

Web-Based Presentation of Course Objectives Across a Mechanical Engineering Undergraduate Degree Program

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Abstract

In preparation for an ABET visit in the Fall of 2001, the Department of Mechanical Engineering (ME) at The University of Alabama (UA) has developed a list of both program objectives and expected outcomes as required by the ABET 2000 guidelines. A natural extension of this program-level effort was to develop educational objectives for each individual course required in the undergraduate ME degree program. To facilitate the distribution of course objectives, the ME Department at The University of Alabama has developed a web-based linkage of course objectives (<http://www.me.ua.edu/me-courses/flowchart.html>) for most of the courses in the undergraduate ME degree program. The posted course objectives are in a standardized format (which proved to be quite helpful in producing the course objectives), and many of the course objectives are augmented with example problems. These example problems serve to clarify exactly the skills and/or knowledge students are expected to develop, learn, or master. Web access provides students and faculty access to the course objectives from any location at any time. The website currently includes course objectives only for ME courses. Future plans include linking course objectives from non-ME courses in electrical engineering, materials engineering, mechanics, math, physics, and chemistry.

Background

In recent years, many prominent engineering educators have described the need for detailed course objectives in engineering courses. In his successful ASEE sponsored teaching workshops and numerous papers, Felder provides a justification for and several examples of course objectives (Felder and Brent, 1997). The recent paper by Felder, et al (2000) on improving engineering education provides several additional references that address the issue of course objectives. Wankat and Oreovicz (1993) devote an entire chapter of their book Teaching Engineering to course objectives. Of course the idea of writing course objectives is not new. Venable (1984) discussed instructional objectives for a mechanical engineering design course more than fifteen years ago. Also, an entire set of course objectives developed in 1975 for statics are available on the web from Plants and Venable (1975).

The University of Alabama will have its first review under the ABET 2000 process in the Fall of 2001. The ABET format requires departments to develop program objectives and program outcomes that detail progress toward these objectives. In preparation for this visit, the Mechanical Engineering Department decided to create detailed course objectives for every course in the undergraduate program. The need for course objectives developed naturally from the program objectives and outcomes. The ME course objectives are reasonably uniform across the degree program and serve four primary purposes:

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- communicate clearly to students exactly what is expected of them in the course, e.g. what skills and/or knowledge they are expected to develop, learn, or master,
- assist instructors who have never taught the courses to identify what material needs to be taught, and how the material in the course is incorporated into the overall degree program,
- let students know what the pre-requisite skills and/or knowledge are before they enroll in a course, and
- provide a baseline that instructors can use when preparing downstream courses, e.g. they have a clear statement of the material students have covered in pre-requisite courses.

Of course, no matter how well course objectives are written, they cannot accomplish these goals if they are not widely distributed to both students and faculty. Additionally, course objectives do change periodically and the most recent versions of the course objectives should be readily accessible by all interested parties. To facilitate the dissemination of course objectives, a web-based presentation has been developed and is located at <http://www.me.ua.edu/me-courses/flowchart.html>.

Website

Figure 1 shows the main page for accessing the course objectives. The flowchart shows the details of the ME program with course pre- and co-requisites. This graphical format was selected since it is

