Tennessee Technological University
Department of Civil & Environmental Engineering
CEE – 4160 (5160) Experimental Stress Analysis
Elective
(Not taught 2007-2008)

2007 Catalog Data: CEE 4160 (5160): Experimental Stress Analysis. Lecture 2. Lab 2. Credit 3. Introduction to theory of elasticity; photoelasticity; theory and application of strain gauges and rosettes; brittle coatings; holographic interferometry; moiré analysis. Prerequisites: CEE 3110, Math 2120.

Textbook: James w. Dally and William F. Riley, *Experimental Stress Analysis*, Third edition, McGraw-Hill Book Co., 1991.

Reference: None

Coordinator: G. R. Buchanan, Professor of Civil Engineering

Goal: The goal of CEE 4160 (5160) "Experimental Stress Analysis" is to familiarize the student with the theory and practice of basic methods of experimental stress analysis.

<u>Course learning objectives:</u>

1. The student is to become familiar with elementary elasticity theory to cover the equilibrium, compatibility, and three-dimensional relationships commonly used in experimental stress analysis.
2. The student is to become aware of the overall concepts of stress/strain analysis by experimental means.
3. The student is to become familiar with the theory and practice of common experimental stress analysis methods including grid methods, photoelasticity, moiré analysis, interferometry and strain gauges.

<u>Course measurable outcomes:</u>

Students will be expected to:

1. demonstrate a working knowledge of basic concepts of the theory of elasticity including: stress, strain, stress equilibrium, strain compatibility, constitutive relations, and three-dimensional stress states;
2. demonstrate a working knowledge of theory, application, and limitations of grid methods;
3. demonstrate a working knowledge of theory, application, and limitations of photoelastic stress analysis including two-dimensional methods, photoelastic coatings, and the frozen stress technique;
4. demonstrate a working knowledge of theory, application, and limitations of classical moiré stress analysis;
5. demonstrate a working knowledge of theory, application, and limitations of interferometric methods of optical stress analysis; and
6. demonstrate a working knowledge of theory, application, and limitations of strain gauge methods and instrumentation.

<u>Topics covered:</u> (Two lecture classes per week, 55 minutes each; one lab per week, 2 hours each)

1. Introduction to elementary elasticity (4 classes)
2. Theory of photoelasticity (4 classes)
3. Two-dimensional photoelasticity (4 classes)
4. Three-dimensional photoelasticity (2 classes)
5. Strain gauge analysis (4 classes)
6. Strain gauge instrumentation (1 class)
7. Holographic interferometry (2 classes)
8. Moiré analysis (2 classes)
9. Moiré interferometry (2 classes)
10. Brittle coatings (1 classes)
11. Tests (2 classes)

<u>Contribution of the course to meeting professional component:</u>

This course is a part of the engineering topics of the curriculum and is an elective.

ABET category content as estimated by faculty member who prepared this course description:

Engineering Science: 3 credits of 100%
Engineering Design: 0 credits of 0%

Relation of course to program objectives:

Objective 1:	The educational program will provide and deliver a broad understanding of relevant principles of mathematics, science, and engineering.
Objective 2:	The educational program will offer a general comprehension of four technical areas appropriate to civil engineering and in-depth knowledge of at least one major civil engineering area.
Objective 4:	The educational program will require that students are taught design activities throughout the professional component of the civil engineering curriculum and have the ability to identify, formulate, and solve engineering problems.
Objective 5:	The educational program will promote effective communication skills.
Objective 7:	The educational program will enhance the understanding of experimental processes through effective laboratory experiences.
Objective 11:	The educational program will maintain an environment to carry out fundamental and applied research and advance engineering knowledge through research.

Relation of course to ABET Criteria:

General Criteria		Bloom's Level of Achievement
(3a)	Knowledge of math, science, engineering	3
(3b)	Design, conduct experiments; analyze and interpret data	5
(3e)	Identify, formulate, and solve engineering problems	4
(3k)	Techniques, skills, modern tools for engineering practice	3

Program Criteria		Bloom's Level of Achievement
1.	Apply knowledge of math and sciences	3
2.	Apply knowledge of four technical areas appropriate to civil engineering	5
3.	Conduct civil engineering experiments and analyze and interpret the resulting data	3

Computer usage: Homework project is assigned to obtain normal and shear stress profiles across a beam from photoelastic data. The shear difference method is used together with a FORTRAN program.

Laboratory projects:

1. Introduction and Lab Safety (1 lab)
2. Measurement of isoclinics and isochromatics using Tardy compensation. Report required (2 labs)
3. Calibration of a photoelastic stress freezing material both at room temperature and stress freezing temperature. Report required (2 labs)
4. Stress and strain distribution near hold in a plate by strain rosettes. Report required (2 labs)
5. Measurement of cantilever beam displacements by holographic interferometry. Report required (2 labs)
6. Practice session mounting strain gauges (2 labs)
7. Demonstration of moiré fringes in a ring (2 labs)
8. Demonstration of moiré interferometry (1 lab)

Prepared by: G.R. Buchanan Date: November 2007