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July 26, 2007

Patrick Cushing, Staff Attorney
Joint Commission on Technology and Science
910 Capitol Street, 2nd Floor
General Assembly Building
Richmond, Virginia 23219

Dear Mr. Cushing:

I want to again express my appreciation for the opportunity to speak to the HJR 25 Subcommittee on July 16, 2007. I am forwarding the information requested by Delegate Cosgrove on the set of educational experiences I have drafted for prospective or in-service PK-12 teachers. I believe these experiences, adapted from our very successful first-year engineering program, will serve to increase the awareness and comfort level of PK-12 teachers to the realities of 21st Century engineering theory and practice. Nationwide there are few examples of university-level engineering courses designed and/or delivered for non-engineering students and these courses are unique in that regard.

These experiences will support the Senior Year Plus initiative in the Commonwealth and also enable PK-12 teachers to bring accurate, relevant engineering information to their students. Drafts of the courses are attached as an appendix. The set consists of eight one-credit courses designed specifically for PK-12 teachers, without engineering backgrounds, who need to be able to deliver engineering content to their students. These courses will be delivered at a distance through various means to maximize access across the Commonwealth and beyond. Successful completion of all of these courses would give teachers a solid foundation in the basics of engineering, typical of what an engineering student would be expected to achieve by the middle of their second year of studies. These courses can also be made available to students working on degrees in education.

In order for this effort to succeed, these courses need to be acceptable options for teacher recertification in the Commonwealth. The Department of Engineering Education will work with the Virginia Department of Education and school systems to supply any information required to make this a reality. Courses will be continually assessed and will undoubtedly evolve as a result of input from the teachers who take them. Our goal is to assist the Senior Year Plus effort and to put Virginia at the forefront of nationwide delivery of engineering theory and methods for K-12 teachers.

We are investigating the creation of a Certificate in Pre-Engineering Studies that could be earned after the completion of a yet-to-be-determined set of the proposed courses.

With regard to the question about the Praxis asked by Dr. Michael Otaigbe, five graduating senior engineering students took the Praxis II in Technology Education, and all passed. All of them were near the end of a standard Virginia Tech Bachelor of Science degree in engineering.

Thank you once again for the opportunity to speak and provide additional information. If I can be of service in the future, please do not hesitate to ask. My direct office number is 540/231-9546, and my e-mail address is griffin@vt.edu.

Yours truly,

O. Hayden Griffin, Jr.

O. Hayden Griffin, Jr., Ph.D., P.E.
Professor and Department Head

APPENDIX

O. Hayden Griffin, Jr., Ph.D. P.E.
Department of Engineering Education
Virginia Tech
July 24, 2007

Courses for PK-12 teachers

This set of courses is intended for non-engineering students, covering the history of the engineering profession, engineering ethics, basic engineering approaches to problem solving, and the applicable theories of basic engineering. Engineering theories and problem solving are presented both in the standard approach and an advanced conservation approach to give the student a deeper understanding of the theories and their application to engineering problems. These courses may not count toward an engineering degree in any way. All courses are 1 semester hour, and the intention is to offer them at a distance using various tools.

Course 1: History and current practice of engineering (prerequisite to all others)
Study of the development of the engineering profession and engineering education. Professions held by engineers in the 21st Century. Common functions and activities of practicing engineers in industry, government, and academia. Comparison of similarities and differences of the technology team members. Basic practices in advising pre-engineering and engineering students.

Learning objectives:
- Describe the history of the development of the engineering profession
- Describe common positions currently held by engineering graduates
- Describe engineering functions and practices
- Describe the similarities and differences between engineers, scientists, technicians, and other technical field professionals

Course 2: Engineering approaches to problem solving and computation (prerequisite – Course 1)
Techniques used by engineers to pose, frame, and solve problems. Development and use of scripted problem solving methods. Discussion and practice in solving simple engineering problems. Discussion of computational techniques used in contemporary engineering practice.

Learning objectives:
- Demonstrate use of a scripted problem solving technique
- Describe the common engineering approach to problem definition and framing
- Describe and perform solutions to simple engineering-type problems
- Describe common computational approaches used by practicing engineers

Course 3: Engineering ethics (prerequisite – Course 1)
An introduction to the application of basic ethical theories to ethical dilemmas in engineering. Topics include risk and design, professional responsibility, loyalty, conflict of interest, safety, and intellectual property concerns with an emphasis on real-world engineering case studies.

Learning objectives:
- Describe fundamental ethical theories
- Demonstrate skills and insights in moral problem solving
- Identify organizational, social, cultural, and legal issues when considering engineering ethical problems
- Identify ethical issues such as risk and design, professional responsibility, loyalty, conflict of interest, safety, and intellectual property concerns in contemporary and hypothetical cases
- Explain the impact of engineering decisions on global communities and the environment
- Describe the importance and relevance of engineering codes of ethics and professional societies

Course 4: Introduction to engineering design (prerequisite – Course 1 and 2)
Introduction to the engineering design process. Comparison to design processes in other disciplines, including instructional design. Study of the individual steps in the design process, including common activities conducted by engineers and other members of the technology team during design activities. Case studies in engineering design.

Learning objectives:
- Describe the engineering design process and its relationship to design processes in other disciplines, including instructional design
- Describe the different steps involved in an engineering design
- Specify the disciplines involved in complex designs using case studies
- Apply the engineering design process to conceptual design of simple systems

Course 5: Engineering problem solving (prerequisite – Course 1, 2, and 3)
Problem solving in an engineering context. Statement, definition, framing, and reduction to mathematical forms of simple engineering problems. Consideration of problems in classical mechanics, electrical theory, and thermal systems.

Learning objectives:
- Demonstrate understanding of basic theory and problem solving in classical mechanics – solids and fluids
- Demonstrate understanding of basic theory and problem solving in electrical theory
- Demonstrate understanding of basic theory and problem solving in thermodynamics

Course 6: Engineering problem solving – approach based on conservation theories (prerequisite – Course 1, 2, 3, and 5)
Problem solving in an engineering context using conservation principles, with comparison to traditional approaches used in previous courses. Consideration of problems in classical mechanics, electrical theory, and thermal systems.

Learning objectives:
- Solve basic engineering problems using an advanced approach based on conservation principles
- Solve problems in classical mechanics
- Solve problems in electrical circuits
- Solve problem in the thermal sciences

Course 7: Engineering graphics (prerequisite – Course 1)
Graphical approaches used by engineers in the solution and reporting of engineering designs and problem solving. Proper method of presentation of data. Contrast and compare engineering graphics to drafting. Print reading of rudimentary drawings of electromechanical and land development systems. Future trends in engineering graphics, including virtual environments.

Learning objectives
- Describe the differences and similarities between "engineering graphics" and "drafting"
- Describe different graphical means of displaying designs
- Read basic engineering drawings for mechanical, electrical, and electromechanical systems
- Discuss current and future trends in engineering graphics

Course 8: Engineering communication (prerequisite – Course 1)
Communication formats, techniques, and technologies used by engineers. Context of written engineering communication and contrast with writing assignments common in other fields. Proper presentation of engineering solutions, engineering reports, and engineering communication.

Learning objectives:
- List the different forms of communication commonly used by engineers
- Describe the context of engineering communication in the engineering workplace
- Describe and demonstrate proper written and oral presentation of engineering solutions