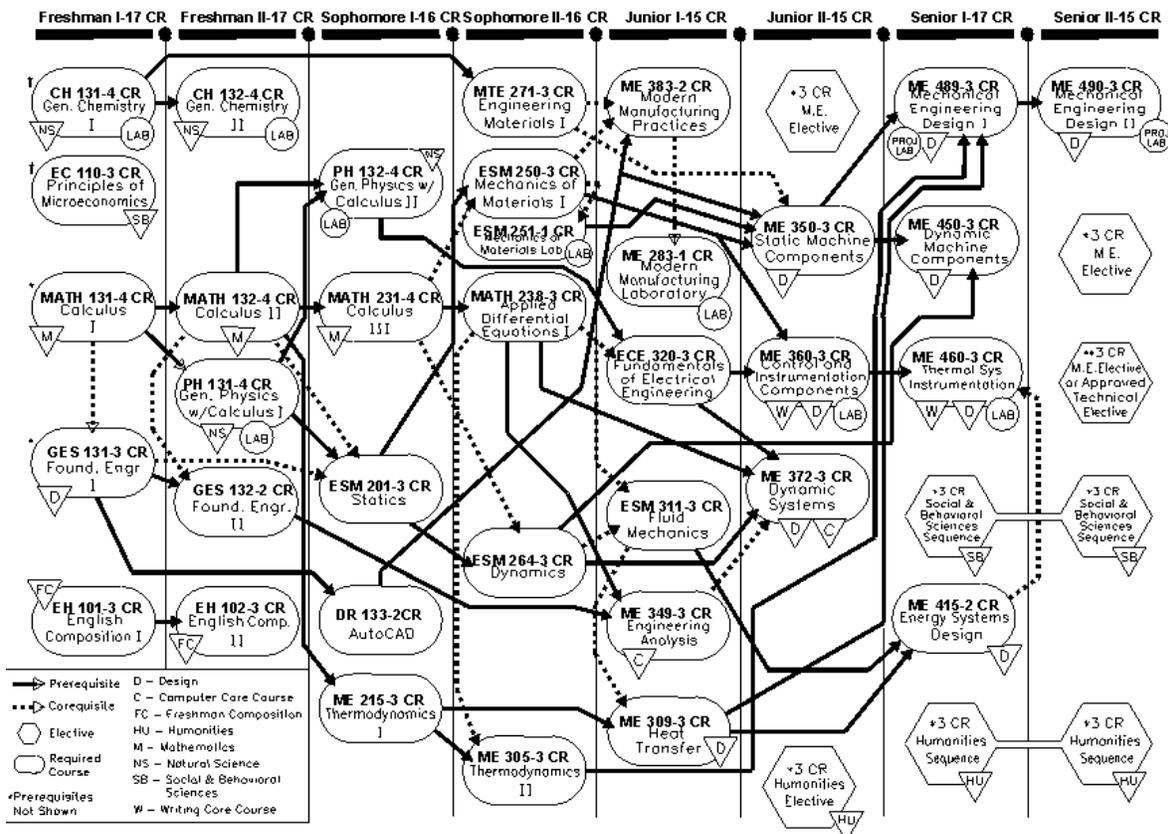


Figure 1. Flowchart for UA Mechanical Engineering Degree Program

very familiar to students, faculty advisors, and staff in the ME department. Each column clearly indicates the courses required for each of the eight semesters in the program. Course pre-requisites (solid lines with arrows) and co-requisites (dashed lines with arrows) are also indicated. Of course very few students remain on this ideal plan, but the document remains useful for planning purposes. Individual course objectives can be accessed on the website by simply "clicking" inside the oval for a particular course. Hyperlinks to the pages with course objectives are also provided from a textual description of the required courses in the undergraduate mechanical engineering program (http://www.me.ua.edu/me-courses/courses_text.html).

Figure 2 shows a portion of the course objective page for one course, ME 360 – Control and Instrumentation Components. The UA catalog description of the course is given first. Typical course instructors are listed next. Hyperlinks (shown as underlined information in the figure) to the home page of each instructor are provided. Many faculty keep contact information (e-mail addresses, phone numbers, etc.) on their home pages. A link to a typical course syllabus is provided for many of the courses. The course syllabi and most other supplementary information are provided in both Acrobat PDF and HTML format.

