COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P Hour*	*Credits*	*ECTS*
Principles of Electrochemical Engineering	CHBE 577	1 or 2	3+0	3	10

Prerequisites	None

Language of Instruction	English
Course Level	Graduate Degree
Course Type	Technical Elective
Course Coordinator	
Instructors	Assistant Prof. Dr. Levent Organ
Assistants	
Goals	The aim of this course is to provide students with knowledge and abilities to solve problems related to electrochemical engineering.
Content	Electrohemical thermodynamics (electrochemical potential, electrochemical reaction equilibrium, Nernst equation); Electrode kinetics (rate laws, Buttler-Volmer equation, reaction mechanisms); Mass and charge transfer in electrochemical systems (transport in dilute solutions, conservation of mass and charge); Applications of potential theory (primary, secondary and tertiary current distributions); convective transport (rotating electrodes)

Course Learning Outcomes	**Program Learning Outcomes**	**Teaching Methods**	**Assessment Methods**
Knowledge about electrohemical thermodynamics	1, 2, 3, 4	1, 2	A, C
Knowledge about electrode kinetics	1, 2, 3, 4	1, 2	A, C
Knowledge about fluid mechanics, mass and charge transfer in electrochemical systems	1, 2, 3, 4	1, 2	A, C
Knowledge about current distributions	1, 2, 3, 4	1, 2	A, C

Ability to communicate effectively both orally and in writing in English via preparation of a project report and a presentation	8	5	D

Teaching Methods:	1: Lecture, 2: Question-Answer, 3: Lab, 4: Case-study, 5: Scientific article critique
Assessment Methods:	A: Testing, B: Experiment, C: Homework, D: Project

COURSE CONTENT

Week	Topics	Study Materials
1	INTRODUCTION: Overview of electrochemical processes	Lecture notes, library resources
2	ELECTRODE KINETICS: Polarization diagrams; Rate laws; Buttler-Volmer equation	Lecture notes, library resources
3	ELECTRODE KINETICS: Mechanisms, Multiple reactions	Lecture notes,
4	ELECTRODE KINETICS: Electric double layer	Lecture notes, library resources
5	ELECTROCHEMICAL THERMODYNAMICS: Electrochemical potential, Activities and activity coefficients; Electrochemical reaction equilibrium	Lecture notes, library resources
6	ELECTROCHEMICAL THERMODYNAMICS: Cells with liquid junctions; Cell potentials; Nernst equation	Lecture notes, library resources
7	ELECTROCHEMICAL THERMODYNAMICS: Pourbaix diagrams; Reference Electrodes	Lecture notes, library resources
8	TRANSPORT PHENOMENA IN ELECTROCHEMICAL SYSTEMS: Transport in dilute solutions; conservation of mass and charge	Lecture notes, library resources
9	TRANSPORT PHENOMENA IN ELECTROCHEMICAL SYSTEMS: Electrode boundary conditions; Limiting cases of boundary conditions and governing equations	Lecture notes, library resources
10	CURRENT DISTRIBUTIONS: Classification; Wagner number; Primary, secondary and tertiary current distributions	Lecture notes, library resources
11	CURRENT DISTRIBUTIONS: Mass transfer-limited current distributions	Lecture notes, library resources
12	CONVECTIVE TRANSPORT: Fluid flow and mass transfer to a rotating disk electrode	Lecture notes, library resources
13	CONVECTIVE TRANSPORT: Rotating ring-disk and rotating cylinder electrodes	Lecture notes, library resources
14	PRESENTATIONS	Lecture notes, library resources

RECOMMENDED SOURCES	
Textbook	
Additional Resources	1. Newman, J. and Thomas-Alyea, K. E.; "Electrochemical Systems", 3rd ed., Wiley-Interscience, 2004 2. Bard, Allen J., and Larry R. Faulkner. "Electrochemical Methods: Fundamentals and Applications", 2nd ed., Wiley, 2001 3. Geoffrey, P., "Electrochemical Engineering Principles", Prentice Hall, 1991 4. West, A., "Electrochemistry and Electrochemical Engineering", CreateSpace Independent Publishing Platform, 2012 5. Scientific articles from the library resources

MATERIAL SHARING	
Documents	
Assignments	
Exams	

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Midterm	2	42.8
Project	1	28.6
Homework	6	28.6
Total		**100.**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		30.0
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		70.0
Total		**100.**

COURSE CATEGORY	Field/Expertise Courses

COURSE'S CONTRIBUTION TO PROGRAM		
No	Program Learning Outcomes	Contribution

		1	2	3	4	5
1	Acquire expanded and in-depth information via performing scientific research in the field of Chemical Engineering, evaluate, interpret and implement knowledge.				x	
2	Be knowledgable in the contemporary techniques and methods applied in Chemical Engineering and their respective constraints.				x	
3	Be cognizant of the novel and developing applications of his/her profession, study and learn them as required.				x	
4	Formulate Chemical Engineering problems, develop methods to solve them and implement innovative techniques in solutions.				x	
5	Design and conduct analytical modeling and experimental research, analyze and interpret complex problems encountered in this process.					
6	Develop novel and/or original ideas and methods; conceive innovative solutions in systems, component and process design.					
7	Complete information via processing limited or incomplete data by the use of scientific methods and implement it; integrate knowledge from different disciplines.					
8	Communicate in at least one foreign language at the level of European Language Portfolio B2 orally and in writing.					x
9	Communicate stages and results of his/her studies in a systematic and clear manner orally or in writing in intra or interdisciplinary national and international settings.					
10	Defines societal and environmental aspects of Chemical Engineering applications.					
11	Observe social, scientific and ethical values during collection, interpretation, and dissemination of data and in all professional activities.					
12	Lead multidisciplinary teams, develop solution methodologies for complex problems and take responsibility.					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	10	140
Midterm Exam	2	2	4
Project	1	30	30
Homeworks	6	4	24
Final Exam	1	3	3
Total Work Load			243

Total Work Load / 25 (h)			9.7
ECTS Credit of the Course			10