Course Name						
FUNDAMENTALS OF SOLUTION THERMODYNAMICS						
Code	**Semester**	**Local Credits**	**ECTS Credits**	**Course Implementation, Hours/Week**		
				Theoretical	**Tutorial**	**Laboratory**
MET 214E	4	2.5	4	2	1	-

Department/Program	Metallurgical and Materials Engineering		
Course Type	Required	**Course Language**	English
Course Prerequisites	MET 215E		

Course Category by Content, %	**Basic Sciences**	**Engineering Science**	**Engineering Design**	**General Education**
		80	20	

Course Description	Thermodynamics properties of solutions, the properties of ideal solutions, non-ideal solutions, dilute solutions, application of the Gibbs-Duhem relation to the determination of activity, the properties of regular solutions, atomistic model for solutions, relation between free energy and phase equilibria in binary systems, binary phase diagrams, the phase rule and application on chemical reactions and phase diagrams, determination techniques of thermodynamic quantities, alternative standard state, solutions containing several dilute solutes.
Course Objectives	1. To provide students to understand solution thermodynamics concepts and thermodynamics basic relations, 2. To teach them to perform thermodynamic calculations of reaction that involve component in solution with the various medium, 3. To provide them the basic concepts of binary phase diagrams 4. To provide students to teach solutions containing several dilute solutes and their thermodynamics behavior. 5. The prepare them to be able to decide about the selection of processes that involve solution
Course Learning Outcomes	Students who pass the course will be able to: 1.Determine all the thermodynamic properties of a solution and its components, 2. Calculate thermodynamics of an ideal solution, 3. Use the Gibb-Duhem equation and can calculate the thermodynamics a component of a solution if the other ones known, 4. Using the interatomic bond character, can determine the solution formation conditions, 5. Determine the thermodynamics of a regular solution, 6. Correlate binary phase equilibria diagrams and thermodynamic properties, 7. Know the thermodynamic properties measurement techniques, 8. Determined the interaction between the dissolved component in a dilute solution
Textbook	1. Aytekin, V., “Metalurji Termodinamiği”, İ.T.Ü. Metalurji Fakültesi Ofset Baskı Atelyesi, İstanbul 1980. 2. Gaskel, D. R. “Introduction to the Thermodynamics of Materials”, Taylor & Francis, Third Edition, 2003
Other References	1. Dikeç, F., Aydın, S., “Çözümlü Metalurji Termodinamiği Problemleri” İ.T.Ü. Kimya-Metalurji Fakültesi Ofset Atölyesi, İstanbul, 1991. 2. DeHoff, R.T., “Thermodynamics in Materials Science”, McGraw-Hill,1993 . 3. Ragone, D.V. “Thermodynamics of Materials”, John Wiley & Sons, Inc.,1995. 4. Kubaschewski, O., Alcock,C.B.,Spencer,P.J., “Materials Thermochemistry”, Pergamon Press, New York, 1993. 5. Bodswort, C., Appleton, A.S., “Problems in Applied Thermodynamics”, Lonnmans, London, 1965.
Homework & Projects	Group projects about the main chapters are given, students should solve the problem in a week and present to the instructor. Homework (every week) are given for better understanding the lecture and to be ready for the following week.
Laboratory Work	
Computer Use	The projects should be prepared using computer, especially all of the graphics should be plotted using excel or similar software. End of the first lecture a crash Excel course is given.
Other Activities	

Assessment Criteria	**Activities**	**Quantity**	**Effects on Grading, %**
	Midterm Exams	**2**	**40**
	Quizzes	**-**	**-**
	Homework	**MIN 10**	**-**
	Projects	**MIN 4**	**10**
	Term Paper/Project	**-**	**-**
	Laboratory Work	**-**	**-**
	Other Activities	**-**	**-**
	Final Exam	**1**	**50**

COURSE PLAN

Weeks	Topics	Course Outcomes
1	Introduction to solution thermodynamics, integral molar thermodynamic properties and partial molar thermodynamic properties of solutions	1
2	Integral molar thermodynamic properties and partial molar thermodynamic properties of solutions	1
3	Ideal solutions and thermodynamic properties	1,2
4	Non-ideal solution, dilute solutions	1,2
5	Application of the Gibbs-Duhem equation of the determination of activity-1	1,3
6	Application of the Gibbs-Duhem equation of the determination of activity-2	1,3
7	Regular solutions and thermodynamic properties	4
8	Investigation of alloys by means of chemical bonding	4,5
9	Free energy – composition change, binary phase equilibrium diagrams	4,5,6
10	Binary phase equilibrium diagrams and Gibbs phase rule	4,5,6
11	Measurement techniques of thermodynamic properties	7
12	Alternative standard states: Raoult and Henry standard state	8
13	Dilute solutions dissolving more than one solute-1	8
14	Dilute solutions dissolving more than one solute-2	8

Relationship between the Course and Metallurgical and Materials Engineering Curriculum

	Student Outcomes	Level of Contribution		
		1	2	3
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering science and mathematics	X		
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare as well as global, cultural, social, environmental and economic factors			X
3	an ability to communicate effectively with a range of audiences	X		
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts		X	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	X		
6	an ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgement to draw conclusions	X		
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies		X	

1: Little, 2: Partial, 3: Full

Course relationships with major elements of the field and material classes

		Level of Contribution		
		1	2	3
MAJOR ELEMENT OF THE FIELDS	STRUCTURE			
	PROPERTIES			
	DESIGN EXPERIMENT/ANALYSE DATA			
	PROCESSING			x
	COST/PERFORMANCE	x		
	QUALITY/ENVIRONMENT			
	DESIGN PROCESS OR PRODUCT	x		
MATERIAL CLASSES	METAL			x
	CERAMICS AND GLAS		x	
	POLYMERS			
	COMPOSITES			
BIO	BIOMATERIALS			

1: Little, 2. Partial, 3. Full

Prepared by	Date	Revision #	Signature
Assist. Prof. Dr. Nuri SOLAK	December 2020		