

# Professional Ethics Education in Engineering and Engineering Technology

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## **Abstract**

It is the authors' experience that current professional registration for engineers requires more knowledge about professional ethics than in the past. This study first investigates the current state of professional ethics education in engineering. The question to be answered is "has engineering education responded to the ethics requirements of professional registration." The data was obtained through the curricula as provided by the institutions on the internet. The top 30 universities as ranked by U.S. News Online ([www.usnews.com/usnews/edu/college/corank.htm](http://www.usnews.com/usnews/edu/college/corank.htm)) were used. Because mechanical engineering was common to all engineering schools, the mechanical engineering curricula were used for evaluation. These curricula were reviewed, including electives, for the requirement and availability of ethics exposure. The results were that exposure to ethics was slight within the ME courses. The only required course with ethics content was the senior seminar. Unfortunately, many mechanical engineering curricula do not require a senior seminar. Moreover, some required senior seminars may not include ethics. To obtain specific ethics content, students must take philosophy electives. Another study by Karl D. Stephan found that 65.8% of engineering programs have no ethics requirement and another 10% required only some ethics content. (1) It is apparent from these studies that ethics exposure is slight. Because of the limit on credits of about 130 semester hours, it is unlikely that another course, particularly on ethics, will be added to the curriculum. This paper presents the need to develop further ethics exposure and discusses techniques that would be helpful without burdening the curriculum.

## **Introduction**

Most technical faculty, believe that the "General Core" courses over burden the curricula of engineering courses and ethics can be thought of as another core course. Engineering ethics deals with technical content in a social context. The social aspects concern fair treatment of other engineers and those who use engineering services. Ethical knowledge is very different from engineering technical solutions and "honest" engineers can have difficulty with ethical situations. The introductory ethics course at the University of Southern Mississippi, PHI 300, Business Ethics (3 Sem. Hrs.), is defined as "A philosophical exploration of how to recognize, analyze, and implement ethical decisions within the multivalued contexts of the various fields of business." This course would help students understand ethical situations but it lacks the technical aspects of the engineering environment. Professional engineers teaching ethics is a better solution. However, the Accreditation Board for Engineering and Technology (ABET) does not emphasize ethics. Their statement in section IV.C.3.j states "An understanding of the ethical, social, economic, and safety considerations in engineering practice is essential for a successful engineering career. Course work may be provided for this purpose, but as a minimum it should be the responsibility of the engineering faculty to infuse professional concepts into all engineering course work."(2) The word "may" indicates that ABET relegates these topics lower in the hierarchy of engineering knowledge. For engineers that become registered and work with the public, professional ethics is much more important. Professional Engineering is a response to a need that involves care. And, care is recognizing the characteristics of the need, assuming responsibility, acting, and assessing whether the need has been met.(3) Unfortunately, our society has

become quite litigious and engineering ethics is more important now than in the past. "Too often, the educators agreed, young professionals get caught by surprise when faced with an ethical problem in their professional practice. Never having seriously thought about such a problem, they may not handle it well." An engineer that shares a standard of conduct with many other engineers is more likely to follow it. (4) Consequently, the need to present ethics to engineering students, within the curricula constraints, is important.

### **Techniques**

With such a cramped curriculum and the need for professional engineer instruction, what options are open? It is apparent that the subject must be covered in existing technical engineering courses. The two ways to present the material are (a) through one course or (b) distributed over several courses. Regarding the one course option: In most programs, a capstone course is required for all students. This is probably the best place to locate the ethics material. Because each student often has an individual or team project, the ethics material should be presented to all students. This can be done in the common meetings of the capstone course. In those cases where common meetings are not used, they should be scheduled. The ethics material should be presented first and the questions about individual projects should be last. Such a schedule prevents the open-ended project discussions from using time allocated for ethics. At least five ethics presentations with assigned "real world" ethical situations should be used. Although this would not cover the subject in depth, it would present the important ethical concepts and several ethical problems to the seniors. Testing on the ethics should be done at the last capstone meeting. It is probably too difficult to test during the presentations. Although it would impact fewer students, ethics can be presented at the graduate level. At the School of Engineering and Applied Science, University of Virginia, ethics and engineering are integrated in a graduate option entitled "Systems Engineering, Ethics, and Technology Studies." This program emphasizes "The Engineer as A Global Citizen" who can evaluate and solve complex engineering ethical issues such as the last launch of the Shuttle Challenger and others found <http://onlineethics.org/>. (5) Some of these real-world problems are very interesting to students that have little practical experience.

In some programs, a nontechnical elective is available and a course in ethics could be required. The instructor would not be a professional engineer but could be asked to include some engineering topics. This approach would devote more time to this topic than other options. The quality of the engineering aspects would depend on the interest of the instructor.

Regarding the distributed delivery system: The professional engineering faculty would be required to meet and determine what portions of the ethics materials would be most appropriate in the courses that they teach. This ethics material would then be presented during the semester along with the technical course material. The important concepts could be presented in a few lectures in each class. This would be particularly germane if an ethics problem could be combined with a technical problem. Testing should include the ethics material on one of the tests or the final exam. It is the authors' experience that if some material is not tested, students will not study it.

At Mississippi State University a "Supplemental Reading Initiative Program" requires students to read and be tested on books and articles that are not presented in class. (6) The objective of this program was to enhance reading and writing skills as needed by employers and accreditation agencies. However, it provides an excellent method for delivering ethics knowledge to engineering students without adding to the curriculum. Some of the methods for evaluating the supplemental reading are daily discussions, pop quizzes, written reports, and the regular exams. Thus, the students must read the material to receive an acceptable grade.

A less attractive, option exists through the widely required technical writing course. This option involves asking all of the technical writing instructors to assign one research paper on business ethics. The engineering students would research engineering ethics, the accounting students would research accounting

ethics, etc. Like the third option, the disadvantage is that engineering ethics would be diluted by other student interests. If all of the technical writing instructors agree, this option would be better than nothing.

### **Conclusion**

Until an engineer becomes involved in a problematic ethical situation, engineering ethics seems unimportant. Hopefully, no unethical acts have occurred and an acceptable solution can be found. A little ethics knowledge is certainly better than none because it introduces the commonly overly technical engineering student to a new realm of professional reality. Some ethics knowledge can alert an engineering practitioner to an issue that can be investigated further and about which he can obtain help. Like engineering economics, an important aspect of engineering ethics is the overlap with nontechnical daily life. The ethical problems and solutions learned in college will certainly aid graduates in both their engineering and non-engineering pursuits.

### **References{ TC V1 }**

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