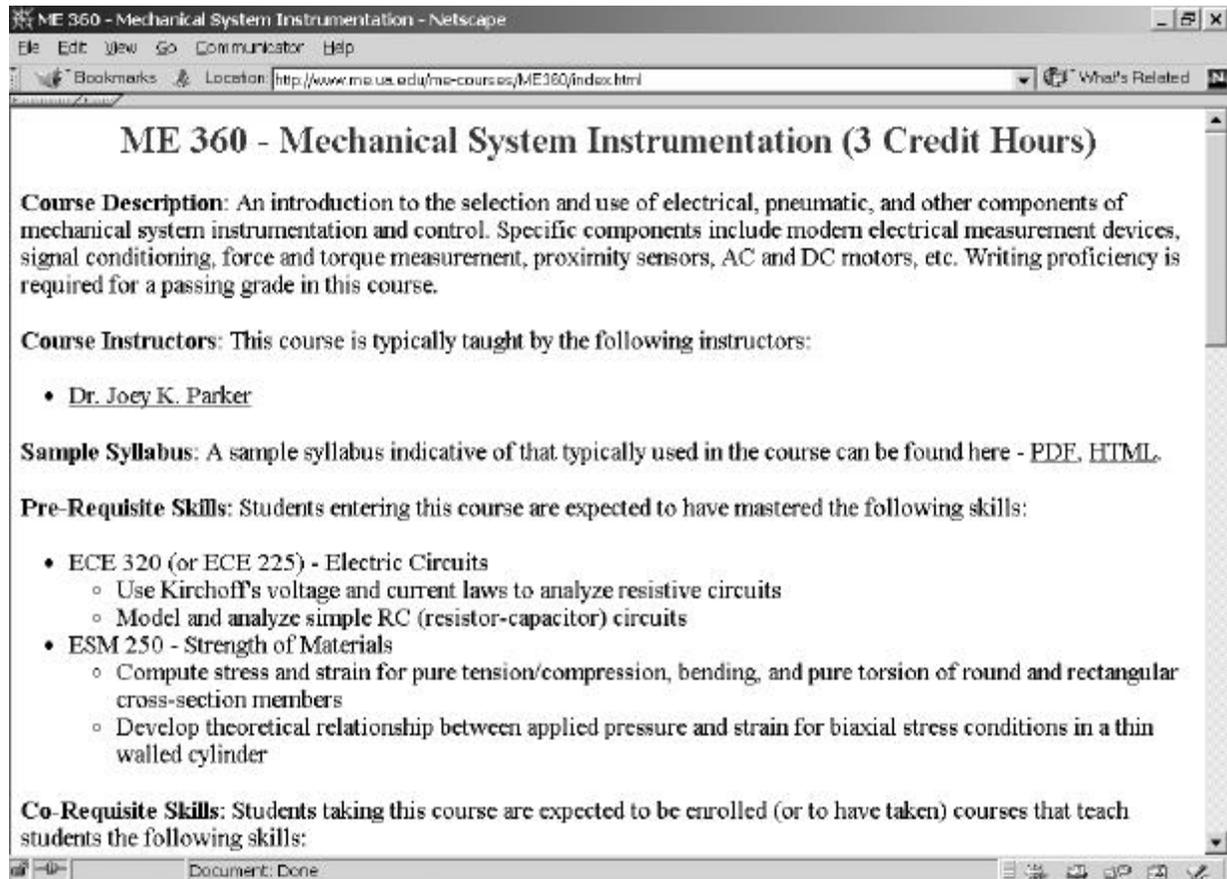


Figure 2. Course Objective Webpage for ME 360

Pre- and co-requisite skills (if any) are listed next. A traditional approach has been to simply list pre-requisite courses and hope that students remember the necessary information and skills. Listing specific pre-requisite skills will inform students and faculty of the key links between courses. Also, providing students with a detailed list of necessary skills should lead to improved retention of pre-requisite material. Faculty knowledge of what materials are actually used in downstream courses will help with both planning

and teaching of earlier courses. Note that in the example given in Figure 2 no hyperlinks are provided to the two pre-requisite courses since they are not taught by the ME department.

Figure 3 shows the remainder of a typical course web page. A listing of course objectives is given after the pre- and co-requisites. Many of the course objectives shown in Figure 3 have hyperlinks to example problems typically found in homework sets or on tests. The purpose of these example problems is to clarify exactly what is meant by many of the objectives. Eventually these clarifying examples will be provided for most of the course objectives for every course. Each course objective on the website is terminated by a letter in parentheses. These letters refer to the ME departmental program outcomes specified in ABET Criterion 3. In this way the course objectives serve to document the ME program for accreditation purposes as well as to serve the needs of students and faculty.

Links are provided to sample tests and examinations for many of the courses. Again, these sample tests are intended to clarify the course objectives and give a clear indication of exactly what the students are expected to learn in the class. The last item includes hyperlinks to the course descriptions of any downstream courses for which this course serves as a pre-requisite.

