VILLANOVA UNIVERSITY
MECHANICAL ENGINEERING DEPARTMENT

ME 8140 Spring 2008
Thermoelasticity and Thermal Structures Dr. B.J. Sullivan

COURSE DESCRIPTION

Thermoelasticity theory is used in the design and analysis of structures and structural components which are subjected to temperatures which vary both in time and with position. Examples include aircraft and spacecraft, missiles, turbines, and nuclear reactors. This class will present the fundamentals of the theory of thermoelasticity and its applications to the analysis and design of structures subjected to thermal loads.

COURSE OBJECTIVE

The primary objective of this course is to provide the fundamental concepts of the theory of thermoelasticity as applied to structural and mechanical systems. Concepts of heat transfer necessary to derive temperature distributions in structures will also be presented. The course will also deal with isotropic (e.g., metallic) and anisotropic (e.g., composite materials) thermal structures.

TENTATIVE COURSE OUTLINE

Week	Date	Topic
1	14 Jan 08	Introduction; Thermal stress problem in high speed flight structures; Heat transfer in structures: conduction theory
	21 Jan 08	*Martin Luther King Day – No Class (?)*
2	TBD	Heat transfer in structures: radiation heat transfer - Part 1
3	4 Feb 08	Heat transfer in structures: radiation heat transfer - Part 2
4	11 Feb 08	Heat transfer in structures: convection heat transfer
5	18 Feb 08	Mechanical and Thermodynamics Foundations of Thermoelasticity
6	25 Feb 08	Formulation of the Thermoelastic Problem
	3 Mar 08	*Semester Recess*
7	10 Mar 06	Thermal Stresses in One-Dimensional Structures: rods and beams
8	17 Mar 06	MID-TERM EXAMINATION
9	24 Mar 06	Plane Thermoelastic Problems
10	31 Mar 06	Thermal Stresses in Cylinders
11	7 Apr 06	Thermal Stresses in Spherical Bodies; Thermal Stresses in Plates-Part 1
12	14 Apr 06	Thermal Stresses in Plates - Part 2
13	21 Apr 06	Thermally Induced Instability
14	28 Apr 06	Thermally Induced Vibrations
15	5 May 06	FINAL EXAMINATION

COURSE CONDUCT

There is no single text book which treats each of the above topics in exactly the same way as they will be covered in this course, or which places the exact same emphasis on the topics as will be placed on them in this course. Consequently, class notes developed by the students from the lectures, supplemented by regularly assigned homework problems, will form the primary source of information. The text book which will be referred to (along with many other texts – see the list below) in the class, and from which most of the homework problems will be assigned, is

N. Noda, R.B. Hetnarski and Y. Tanigawa, Thermal Stresses, 2nd Edition, ISBN 1-56032-971-8, Taylor & Francis, New York, NY, 2003.

Other books, from which lecture materials have been derived, include the following supplementary texts:

Earl A. Thornton, Thermal Structures for Aerospace Applications, ISBN 1-56347-190-6, AIAA Education Series, Reston, VA, 1996.

B.A. Boley and J.H. Weiner, Theory of Thermal Stresses, ISBN 0-486-69579-4, Dover Publications, Mineola, NY, 1960.

B.E. Gatewood, Thermal Stresses, LCCN 57-6380, McGraw-Hill Book Company, New York, NY, 1957.

S.P. Timoshenko and J.N. Goodier, Theory of Elasticity, McGraw-Hill Book Co., 3rd Edition, 1970.

S.P. Timoshenko and S. Woinowsky-Kreiger, Theory of Plates and Shells, McGraw-Hill Book Company, 2nd Edition, 1959.

J.M. Whitney, Structural Analysis of Laminated Anisotropic Plates, Technomic Publishing Co., 1987.

R.M. Jones, Mechanics of Composite Materials, Taylor & Francis Publishing Group, 2nd Edition, 1998

F.P. Incropera and D.P. DeWitt, Fundamentals of Heat and Mass Transfer, 4th Edition, John Wiley & Sons, 5th Edition, 2002.

R. Siegel and John Howell, Thermal Radiation Heat Transfer, 4th Edition, Taylor & Francis, 2002.

Other appropriate texts from the engineering literature will be referenced as required. On occasion, selected papers from the literature of Thermoelasticity and Thermal Structures and Heat Transfer will be referenced and distributed.

Students must do a Course Project, which will involve either further study of a concept introduced in the class, or an investigation of a topic which is not reviewed in class due to lack of sufficient time. The final course grade will be determined on the following basis:

Homeworks	10%
Course Project	30%
Mid-Term Examination	30%
Final Examination	30%

Potential topics for Course Projects will be provided to the students. Students must inform the instructor no later than March 31, 2008 of the topic they have chosen for their Course Project. Since the topic of course projects is subject to the approval of the instructor, students are encouraged to discuss (verbally or via email) their potential topic with the instructor well in advance of the March 31, 2008 topic selection deadline.

INSTRUCTOR AVAILABILITY

The best way to contact me is via email. My e-mail address is brian.sullivan@villanova.edu. I will respond as promptly as possible.

Please note that work does take me out of town, usually in the middle of the week, on average, for part of approximately two weeks each month. Except in the case of unplanned trips, students will be advised when I will be out of town so that they are not waiting too long for responses to e-mail messages.