RESOURCES

(A) List of Books

S. No.	Title of Books	Author	Publication
1	Corrosion engineering	Fontana and Greens	Tata McGraw-Hill, New Delhi
2	Electro-Metallurgy	Sharan and Narain	Latest edition
3	Corrosion and passivity	Evas, U.R.	Latest edition
4	Corrosion and corrosion control	Ublig, H. H.	Latest edition
5	Metallic coatings for corrosion control	Carter, V. E.	Latest edition

B) List of Major Equipment/Materials with Broad Specifications

Potentiostat/Galvanostat with AC impedance measurement

C) List of Software/Learning Websites

- i. NPTEL VIDEOS
- ii. <http://en.wikipedia.org/wiki/Corrosion>
- iii. <http://corrosion-doctors.org/MatSelect/corrsteel.htm>
- iv. http://en.wikipedia.org/wiki/Galvanic_corrosion
- v. <http://www.nace.org/Publications/CORROSION-Journal/>
- vi. <http://www.corrosion.nl/>

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Dr I. B. DAVE, HOD**, Dept of Metallurgy, Dr S and S.S.Ghandhy College of Engg. and Technology, Surat.
- **Dr. G.H Upadhyay**, Professor of Metallurgy, Department of Mechanical Engineering, L.D.College of Engineering, Ahmedabad.
- **Prof. V. N. Kaila**, Head, Metallurgy department, Government Polytechnic Rajkot.

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. C. K. Chugh**, Professor, Department of Mechanical Engineering
- **Dr Joshua Earnest**, Professor, Department of Electrical and Electronics Engineering