Name: Enrolment No:	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2019

Programme Name: B.Tech (CE+RP) **Semester : VIII**
Course Name : Corrosion Engineering **Time : 03 hrs**
Course Code : MTEG364 **Max. Marks : 100**

Nos. of page(s) : 2

Instructions: *The question paper consists of two sections. Answer the questions section wise in the answer booklet.*

Note: *Assume suitable data wherever necessary*

SECTION A
(Answer all questions)

S. No.		Marks	CO
Q1	**Define** corrosion with an example.	**5**	**CO1**
Q2	**Explain** standard hydrogen electrode.	**5**	**CO2**
Q3	**Illustrate** typical changes in the environment that can prevent corrosion.	**5**	**CO3**
Q4	**Name** any two different forms of corrosion and its prevention.	**5**	**CO1**
	SECTION B **(Answer all questions)**		
Q5	**Summarize** concentration and activation polarization.	**10**	**CO2**
Q6	A new heat exchanger is required in conjunction with a rearrangement of existing facilities. Because of corrosion, the expected life of a carbon steel heat exchanger is 5 years. The installed cost is $9500. An alternative to the heat exchanger is a unit fabricated of AISI type 316 stainless steel, with an Installed cost of $26,500 and an estimated life of 15 years, to be written off in 11 years. The minimum acceptable interest rate is 10 percent, the tax rate is 48 percent, and the depreciation method is straight line. **Justify** which unit would be more economical based on annual costs.	**10**	**CO5**
Q7	**Demonstrate** different coating methods to prevent corrosion.	**10**	**CO3**
Q8	**Criticize** corrosion in concrete environment.	**10**	**CO4**
	SECTION-C **(Answer all questions)**		
Q9	a. **Analyse** the selection of proper metal or alloy for specific environment to prevent corrosion. b. **Illustrate** various stainless steel alloys and its corrosion behaviour.	**(7+13)**	**CO4**
Q10	a. **Present** and derive Nernst equation for the redox reaction. b. **Calculate** emf of a cell constructed from a lead electrode in lead sulfate of pH = 1 with activity of Pb^{2+} = 0.01 and a hydrogen electrode?	**(10+10)**	**CO3**

	Reaction	Standard Potential, $e°$ (volts vs. SHE)
Noble	$Au^{3+} + 3e^- = Au$	+1.498
	$Cl_2 + 2e^- = 2Cl^-$	+1.358
	$O_2 + 4H^+ + 4e^- = 2H_2O$ (pH 0)	+1.229
	$Pt^{2+} + 3e^- = Pt$	+1.118
	$NO_3^- + 4H^+ + 3e^- = NO + 2H_2O$	+0.957
	$O_2 + 2H_2O + 4e^- = 4OH^-$ (pH 7)*a*	+0.82
	$Ag^+ + e^- = Ag$	+0.799
	$Hg_2^{2+} + 2e^- = 2Hg$	+0.799
	$Fe^{3+} + e^- = Fe^{2+}$	+0.771
	$O_2 + 2H_2O + 4e^- = 4OH^-$ (pH 14)	+0.401
	$Cu^{2+} + 2e^- = Cu$	+0.342
	$Sn^{4+} + 2e^- = Sn^{2+}$	+0.15
	$2H^+ + 2e^- = H_2$	0.000
	$Pb^{2+} + 2e^- = Pb$	–0.126
	$Sn^{2+} + 2e^- = Sn$	–0.138
	$Ni^{2+} + 2e^- = Ni$	–0.250
	$Co^{2+} + 2e^- = Co$	–0.277
	$Cd^{2+} + 2e^- = Cd$	–0.403
	$2H_2O + 2e^- = H_2 + 2OH^-$ (pH 7)[a]	–0.413
	$Fe^{2+} + 2e^- = Fe$	–0.447
	$Cr^{3+} + 3e^- = Cr$	–0.744
	$Zn^{2+} + 2e^- = Zn$	–0.762
	$2H_2O + 2e^- = H_2 + 2OH^-$ (pH 14)	–0.828
	$Al^{3+} + 3e^- = Al$	–1.662
	$Mg^{2+} + 2e^- = Mg$	–2.372
	$Na^+ + e^- = Na$	–2.71
Active	$K^+ + e^- = K$	–2.931