MEC 456/556 - Introduction to Engineering Mechanics of Composites

Fall Semester 2017

Credit: 3 credits

Prerequisite: MEC 363 or equivalent course

Lectures: Thur 4:00 – 6:50PM at Staller Center 2314

Instructor: Kedar Kirane (kedar.kirane@stonybrook.edu)
Toshio Nakamura, (toshio.nakamura@stonybrook.edu) (First 2 lectures)

Include MEC456 or 556 in the subject line when emails are sent

Office Hours: Mon, Wed 1:30 – 3:00PM in Light Engineering 133

Text/Primary Reference Book:

- *Engineering Mechanics of Composite Materials*, Isaac M. Daniel & Ori Ishai. Oxford Press

Other Related Books:

- *Autar K. Kaw, "Mechanics of Composite Materials," 2nd ed., Taylor and Francis*
- *Carl T. Herakovich, "Mechanics of Fibrous Composites," Wiley.*
- *Michael W. Hyer, "Stress Analysis of Fiber-Reinforced Composite Materials," McGraw-Hill.*
- *Robert M. Jone, "Mechanics of Composite Materials," Taylor and Francis.*

Homework: Homework and/or computer assignments are given about every two weeks.

Grading:

Homework	30%
One Mid-Term Test (mid-late October)	30%
Final Exam (December 18, 2:15-4:45pm)	40%

Course Description:

Introduction to the engineering mechanics of fiber reinforced composites. Brief history of the development of fiber composites, their properties, advantages, limitations and applications. Overview of the different types of composites but with focus on long fiber re-inforced composites; particularly, lamina and laminate concepts characteristics and configurations. Topics covered include: elastic properties of unidirectional lamina, strength of unidirectional lamina, elastic behavior of multidirectional laminates and stress and failure of multidirectional laminates. Design methodologies and considerations for structural composite materials.

Course Learning Objectives:

1. Become familiar with the advantages and limitation of fiber composites in comparison with conventional structural materials
2. Ability of using stress-strain linear elastic constitutive relations in structural analysis, including Isotropic, Anisotropic, Orthotropic and transverse isotropic relations
3. Knowledge of coordinate transformation of stress, strain, stiffness and compliance matrices
4. Knowledge of theoretical methods for predicting effective elastic properties using rule of mixture, Halpin-Tsai formulation, including advantages and limitations
5. Ability to determine the onset of failure in composites using maximum stress theory, maximum strain theory, Tsai-Hill and Tsai-Wu theories
6. Ability to determine the elastic behavior of multidirectional laminates composed of plies with different orientations

Topics:

- *Introduction to Composites* - Basic concepts, Advantages & disadvantages, Role of constituents (fibers, matrix), Synthesis and fabrication techniques
- *Basic Concepts* – Composites terminology, Types of composites, Degrees of anisotropy, Lamina properties
- *UD lamina* – Elastic constitutive relations, Relations between mathematical and elastic constants, plane stress constitutive relation, Transformation of elastic parameters, effective elastic properties (fiber volume ratio, rule of mixtures)
- *Strength of UD lamina* – Failure mechanisms and failure criterion, failure theories (stress, strain, Tsai Hill, Tsai Wu)
- *Multi-directional laminates* – Macro-mechanical Analysis, Elastic properties, Laminate theory, *(*Cross-Ply, Moment-Curvature, Basic), Stress and Failure analysis
- *Failure and Design of Laminates* - Ply Arrangements, Failure Theories, Failure Criterion
- *Other topics:* Fracture and fatigue, Mechanical testing methods overview, Hygro-thermal effects

DISABILITY SUPPORT SERVICES (DSS) STATEMENT

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Disability Support Services, ECC (Educational Communications Center) Building, room128, (631) 632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.

ACADEMIC INTEGRITY STATEMENT

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty are required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at http://www.stonybrook.edu/uaa/academicjudiciary/

CRITICAL INCIDENT MANAGEMENT

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Judicial Affairs any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures.

CALCULATOR POLICY

Only the following calculators will be permitted to be used on all midterm and final exams in the Department of Mechanical Engineering. There will be no exceptions! This list of calculators is identical to that allowed for the National Council for Examiners for Engineering and Surveying (NCEES) Fundamentals of Engineering (FE) exam that many of you will take in your senior year, as well as Professional Engineering (PE exam) that you may take.

Casio: All fx-115 models. Any Casio calculator must contain fx-115 in its model name.

Hewlett Packard:	The HP 33s and HP 35s models, but no others.
Texas Instruments:	All TI-30X and TI-36X models. Any Texas Instruments calculator must contain either TI-30X or TI-36X in its model name.

For detail information, follow https://ncees.org/exams/calculator-policy/