

# RE-ENGINEERING ENGINEERING EDUCATION CHEMICAL ENGINEERING AND ABET EC 2000

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**A**doption of ABET Engineering Criteria 2000 by the Accreditation Board for Engineering and Technology, along with a revised set of Program Criteria for Chemical Engineering by AIChE, will certainly have a significant effect on the education of chemical engineering graduates as we move into the 21st century. There is a profound shift in emphasis, from requiring a specified curricular content to evaluation of programs for the success they demonstrate in meeting their own goals for how and how well they prepare their graduates. This, along with how well programs continuously assess and improve their processes to achieve these goals, is a major “sea change” for engineering accreditation. A concomitant increase in flexibility, which should allow chemical engineering programs significant latitude in meeting their objectives, is perceived by many, particularly those in industry and in higher academic administration, as being long overdue. There is, however, a significant price to be paid.

For the first time in three decades, many chemical engineering programs are now thinking carefully about the goals and execution of their undergraduate curricula. The typical

curriculum that has been in place since the 1960s, an amalgam of our petroleum- and industrial-commodity-chemistry based past and the transport-phenomena revolution of the 1960s, now faces new challenges. An increasing number of our graduates find employment in the biologically based industries (food, textiles, agricultural byproducts, pharmaceuticals, biomedical industries) and in the information-processing industries (microchip manufacturing, solid-state processing, software development). Many graduates find employment as financial analysts, seek careers in law and medicine, and embark, as engineers, on a wide variety of career paths. The faculty in charge of undergraduate curricula, who have put their trust in a prescribed and somewhat narrow set of courses (usually organic and physical chemistry, fluid mechanics, heat and mass transfer, chemical reactor design, thermodynamics, process control, and design) are now beginning to think seriously about the role of subjects such as biology, solid-state chemistry and physics, new materials, nanotechnology and mega-systems, etc., as they relate to their goals for their graduates. They are becoming more concerned about how elements of the curriculum fit together and support each other in the educational process.

ABET Engineering Criteria 2000 attempts to provide a framework by which chemical engineering faculty members can develop their programs to achieve these desirable evolutionary changes without jeopardizing their accreditation standing, while at the same time requiring them to change their emphasis from what is taught to what is learned. This is no small feat. The new criteria essentially requires that chemical engineering programs address three basic questions:

- ▶ *Within the context of chemical engineering, what are your objectives for your graduates, and how did you and your constituencies set them?*
- ▶ *How do you determine if your objectives are being met?*
- ▶ *What are you doing to fix things if your objectives are not being met, or improve things even if they are?*

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After a considerable amount of discussion and public input, the Engineering Accreditation Commission agreed on a basic set of attributes (outcomes) which should be required of all engineering graduates. This list of 11 attributes (a through k from Criteria 3) forms the minimum "experience base" that the profession accepts as necessary attributes (or outcomes) for all engineering graduates. It is expected that individual programs will supplement this list, which is not intended to be exhaustive.

The "knowledge base" that is required by the general criteria for all engineering graduates has been considerably modified in the new criteria. For example, neither courses in physics nor chemistry are specifically required. Specification of a minimum amount of social sciences and humanities courses is no longer stated. The appropriate coursework will still need to be prescribed by the faculty, with an eye towards fulfilling the attributes stated in EC 2000 and the program criteria, consistent with the overall goals of their program and the nature of their discipline.

AIChE, through its representatives on the Education and Accreditation Committee, has taken a conservative approach in proposing its new outcomes-based program criteria. The current state of these criteria, as well as other items of interest regarding the new process, may be monitored on the World Wide Web at <http://www.abet.org>. Note that the language addresses the requirements placed on the capabilities of the graduates. No courses are specifically required. Perhaps the most significant change is the discontinuance of the requirement of one-half year of advanced chemistry, which has been replaced by a more demanding requirement of a thorough grounding in advanced chemistry, in a list of areas of chemistry which may be specified more precisely by the faculty itself in any program. For many years, there has been the conventional and wide-spread belief that either ABET or AIChE "required" both organic and physical chemistry, although this has never been the case. Chemical engineering faculties throughout the country have locked themselves into this box. It will be interesting to see, now that the box has been unlocked, what choices will be made.

Unquestionably, the greatest area of concern that has been expressed among chemical engineering faculty and department chairs has been an uncertainty with respect to "what does ABET expect of us in the areas of outcomes assessment and continuous improvement?" The short answer, we believe, is that programs will need to set their own expectations in this area, as well as in other areas. Actually, they always have. In a profession that has placed the principles of process control in a central place in its curricula, it

should not be difficult to adapt the basic principles of measurement, feedback, set-points, and load changes, to determining the degree to which their graduates are meeting their objectives. The public, of course, expects this.

To aid faculty and administrators in this area, as well as to gain experience in the new accreditation process, a series of pilot visits has been completed. In the 1996-97 academic year, two institutions, the University of Arkansas and Worcester Polytechnic Institute, were visited using EC 2000. In the 1997-98 academic year, three more institutions, Harvey Mudd College, The Georgia Institute of Technology, and Union College were evaluated using EC 2000. One result of these pilot studies will be a set of case studies that should be useful in helping to set goals, in establishing mechanisms of outcomes assessment, and in preparing for and participating in accreditation visits. These studies are not intended to be a "how to" set of instructions, but rather a set of examples that have been used successfully. The first case study, for a fictitious institution, Coastal State University, is now available on the ABET Web site at <http://www.abet.org>. It represents an amalgamation of experiences from

the pilot studies.

In addition, the Engineering Accreditation Commission, in concert with the educational elements of the various technical societies, including AIChE, is developing a standard set of training materials for engineering program evaluators. This course will be useful for faculty and administrators in getting a better understanding of the accreditation process that will accompany the new criteria. Also, with the sponsorship of NSF and with the cooperation of industry, a series of twelve regional NSF-sponsored industry-hosted workshops for training faculty from every engineering program in the U. S. began in late 1998 and will continue for the next three years. Watch the ABET Web site for more information.

The challenge provided by Engineering Criteria 2000 for programs to evolve in meeting their goals is also an opportunity. Those faculties who felt constrained by ABET in the past now have an opportunity to experiment. Those institutions whose general accreditation review was scheduled in 1998-99 academic year and is scheduled to occur in the 1999-2000 or 2000-2001 academic years have the choice to seek re-accreditation under either the existing criteria or under EC 2000. All engineering programs at the institution must make the same choice. Beginning in the year 2001-2002, all institutions will come under the new Engineering Criteria 2000. What the future holds will be determined by the experiences we will share during that period. □

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