**MAE 4880: Introduction to Packaging Using Anisotropic Natural Materials**

**4 credits**

**Contact Hours:** Three 50-minute lectures each week. Labs meet every week during the semester for 2 hours and 30 minutes.

**Instructors:** Erb Volkswagon

**Textbook(s) and other required material:**

*Web Designs for the 21st Century,* W. Gaits, Pretentious Hall, 2000.

*Basket Weaving for Engineers,*D. Ralliday and R. Hesnick, J Smiley & Sons, Fifteenth edition, 2004.

**Course (catalog) description:** Spring. Also offered in the summer through the Cornell study abroad program at Cornell in Tahiti. 4 credits.

Introduction to the design, analysis, and fabrication of packaging and other structures made by weaving strongly anisotropic natural materials, such as reeds, fronds, and twigs. Topics include material selection, structural design and analysis, prediction of life-cycle performance, and design for aesthetics.

**Prerequisite(s):** MATH 2940, MAE 3250, ART 1410.

**Designation as a ‘Required’ or ‘Elective’ course:** Elective.

**Course learning outcomes[[1]](#footnote-1):**

Upon completion of the course, students should be able to:

* + - 1. Know and understand the primary analytical, computational, and experimental tools for analyzing and simulating the material and functional properties of containers and other structures ('baskets', for brevity) woven from strongly anisotropic natural materials (ABET outcomes a, b, e and k);
      2. Know and understand key aesthetic concepts pertinent to basket design, and tools for analyzing the aesthetics of particular designs (ABET outcome c);
      3. Know and understand the two major manufacturing paradigms (artisan, automated) used to weave baskets;
      4. Design and make a basket to meet specified load, aesthetic, and durability requirements (ABET outcome c);
      5. Conduct load and fatigue tests on baskets (ABET outcomes b and k);
      6. Learn, through self-study, new techniques for design, analysis, or fabrication of baskets that are made from anisotropic natural materials (ABET outcome i).

**Topics covered:**

* Anisotropic material properties, solid mechanics, and failure modes of engineering grade marsh reeds and palm fronds.
* Load and deformation analysis of woven web structures.
* Experimental load testing, the how-many-bananas-till-the-bottom-falls-out test.
* Fast furrier cross-weave transforms.
* CAD of curvilinear baskets to meet volumetric and aesthetic requirements
* Fatigue analysis of marsh reeds and palm fronds.
* Experimental fatigue testing, the how-many-miles-on-a-camel-till-the-handles-break test.
* Experimental toughness testing, the how-long-does-it-take-the-TA-to-break-out test.
* Weaving, the basic basket.
* Numerically controlled weaving of high-tech plant-tissue-based packaging: CD cases, laptop carriers, artistic cell phone bodies, etc.
* Advanced weaving project in which students must learn a new technique through self-study and apply it. Possible topics include straw lamp shades, thatched roofs, Popsicle stick art, etc

**Outcome Assessment:** In addition to analyzing student surveys administered by the College, the instructor will assess the outcomes of the course by considering student results on specific questions on homework, quizzes, and exams.

**Person(s) who prepared this description and date of preparation:**

Mark Psyche and Erb Volkswagon, April 1, 2004

Updated by Tim O’Shenko and Erb Volkswagon, November 9, 2009

Update by E. Thompson and Erb Volkswagon, March 5, 2015

ABET "Outcomes"   
Engineering programs must demonstrate that their graduates have:

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| a | an ability to apply knowledge of mathematics, science, and engineering; |
| b | an ability to design and conduct experiments, as well as to analyze and interpret data; |
| c | an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability; |
| d | an ability to function on multi-disciplinary teams; |
| e | an ability to identify, formulate, and solve engineering problems; |
| f | an understanding of professional and ethical responsibility; |
| g | an ability to communicate effectively; |
| h | the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context; |
| i | a recognition of the need for, and an ability to engage in life-long learning; |
| j | a knowledge of contemporary issues; |
| k | an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. |

1. ABET outcomes are listed on page 3 of this document (please remove this footnote from the final syllabet). [↑](#footnote-ref-1)