SELF-STUDY REPORT FOR
MECHANICAL ENGINEERING

A. BACKGROUND INFORMATION

1. Degree Titles

The Department of Mechanical Engineering at Auburn University offers an undergraduate degree in Mechanical Engineering (the Bachelor of Mechanical Engineering). The basic information on the program is presented in Appendix I.A as follows: Table I-1. Basic Level Curriculum, Table I-2 Course Section Size Summary for Mechanical Engineering, Table I-3 Faculty Analysis and Workload (Note: Combines EAC/ABET Tables I-3 Faculty Workload Summary and I-4 Faculty Analysis), and Table I-4 Program Support Expenditures (Note: EAC/ABET Tables I-5).

2. Program Modes

Students who pursue the Bachelor of Mechanical Engineering may elect to participate in the Co-operative Plan. This plan operates only in day mode (Night courses are not offered). Successful completion of the Co-operative Plan requires that students complete a minimum of five work semesters. Approximately 21.5% of mechanical engineering students participate in the cooperative plan, representing 21.6% of the total number of participating Auburn University students and 26.3% of participating students in the College. Mechanical Engineering has the largest group of students in the University participating in the Co-operative program.

3. Actions to Correct Previous Shortcomings

There were no deficiencies, specific weaknesses or concerns identified by the EAC/ABET during the fall 1998 visit. However, the Auburn University Department of Mechanical Engineering strives for the continuous improvement of its programs. Several improvements have been made and are outlined in the next section.

4. Major Developments Since the Last EAC/ABET Visit

4.1 _Conversion to Semesters:_ A very significant development since our last accreditation was conversion to semesters. Our constituents are actively involved in academic decision-making in the Department and were a significant ingredient in the development of the semester curriculum for the Department. Additional information is subsequently provided concerning constituent interaction for positive program improvement.

The Board of Trustees of Auburn University mandated a move to semesters in 1996. Shortly after the Board's announcement, a committee of faculty and administration from across the University was established by the President to study the impact of conversion on the University, especially on students, laboratories, classrooms, and facilities in general. The committee was active over the next 3.5 years and reported its findings in several reports over that period.

Several broad guidelines were set forth by the committee including maximum hour limits (120 semester hours unless a documented requirement for additional hours was approved) and a very elaborate core of 41 semester hours to include English Composition (6 semester hours), English Literature (6 semester hours), Philosophy (3 semester hours), Fine Arts (3 Semester hours), Mathematics (3 semester hours), Science (8 semester hours), History (6 semester hours), and Social Science (6 semester hours). A committee appointed by the Dean of the College of Engineering further refined the Board's mandate to require two freshman courses ENGR1100 (Engineering Orientation-0 credit) and ENGR1110 (Introduction to Engineering-2 semester hour credit). Also the College established that a common 1st level thermodynamics course (ENGR2010) be utilized by the Mechanical Engineering Department.

approval in late 1998 and the University curriculum committees studied and approved the semester curriculum in the spring of 1999. The Board of Trustees approved the Departmental curriculum (and all other University program curriculum) later in 1999. Extensive counseling of students took place in the year preceding conversion to semesters to ensure students took the appropriate courses and did not lose credits in the process. The fall of 2000 was the first term on the semester calendar.

The Departmental Chair tasked the departmental curriculum committee with providing the leadership for the process of developing its semester curriculum. This committee of faculty worked with the remaining faculty, students, the External Advisory Board, alumni, and industrial sponsors in developing the curriculum and supporting assessment/feedback mechanisms. This committee also did a thorough job of benchmarking against the curriculum of peer institutions including Georgia Tech, Purdue, MIT, University of Maryland, and Virginia Tech. Several members of the curriculum committee also attended various workshops aimed at equipping these members with knowledge of how to develop a program that meets the ABET2000 criteria. Several general faculty meetings were held to refine and involve all faculty members in the process. The individual involvement of the various constituent groups listed above is briefly summarized.

