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 behaviour. 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	• Aytekin, V., “Metalurji Termodinamiği”, İ.T.Ü. Metalurji Fakültesi Ofset Baskı Atelyesi, İstanbul 1980. • Gaskel, D. R. “Introduction to the Thermodynamics of Materials”, Taylor & Francis, Third Edition, 2003
Other References	• Dikeç, F., Aydın, S., “Çözümlü Metalurji Termodinamiği Problemleri” İ.T.Ü. Kimya-Metalurji Fakültesi Ofset Atölyesi, İstanbul, 1991. • DeHoff, R.T., “Thermodynamics in Materials Science”, McGraw-Hill,1993 . • Ragone, D.V. “Thermodynamics of Materials”, John Wiley & Sons, Inc.,1995. • Kubaschewski, O., Alcock,C.B.,Spencer,P.J., “Materials Thermochemistry”, Pergamon Press, New York, 1993. • 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	1,3
6	Tutorial, 1. Mid-term	
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	8
14	2. Mid-term	

Relationship between the Course and METALLURGICAL AND MATERIALS ENGINEERING **Curriculum**

	Program Outcomes	Level of Contribution		
		1	**2**	**3**
1	Ability to apply the knowledge of mathematics, science and engineering principles to solve problems in metallurgical and materials engineering (ABET:a)			x
2	Ability to characterize materials using standard and/or self designed experimental methods and to evaluate the results (ABET:b)			
3	Ability to design a system or a process, taking into consideration of the desired specifications, quality, ethics and environment. (ABET:c)			
4	Ability to communicate both orally and in the written form and to take part in, and provide leadership of the teams in the elucidation of engineering problems; (ABET:d, g)		x	
5	Ability to define, formulate and solve engineering problems in the development, production, processing, protection and usage of engineering materials. (ABET:e)			x
6	An understanding of professional and ethical responsibilities(ABET:f)			
7	An understanding of current/contemporary issues and impact of engineering solutions in broad cultural, national and global levels;. (ABET:h, j)		x	
8	A comprehension of the nature of engineering progress closely linked with the development of new materials and production processes. An ability to engage in life-long learning and a recognition of its necessity (ABET:i)		x	
9	Ability to use essential tools and techniques of modern engineering in the development, production, processing, protecting of the existing and new engineering materials. (ABET:k)			

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		**x**	
	POLYMERS			
	COMPOSITES			

1: Little, 2. Partial, 3. Full

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