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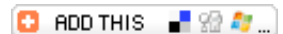> Editorial Info
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opinion

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Why Computer Engineering Students Should Take the Fundamentals of Engineering Examination and How Professors Can Help

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Many senior-year computer engineering majors never imagine that it is to their advantage to take the fundamentals of engineering (FE) exam to become registered as an engineering intern (EI) or engineer-in-training (EIT) in their state. Many of these students believe that this first step to professional licensure is for other disciplines and that computer engineering students cannot pass the examination. While it may be true that in some curricula computer engineers have not taken many of the courses covered under the FE examination and must choose between taking the afternoon examination for electrical engineering or the 'other discipline' examination (formerly known as the 'general engineering' examination, to a true engineer, these facts serve more as challenges than deterrents. The number one factor deterring computer engineering seniors from taking the FE examination is not a fear of failure, but rather because they do not see the benefits of becoming a registered EI.

An increasing number of students have aspirations not to use their degrees to gain employment within industry, but to start their own company or go into private practice. What most of these future entrepreneurs do not realize is that without obtaining Professional Engineering (PE) licensure, they cannot legally offer engineering services to the public or even refer to themselves as engineers in most jurisdictions. Other advantages that many of these students fail to appreciate are that in addition to being able to legally offer engineering services to the public, they can also miss out on other possible opportunities for consulting work. Also, being a professional engineer might cause their resumes to stand out even for jobs for which it is not required (under

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industrial or government engineering practice exemptions).

The low number of computer engineers taking the FE examination is a concern for the entire engineering community. This article details what computer engineering students can and should do to prepare themselves for EI registration at different stages of their academic experience, and how they can be encouraged to do so. Students should be reminded that it is never too late to start preparation for licensure and that the earlier that one starts this process, the better their chances for success.

Choosing the Right Classes

Out of the subjects that are covered by the FE examination, the typical computer engineer is prepared to answer questions in the areas of algebra, trigonometry, geometry, properties of areas and solids, probability, statistics, calculus, differential equations, engineering economics, ethics, inorganic and organic chemistry, energy, work, power, electrostatics, DC and AC circuits, and electronics. This leaves 15 subjects that the typical computer engineering student may not have studied at all. Students should use their elective courses to learn about the remaining topics. Just as important as the selection of math and science electives is the choice of how to use one's free elective hours. Use these hours to take an additional math, science or engineering class. Any elective course that will allow the student to reduce the number of uncovered FE subjects is a good choice. Convincing students to not just enroll in the easiest course that meets elective requirements and instead to take courses that will help them the most in their future career is one of the biggest challenges facing academic advisors.

When students reach their senior year, if they have not been preparing for the FE, it is important to reassure them that it is never too late to start. They should also be advised that they may have to work a little harder and longer than those students who have been preparing themselves previously. All students, whether they have been preparing for the examination or not, should be encouraged to take a review course prior to attempting the FE examination. No matter how much attention is given in courses taken three years earlier, students will still be rusty and need a refresher.

Study Groups

While students tend to be more comfortable in study groups with people they know, students usually know more people in their own engineering field than students in other fields. When assembling a study group, the best make up is to have one student from each engineering field so that students can help others in their own different areas of expertise. Computer engineering students may need to be able to help other engineering students in subject areas such as mathematics, physics and chemistry in order to receive help in subjects such as materials science or thermodynamics. A good way to meet people in other disciplines in order to form these groups is through attending FE examination review courses.

Preparation During the Semester of the Exam

One of the hardest parts of preparing for the FE examination for most students is that it may be one of the first times that they have to truly work independently. Students must also decide whether to take the 'other engineering disciplines' or the 'electrical engineering' examination module in the afternoon session. Most computer engineering students are far better prepared to choose the electrical engineering afternoon module and should be discouraged from taking the 'other engineering discipline' module that was designed for specialty engineering majors.

The following study plan is suggested to help students maximize their possibility of passing the FE examination:

- **Step 1:** Sign up for a review course and buy an FE study guide. Also, purchase the FE Supplied-Reference Handbook from the National Council of Examiners for Engineering and Surveying (NCEES) and familiarize yourself with its content as this will be the only reference material available during the examination. Students may download a free electronic version of the FE Reference Handbook from teh NCEES Web site. Familiarize yourself with the format and logistics of the examination by reading through the NCEES webpage [http://www.ncees.org/exams/fundamentals/].

- **Step 2:** Take one sample test before beginning to study. Then use the sample test to identify strengths and weakness. In addition to sample examination problems available from independent publishers, the NCEES also offers a sample examination for the FE examination.

- **Step 3:** Identify subjects that you have little hope of mastering before the examination and spend less time in these areas.

- **Step 4:** Spend only a small amount of time on your area of strengths, possibly only listening to the lecture on the subject and skimming through notes.

- **Step 5:** In the areas that you are very rusty or feel you have the background to master in the time before the test, carefully read the review manual chapter and attempt to work the problems at the end of the chapter before the lecture. During the lectures on these subjects, pay close attention and ask lots of questions. After the lecture, read the chapter again and find someone that can help you in that subject if you are still having trouble with some of the content. Students should devote the most time to this category of subject areas.

- **Step 6:** Approximately one week before sitting for the FE examination, take another practice exam. This time only identify areas that need just a little more work.

- **Step 7:** Work only on the areas identified in Step 6.

- **Step 8:** Do not stay up all night cramming before the exam. Get eight full hours

of sleep. About one hour before going to sleep, stop studying and use this hour to clear your mind and relax.

Strategies for Encouraging Students to Achieve EI Registration

Due in part to the lack of public awareness of professional licensure of engineers and the large majority of working (computer) engineers that are employed under the industrial exemption clause, many undergraduate computer engineering students are totally unaware of the process for achieving licensure. Even those who have heard of PE licensure often believe that it is not relevant for computer engineering; or even worse, have been counseled by others that they do not need licensure. For these reasons, it is important to mention licensure as early as possible and in as many different classroom settings as possible. Students should be reminded that the purpose of engineering licensure is to protect public health, safety, and welfare and not to test their academic prowess. If a prospective computer engineer plans to practice in any area that does affect public health, safety, and welfare, then they should automatically be interested in achieving professional licensure.

As an example, during a basic digital logic course, which is typically a second-year computer engineering requirement, there is usually a discussion of how to avoid hazards or glitches in digital circuits that manifest themselves as momentary transient pulses. A good example is to point out what would happen if this glitch were to appear at the reset input of another digital circuit — a reset could occur when it was not intended. Then the conversation could proceed by assuming that the circuit that was mistakenly reset was the control circuit for an elevator controller or perhaps the electronic braking control system for an automobile. Clearly, these are issues of public safety and this is exactly the purpose of professional licensure— to protect the public. This can lead to interesting classroom interaction and helps students to understand that licensure makes as much sense for computer engineers as it does for structural engineers who design bridges.

A final and more pragmatic reason for encouraging students to sit for the FE examination in their senior year is to point out that, even if they do not plan for private practice immediately, they may wish to do so in the future. After several years of engineering experience in a practice field have been obtained, it is more difficult to pass the FE examination than if it were taken during the senior year when coursework pertaining to the fundamentals is still fresh in students' minds. While it is never too late to start preparation for licensure, the earlier that one starts this process, the better their chances for success.

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