

Chapter 49

Semester–Long Team Project Integrating Materials and Mechanics Concepts

Kyle G. Gipson

James Madison University, USA

Robert J. Prins

James Madison University, USA

ABSTRACT

The Madison Engineering Department is an undergraduate non-discipline specific engineering program. The program maintains the university-wide liberal arts core and blends engineering science fundamentals with sustainable design to integrate environmental, social, economic, and technical contexts plus systems thinking within the academic experience. Madison Engineering is dedicated to the development of engineering versatilists who can readily integrate knowledge from historically different fields of engineering. In support of this development, several courses within the curriculum integrate topics to provide space for future engineers to not be constrained by disciplinary boundaries but demonstrate the ability to adapt and work across disciplines within team atmospheres. The focus of this paper is on a course project that integrates concepts from the traditional content of stand-alone courses (materials science and mechanics of materials) via a semester long design project in which students must incorporate knowledge of both sets of content.

INTRODUCTION

Madison Engineering, the engineering program at James Madison University, is the sole engineering program at a state funded university in Harrisonburg, Virginia, USA. Madison Engineering is designed to be a progressive program unrestricted by the boundaries of traditional engineering disciplines. The program employs a range of learner-centered approaches within its curriculum and intentionally builds students potential for higher order thinking. Pedagogies incorporated into the Materials & Mechanics

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course include experiential learning, problem and project based learning, and work integrated learning in addition to more traditional approaches. This paper outlines the learning approaches associated with the project and the evolution of the semester design project.

BACKGROUND

James Madison University is a public regional university situated in the Shenandoah Valley located in Harrisonburg, Virginia. James Madison University has a total enrollment of approximately 20,000 students across all of its seven colleges, with approximately 1,700 of those students enrolled in a graduate program. The College of Integrated Science and Engineering was established in 2012.

Madison Engineering was founded in 2005, with the first cohort of students starting in 2008. Currently, the department is housed in the College of Integrated Science and Engineering. The program was designed based on the following description of the Engineer of 2020 by the National Academy of Engineering: “one who possesses strong analytical skills, strong communication skills, a strong sense of professionalism, creativity, and versatility” (National Academy of Engineering, 2004; National Academy of Engineering, 2005). The ABET accredited, accredited 10/01/2011 – present, under the Engineering Accreditation Commission program is 126 credit hour program where most students complete the degree in four years. The program has a current enrollment of approximately 450 students as of August, 2015.

MADISON ENGINEERING CURRICULUM

The Madison Engineering program was established to instruct, train, and guide engineering versatilists. The curriculum combines a campus-wide, liberal arts general educational core with courses in mathematics, science, science, engineering specific design, science, and management, systems analysis, and sustainability (Nagel, Gipson, & Ogundipe, 2014). Individual skills taught developmentally through the curriculum beginning in the first year. Courses are blended with engineering science fundamentals and engineering design theory concepts, which are ultimately utilized in various projects. With this backdrop, the program also equips students with opportunities outside of the traditional academic environment inclusive of industrial facility tours, community service, and study aboard programs. The program ultimately aims to engage students and to aid in their development of knowledge, skills and values.

Description of Course: ENGR 314 Materials and Mechanics

The following case study is focused on the project that is in the ENGR 314: Materials & Mechanics course. Materials & Mechanics is a four credit hour lecture/laboratory required course within the Madison Engineering curriculum. ENGR 314 is most often taken in the third year and was created to provide students with a working foundation to explore the governing principles of materials science and the mechanics of materials. Typical class size is 25 students per section, with two sections running per semester.

Depicted in Table 1 are the pedagogical methods within the course and the four major topic areas are listed as follows:

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