Work in Progress - A Freshman Engineering Course Designed to Convey the Essence of the Engineering Program at James Madison University

Robert Prins, Olga Pierrakos, Eric Pappas, and Ronald Kander
James Madison University, prinsrj@jmu.edu, pierraox@jmu.edu, pappasec@jmu.edu, kanderrg@jmu.edu

Abstract - James Madison University has established a School of Engineering commencing in fall 2008. Students will earn Bachelor of Science degrees in Engineering. The curriculum features a broad base of humanities coursework to accompany the traditional math, science, and engineering courses. The curriculum also features integrated business courses, a six semester sequence of Engineering Design courses, and a sustainability focus. The engineering program is designed to meet ABET criteria and prepare students for the Fundamentals of Engineering Exam. The introductory course is designed to be representative of the program content, teaching techniques, assessment techniques, and culture. As such the introductory course will contain material related to social context as well as engineering practice. This paper discusses the content and culture aspects of the introductory course.

Index Terms – freshman, engineering, sustainability.

INTRODUCTION

The new School of Engineering at James Madison University (JMU) aims to prepare students for future engineering careers by providing instruction that is grounded in basic science and liberal arts education. The engineering program also features fundamental engineering courses, a six course sequence in Engineering Design, and three courses that provide the basics of business practice. Sustainability is the focus of the program; sustainable solutions to engineering problems are stressed throughout the program and especially emphasized in a two course senior sequence. Sustainable solutions are described as solutions that take technical, economic, environmental, and social concerns into account. The introductory course will include discussions of social contexts in engineering as well as engineering practice to prepare students for the remaining engineering curriculum.

This paper begins with the design parameters of the engineering program to establish the context that the freshman course resides in. The freshman course is then discussed, with descriptions of planned course content and our plans to influence program culture at the freshman level.

THE NEW ENGINEERING PROGRAM AT JMU

A multidisciplinary task force was assembled at JMU to create an engineering program that spans traditional engineering disciplines. Significant features of the program include integrated business courses, a design-centric approach to engineering, and a focus on sustainability. The intended result is engineers whose broad education has prepared them for the wide range of challenges they will face in the workplace.

Design Parameters Applied to JMU’s Engineering Program
In addition to the broad-reaching themes described above, the task force established a set of six basic design parameters for the program. Namely, the new engineering program at James Madison University will [1]:

- provide a single engineering Bachelor’s degree spanning the traditional engineering disciplines
- graduate approximately 50 students per class,
- meet ABET-EAC accreditation standards [2]
- prepare students to pass the Fundamentals of Engineering (FE) pre-licensure exam [3]
- be designed to be completed as a 4-year, 120-credit curriculum
- have a program focus on sustainability, engineering design, and systems analysis.

THE FRESHMAN ENGINEERING COURSE AT JMU

ENGR 112 is the first course in our engineering curriculum; our objectives are to introduce the students to our program content, teaching techniques, assessment techniques, and program culture. The course will be taught as a three credit course divided into one lecture credit and two laboratory credits. Class periods will typically include time dedicated to instruction and time dedicated to individual or group project work. We will meet in a specially designed Engineering Design Studio that consists of two rooms. The larger room (30’ x 40’) will be used for instructional space, design team meeting space, and construction space. The second room (20’ x 30’) houses light duty machine tools and will be used for additional construction activities.

Engineering Program Content Represented in ENGR 112
ENGR 112 will introduce students to aspects of engineering practice as well as social context; these are themes that will
be revisited throughout the remainder of their engineering studies at JMU.

Much of the engineering practice content is broken into modules; we will present modules in the areas of Programming, Engineering Fundamentals, Business, Design, Sustainability, Visualization and Graphics, and Critical Thinking. These modules introduce topics that the students will be occupied with throughout the engineering curriculum. In addition to the modules described below, we will include content that is directed at shop safety and basic prototyping skills.

The Programming modules will concentrate on building student skills in working with spreadsheets in Microsoft Excel. Topics within this module include graphing, formulas and linked cells, working with real data, and modeling the behavior of real systems.

The modules that focus on Engineering Fundamentals will include instruction, demonstration, and laboratory activities related to the topics of statics, dynamics, fluid mechanics, and thermodynamics.

The Business modules will introduce engineering economics and project management including Gantt charts.

The Design modules will give an overview of a typical design process including problem description, concept generation and evaluation, and benchmarking.

Sustainability is a distinguishing feature of our program; we will spend time introducing students to our criteria for a sustainable design in this module. Specifically, we will discuss the interactions between technical, economic, environmental, and social concerns related to engineering solutions. We will also include case studies and simple decision tools so that they have concrete examples of how sustainability principles are applied.

The modules on Visualization and Graphics will introduce the basics of engineering drawings including three-dimensional visualization, orthographic projection, sketching of traditional three view drawings, and dimensioning. We will also introduce a 2-D CAD package.

In the Critical Thinking module we will examine personal thought processes, procedures for making personal change, problem solving processes, and the integration of these matters into daily lives. This material will be presented at an introductory level in the freshman course.

The remainder of the course focuses on social contexts within engineering and includes discussions of social and ethical responsibilities of engineers, professional and ethical performance of job duties, and the place of technology and the engineer in society.

Establishing JMU’s Engineering Culture in the Introductory Course

Another way that ENGR 112 will prepare students for the remainder of the engineering curriculum is by introducing them to the program culture. We intend to establish a culture that teaches students to value multi-disciplinary approaches to problem solving, to engage in extra-curricular engineering activities, and to be aware of social contexts in engineering. We will begin to establish this culture in the introductory class through team teaching, maintaining open laboratory hours, and considering social contexts.

Each of the engineering faculty will be involved in this class; since our faculty come from different disciplines and backgrounds, this gives us an opportunity to display a multi-disciplinary approach to course topics. Our students will have access to the Engineering Design Studio outside of class hours; the availability of this venue will foster students’ initiative by encouraging them in their assigned project work as well as extra-curricular engineering projects. We will directly influence our students’ level of awareness of social contexts in engineering through assignments and in-class discussion of sustainability issues, engineering ethics, and the place of engineering and technology in society.

CONCLUSION

The curriculum of JMU’s new School of Engineering includes basic science and liberal arts education, fundamental engineering courses, a six course sequence in Engineering Design, and three integrated business courses. Sustainable solutions to engineering problems are stressed throughout the program. Upon completion of ENGR 112, the introductory engineering course in JMU’s new school of engineering, students will have had exposure to engineering program content areas as well as a feel for the teaching methods, assessments, and culture of the engineering program.

REFERENCES


AUTHOR INFORMATION

Robert Prins, Assistant Professor, School of Engineering, James Madison University, prinsrj@jmu.edu

Olga Pierrakos, Assistant Professor, School of Engineering, James Madison University, pierraoox@jmu.edu

Eric Pappas, Associate Professor, College of Integrated Science and Technology, James Madison University, pappasec@jmu.edu

Ronald Kander, Director, School of Engineering, James Madison University, kanderrg@jmu.edu