MAE 459/559 Characterization of Strategically Tuned Absolutely Resilient Structures (STARS)

Responsible Department:
Mechanical and Aerospace Engineering

Catalog Description:
Given as an independent study course… no catalog description at present. Draft:

STARS are designed to store potential energy in the form of elastic deformation that can be released in a controlled fashion in the form of work or kinetic energy. Overview of solid mechanics and the design strategy for producing STARS with introductions to composite materials, concrete mixture design, stress analysis, and modal testing. Experimental techniques and numerical methods for designing and building smart structures having embedded sensors and control elements with unique properties such as morphing and self-healing. Out-of-class project required. Prerequisite: MAE/CE 370 or permission of instructor.

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Textbook:
Reference material distributed in class.

Course Objectives:
1. To present techniques for designing and building structures capable of storing potential energy in the form of elastic deformation that can be released in a controlled fashion in the form of work or kinetic energy.
2. To design structures based on the strength, stiffness, and the position of the component materials.
3. To understand how the ability to store and release energy depends upon a complex interaction between the shape, modal response, and the forcing function initiated to the structure.
4. To develop methodologies for designing and building smart structures having embedded sensors and control elements with unique properties such as morphing and self-healing.

Topics Covered:
1. Introduction to STARS; review of Statics and Mechanics of Materials
2. Overview of solid mechanics
3. Design strategy for producing STARS
4. Visualizing stress transfer in STARS via photoelasticity
5. Concrete mixture design
6. Design of composite structures
7. Numerical and experimental characterization of STARS
8. Vibration analysis
9. RRAPDS
10. Dynamic characterization of STARS
11. Stress analysis
12. Advanced STARS concepts

Class Schedule:
    Once per week; class is 2 hours 40 minutes.

Contribution of Course to Meeting the Professional Component:
    Basic Mathematics & Science: 0 credits.
    Engineering Science: 3 credits.
    Engineering Design: 0 credits.

Relationship of Course to Program Outcomes:
    In this course the student will have to show:

1) To develop within our students an ability to:

    a) apply knowledge of mathematics, science, and engineering;

    b) apply a knowledge of calculus-based physics;

    c) apply advanced mathematics through differential equations;

    d) apply a knowledge of linear algebra;

    e) design a system, component or process to meet desired needs;

    f) work professionally in mechanical systems;

    g) use the techniques, skills, and modern engineering tools necessary for engineering practice;

    h) conduct experiments and to analyze and interpret data;

    i) identify, formulate and solve engineering problems;

    k) communicate effectively.

Person Preparing this Description:
    John A. Gilbert, Ph.D., Course Coordinator, Professor
    MAE Program
    20 September 2004