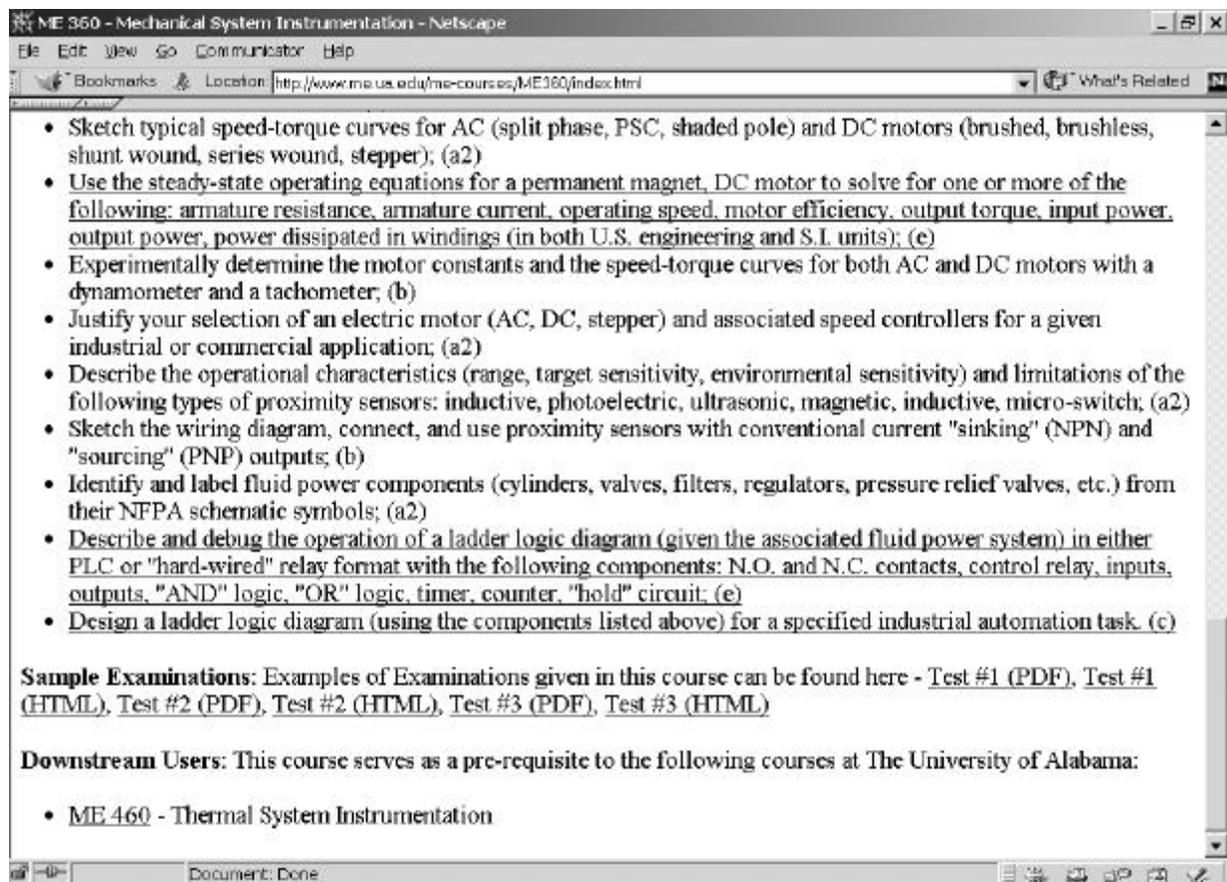


Figure 3. Course Objective Webpage for ME 360 (continued)

Process for Developing Website Materials

Figure 4 shows a timeline for developing the course objective materials. The authors initiated the concept during the summer of 1999 based on some of their activities in the Foundation Coalition. A draft format for the website was developed and example webpages were created. Materials from two courses frequently taught by the first author (ME 360 – Control and Instrumentation Components and ME 372 – Dynamic Systems) were used to create the samples. In conjunction with other instructors, course objectives had been written and used to some degree for these two courses for several semesters. After modifications and improvements were made to the initial formats, departmental input was solicited. The ME departmental ABET committee reviewed the draft website and approved the concept.

