COURSE OUTLINE

AEE 361 APPLIED ELASTICITY

[Section – 01]

OBJECTIVE:

The objective of the course is to introduce the advanced methods for the analysis of deformable bodies and to educate students to apply this knowledge in the solution of aerospace engineering problems. The course also aims at equipping students with the necessary background to design aerospace structures and components.

The first part of the course is intended to introduce advanced concepts in the structural analysis of beams which are fundamental building blocks of aerospace structures. Emphasis is placed on the structural analysis of beams of arbitrary cross-sections under bending, shear and torsional loading.

The second part of the course aims at teaching the basic principles of the linear theosry of elasticity and its application to practical engineering problems frequenctly encountered in aerospace structures. Theory of Elasticity provides exact solutions for the relatively simple configurations of loading and boundary conditions, and it provides a check on the limitations of mechanics of material approach. Findings of theory of elasticity approach yield important results for the strength of structures, under certain critical loading situations, which is extremely important in design. Theory of elasticity also serves as the basis of approximate solutions employing numerical analysis.

INSTRUCTOR:

Asst. Prof. Dr. Melin ŞAHİN (Room: 103, Tel:4256), msahin@metu.edu.tr

COURSE ASSISTANT:

TEXTBOOKS AND REFERENCE BOOKS:

Textbook:

A.C. Ugural and S.K. Fenster, "Advanced Strength and Applied Elasticity" Prentice Hall PTR, 4rd Edition, 1995, ISBN: 0-13-047392-8

Reference Books:

Library books on theory of elasticity, advanced strength or advanced mechanics of materials will have the related sections that will be covered throughout this semester. Some references are given below as examples:

1- 'Theory of Elasticity,' by S.Timoshenko and J.N. Goodier,
Call Number: QA 931 T55, 1970

2- 'Advanced Strength and Applied Stress Analysis,' by Richard G. Budynas,
Call Number: TA 405 B82, 1977

3- 'Mechanics of Materials,' F.P. Beer, E.R. Johnston, J.T. Dewolf
AE 264 textbook

4- 'Analysis of Aircraft Structures,' B.K. Donaldson, 1993
Call Number: TL671.6 .D56

5- 'Elasticity in Engineering Mechanics,' by Arthur P. Boresi, Paul P. Lynn,
Call Number: TA 405 B67, 1974

6- 'Theory of Elasticity for Scientists and Engineers,' by Teodor M. Atanackovic, Ardeshiir Guran,
Call Number: QA 931 A76, 1999

7- 'Advanced Mechanics of Materials,' by Roman Solecki, R. Jay Conant,
Call Number: TA 405 S655, 2003

Course Outline:

1- STRUCTURAL ANALYSIS OF BEAMS: **6 HRS**

Subject	Hours
Generalized theory of pure bending	1
Unsymmetric loading of beams and shear center	1
Shear stresses in beams of thin walled open sections	1.5
General theory for shear stresses	1.5
Analysis of statically indeterminate beams	1

2- ANALYSIS OF STRESS AND STRAIN: **11 HRS**

Subject	Hours
Stress, stress tensor, variation of stress within a body, 3-D stress equlibrium equations, definitions of plain stress and plain strain	2
Three dimensional stress at a point, transformation of stress, principal stresses in 3D, normal and shear stresses on an oblique plane	3
Strain displacement relations, strain compatibility equations, state of strain and transformation of strain, measurement of strain	4.5
Generalized Hooke's law	1.5

3- TORSION OF NON-CIRCULAR CROSS SECTION BARS: **8 HRS**

Subject	Hours
General solution of torsion problem	2
Prandlt's membrane analogy, torsion of thin-walled members of open cross sections, torsion of multiply connected thin walled sections, stress concentrations	3
fluid flow analogy	0.5
Warping function, significance of torsion in open section thin walled members	1.5

4- TWO DIMENSIONAL PROBLEMS IN ELASTICITY: **9 HRS**

Subject	Hours
Plane stress and plane strain problems	2.5
Stress function and applications	2.5
Equations of elasticity in polar coordinates	1
Stress concentrations and thermal stresses	3

5- AXISYMMETRIC PROBLEMS IN ELASTICITY: **8 HRS**

Subject	Hours
Thick walled cylinders	3
Compound cylinders	1
Rotating disks of constant thickness	2
Thermal stresses in thin disks	2

GRADING

Homeworks 15%

1 homework from each section - total of 5 homeworks

Midterm 1 25% (Sections 1& 2)

Midterm 2 25% (Sections 3&4)

Final exam 35% (All sections)

Examinations will be closed books but class notes and formula sheets prepared by the students will be allowed. **No photocopy is allowed.**