COURSE CATALOG

Course Code: CE402				Course Name: Theory of Elasticity			
Semester	T + P + L	Credits	ECTS	Language of Instruction	Course Type	Instruction Methods	Prequisite(s)
6-7-8	3 + 0 + 0	3	6	English	Elective(D2)	Lecture	CE201, CE202, CE204

Course Objectives	The objective of this course is to introduce to the student the analysis of linear elastic solids under mechanical and thermal loads. The material presented in this course will provide the foundation for pursuing other solid mechanics courses such as theory of plates and shells, elastic stability, composite structures and fracture mechanics. This course will introduce basic definitions of strain and stress tensors, derive strain deformation relationships for finite and small deformations, derive compatibility conditions for strain tensors, equilibrium equations, and formulate constitutive properties of orthotropic and isotropic elastic materials; then introduce the Airy stress functions for 2-D plane stress and plane strain problems in Cartesian and cylindrical coordinate systems. A few examples in 3-D stress analysis will be provided. The homework exercises will train students in the use of principles of elasticity theory for developing simple and quick estimates of stress and displacement fields for use in elastic stress analysis.
Topics Covered	Stress and strain analysis. Compatibility conditions. General theory of plane elasticity. Plane stress. Plane strain. Solutions in Cartesian coordinates. Stress functions. Airy stress function. Boundary conditions. Polynomial solutions. Biharmonic functions. Examples. Solutions with Fourier series. Solutions in polar coordinates. Solutions with complex functions. Three dimensional elasticity. Saint-Venant torsion. Bending theory.
Learning Outcomes of the Course	After completing this course students should gain: 1. Read current literature. [1,4] 2. Understand the basic concepts in continuum mechanics of solids, including of strain, internal force, stress and equilibrium in solids. [1,4,12] 3. Characterize materials with elastic constitutive relations. [1,4,8,10,12] 4. Use analytical techniques to predict deformation, internal force and failure of simple solids and structural components. [1,4,13,14] 5. Apply principles of continuum mechanics to design a structure or component to achieve desired performance under realistic constraints. [1,4,10,12,14] *[Note that the numbers in between the brackets address the bullet numbers in the program outcomes list.]*
ISCED Category of the Course	52 Mühendislik
Textbook	Elasticity: Theory and Applications, Adel S. Saada, Second Edition, Krieger Publishing, Malabar, Florida, 1993.
Recommended Sources	1- V.Z. Parton, Mathematical Methods of the Theoty of Elasticity, Mir Publisfers,1984. 2- M. Inan, Elastisite Teorisi, İTÜ 3- A.E.H.Love, A Treatise on the Mathematical Theory of Elasticity (Dover Books on Engineering) 4- Theory of Elasticity, S. P. Timoshenko and J. N. Goodier, 3rd Edition, McGraw Hill Book Company, 1970, 1987. 5- Elasticity in Engineering Mechanics, 2nd Edition, A. P. Boresi and K. P. Chong, John Wiley &Sons, 2000. 6- Advanced Strength and Applied Elasticity, A. C. Ugural and S. K. Fenster, 2nd Edition,Elsevier Science Publishing Co., Inc., 1987. 7- Elasticity: Tensor, Dyadic and Engineering Approaches, P. C. Chou and N. J. Pagano, Dover Publications, 1967. 8- H. Leipholz, Theory of Elasticity, 1974, Noordhoff Int. Publ.Engineering Solid Mechanics: Fundamentals and Applications, Abdel-Rahman Ragab and Salah Eldin Bayoumi, CRC Press, Boca Raton, Florida, 1999.

WEEKLY SCHEDULE

Week	Theoretical Topic	Applied / Laboratory Topics
1	Stress and strain analysis.	
2	Compatibility conditions.	
3	General theory of plane elasticity.	
4	Plane stress. Plane strain.	
5	Solutions in Cartesian coordinates.	
6	Stress functions. Airy stress function.	
7	Boundary conditions. Polynomial solutions.	
8	Biharmonic functions.	

9	Solutions with Fourier series.	
10	Solutions in polar coordinates.	
11	Solutions with complex functions.	
12	Three dimensional elasticity.	
13	Saint-Venant torsion.	
14	Bending theory.	

COURSE ASSESSMENT POLICY

	Activities	Number	Contribution (%)
Studies throughout the term	Quizes	3	10
	Term Homework/ Project		
	Reports	-	-
	Graduation Thesis/ Project	-	-
	Seminar	-	-
	Homeworks	5	10
	Presentations	-	-
	Midterm Exams	2	40
	Project		
	Laboratory	-	-
	Other (attendance)	-	-
FINAL EXAM		1	40
Total			100

CONTRIBUTION OF THE COURSE TO CIVIL ENGINEERING PROGRAM OUTCOMES

	Program Outcomes	1	2	3
1	The ability to apply knowledge of mathematics, science, and engineering			X
2	The ability to identify, formulate, and solve engineering problems			X
3	The ability to design a system or component to meet desired needs with realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability and sustainability		X	
4	The ability to analyze and interpret data			X
5	The ability to design and conduct experiments and apply experimental results to improve processes		X	
6	The ability to convey technical material through oral presentations and written papers/reports			X
7	The ability to function within multidisciplinary teams			X
8	The understanding of professional and ethical responsibilities			X
9	The understanding of the impact of engineering on society		X	
10	The understanding of the necessity to engage in life-long learning			X
11	The understanding of management and leadership principles and techniques		X	
12	The appreciation of the role of research in civil engineering problems			X
13	A knowledge of contemporary issues in civil engineering			X
14	The ability to use modern engineering techniques, skills, and tools		X	
15	The ability to understand and explain basic concepts in management, business, and leadership	X		
16	A commitment to quality, punctuality and continuous improvement		X	

Contribution Level: 1 low, 2 medium, 3 high

ECTS-WORKLOAD TABLE

ACTIVITIES	Number	Duration (Hour)	Workload(Hour)
Lecture Time	14	3	42
Final Exam (Including Prepation Time)	1	13	13
Quizes	3	4	12
Term Homework / Project	-	-	-
Reports			

Graduation Thesis/Project	-	-	-
Seminar			
Study Time Outside the Class	14	2	28
Homeworks	5	7	35
Presentations	-	-	-
Midterm Exams (Including Prepation Time)	2	10	20
Project	-	-	-
Laboratory	-	-	-
Total Workload			150
ECTS Credits of the Course (Total Workload / 25)			6

Last update on 19.01.2014	Coordinator / PREPARED BY Esin Inan	APPROVED BY Esin İnan