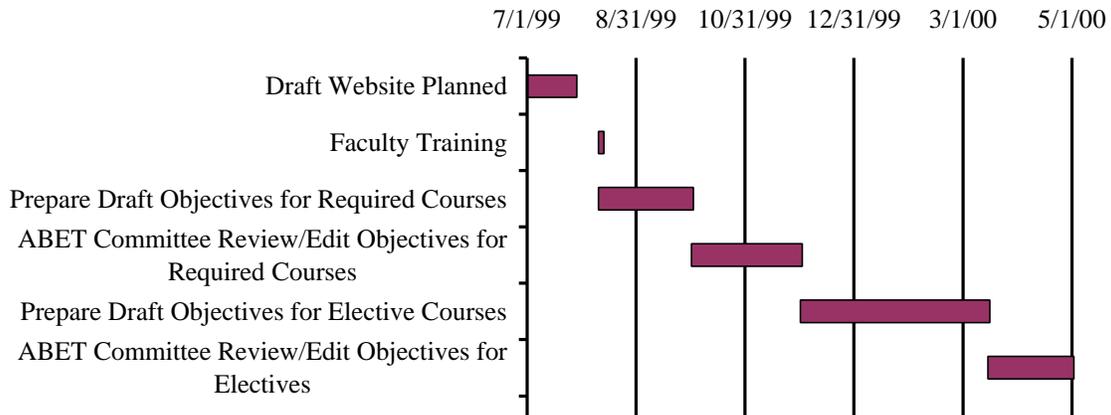


Figure 4. Timeline for Developing Course Objectives

Faculty training in writing course objectives was a necessary next step. A two-hour "mini-course" on writing course objectives was developed. This training was delivered during the ME departmental annual retreat held just before classes started in the Fall 1999 semester. The material for the training session was largely developed from an on-site *Effective College Teaching* seminar presented by Richard Felder and Rebecca Brent earlier in the year. A discussion of the utility of course objectives was followed by several examples drawn from existing courses. Guidelines for writing good course objectives were followed by a "hands on" session in which each faculty member wrote and critiqued a few course objectives. At the conclusion of this meeting, each faculty member was assigned from one to four courses in the ME program. Untenured faculty members were given only one course to write objectives for (one that they had taught before), while the more experienced faculty members were given more courses. The department felt that it was important to have all faculty members participating in the exercise, but did not want to unduly burden untenured faculty. Only required courses in the ME undergraduate program were included in this initial effort. A deadline of October 1999 was established for drafts.

After all of the draft objectives for the required courses were written, the departmental ABET committee reviewed each document. Some minor inconsistencies in wording were eliminated at this stage. The primary task at this time was the assigning of the ABET Criteria 3 categories to each course objective. Initially, each faculty member made these assignments for their objectives. There was a great deal of confusion over some of the ABET outcomes, so this approach was abandoned. Instead, members of the ABET committee made criteria assignments for a few key courses during a committee meeting. This process provided the required consistency in matching course objectives to departmental outcomes. Each committee member then prepared draft assignments of outcomes to course objectives for several other courses. The entire committee

then reviewed these assignments as a final check. As shown in Figure 4, this process took two months. The edited course objectives files were placed in a folder on the departmental file server for faculty review.

Once the course objectives were developed for all of the required courses, all that remained were the electives. In December 1999, faculty assignments for all elective courses were made. In most cases faculty members were assigned elective courses that they normally teach. There were some elective courses taught by faculty members that were no longer with the department that needed course objectives as well. In this case, one of the more experienced faculty in a closely related area was assigned the course. Drafts for the elective courses were due March 15, 2000. At this time the departmental ABET committee again reviewed and edited the course objectives and made the Criteria 3 outcome assignments. Final copies for most courses were posted to the departmental file server in May 2000. The current draft of the departmental website was first posted in November 2000. This website will always be a "work in progress" with continual updating of course objectives and posting of new supplemental information.

Lessons Learned

Several important lessons were learned during this process of developing course objectives across the ME curriculum. Many faculty had long suspected that there were "holes" in the ME curriculum, i.e. topics that were not being given adequate coverage. Having the fairly detailed course objectives clarified places where the curriculum was weakest. A significant effort is currently underway to substantially revamp and improve one course (ME 349 – Engineering Analysis) based in part on this review of course objectives.

Two other lessons learned would be of interest to any other department that wanted to attempt something similar. First, good course objectives are not easy to write. The course objectives currently posted to the website are definitely not in their final form. More detail and specificity is needed for many of them. Also, some courses have objectives that are too detailed, and thus need to be shortened. During the training session and in the early stages of developing course objectives, some faculty resisted the idea of specifying course content. Some of these objections were philosophical (students need to discover what the course is about themselves), while other objections were more practical (faculty don't want their hands tied in the future). An up-front discussion and agreement about the need for consistency in required courses (in particular) would have minimized most of these objections.

Several other more practical lessons were learned during this exercise. The logistics of keeping the departmental website updated are difficult. For example, some of the faculty resumes are three years out-of-date. Obtaining sample materials and posting them in a consistent format is also difficult and time-consuming. Plans are underway to hire an undergraduate student to help with some of these tedious tasks in the future. A larger problem is that course objectives for non-ME courses are virtually non-existent. This situation will likely change for many of the other courses taught within the College of Engineering (ESM 201, ECE 320, etc.). Unfortunately, this situation may never change for courses taught outside engineering (math, physics, chemistry, etc.). The best hope is that having numerous examples and experience with developing course objectives for the ME courses will encourage other departments to do so as well.

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