- **Faculty**: Leadership by curriculum committee with frequent faculty meetings and numerous individual consultations among all the faculty members.

- **Students**: The graduating seniors were asked to fill out a two-part questionnaire, which provided an evaluation of their experience at Auburn and also contained an EBI survey that benchmarks our students with peer institutions. These survey results were the primary vehicle for student input. However, numerous ad hoc interviews with students were conducted and used in developing the semester curriculum.

- **External Advisory Board**: The external advisory board met twice per year during the process of developing the semester curriculum. The chairman of the faculty curriculum committee and other faculty made various presentations concerning the curriculum to this board and received feedback that was used in developing the semester curriculum.

- **Alumni**: A very large sample of Engineering Alumni was asked to fill out a questionnaire related to their academic experience while at Auburn. A summary of the results is given in **Table A4.1, Alumni Survey Results.** This survey provided valuable input in the process of developing the semester curriculum. These results formed a very important basis for our Program Educational Objectives and semester curriculum.

- **Industrial Sponsors**: The senior capstone design class undertakes projects sponsored by industry. These industries regularly interact with all senior students. During the development of the semester curriculum, these survey results were also used in the formulation of the semester curriculum.

Table A4.1 Alumni Survey Results

Attribute Statement	Essential	Highly desirable	Desirable	Not Necessary
In depth technical knowledge of students major field	53.4	28.5	17.4	.7
Ability to Learn on their own	51.0	43.0	6.0	0.0
Experience in communicating technical information through written documents	47.7	39.6	12.4	.3
Experience in working with people of different gender, race, and cultural background	44.0	30.9	21.8	3.4
Experience in communicating technical information through oral presentations	39.9	40.9	17.8	1.0
Experience in using or ability to quickly learn existing software such as AutoCad, Lotus or dBase to solve practical problems.	34.2	40.3	22.5	3.0
Experience with practical design projects	13.8	48.0	30.5	6.4
Experience in working in teams with students from outside the engineering college to solve large-scale practical problems	10.4	31.9	44.0	13.8
Ability to develop custom computer software using FORTRAN, C or other high level languages for specific applications	9.1	16.4	32.2	39.3
Experience working with students from other engineering disciplines in solving large-scale, practical problems	7.0	30.9	45.0	16.8
Well rounded background demonstrated by non-engineering elective courses	6.4	34.2	51.3	7.7
Summer internship with industry	5.0	51.0	38.3	5.7
Coop experience with industry	4.4	58.7	30.9	6.0
Ability to develop computer software using an assembly language	3.4	10.7	32.0	50.0
Other job experience working on practical projects	3.4	39.6	53.4	3.4
Knowledge of several areas of engineering outside major	2.7	27.2	58.1	10.7
Knowledge of a foreign language	0.0	3.0	24.2	72.8

It is important to note that the transition involved re-thinking and re-setting course objectives and their associated outcomes, especially in relation to our Program Educational Objectives, and that this exercise was an important part of the process of semester conversion. The resulting semester curriculum included a number of changes and innovations and, when finally adopted by the faculty, incorporated ideas and suggestions that can be traced directly to our various constituents. In the following list of features of the semester curriculum, constituent involvement is noted using italics.

- The quarter-system curriculum in place was fairly new having been developed in 1995. The curriculum contained many of the elements that our constituents sought including teaming, economics, hands-on experience, communication skills, etc. Therefore, the development of the semester curriculum was evolutionary in that feedback from the quarter system curriculum was used to modify that curriculum rather than undergoing a revolutionary change. (*all constituents)*

- The *faculty* decided that the number of required course hours should be kept to a minimum to encourage lifelong learning. Initially, the *curriculum committee* attempted to develop a curriculum with 120 semester hours in line with the University guidelines. However, the *University* dictated a 41-semester hour core that made it impossible (in the opinion of the curriculum committee) to develop a 120-semester hour curriculum that effectively met the requirements that our constituent groups mandated. Hence, a curriculum with 128 Semester hours was adopted.

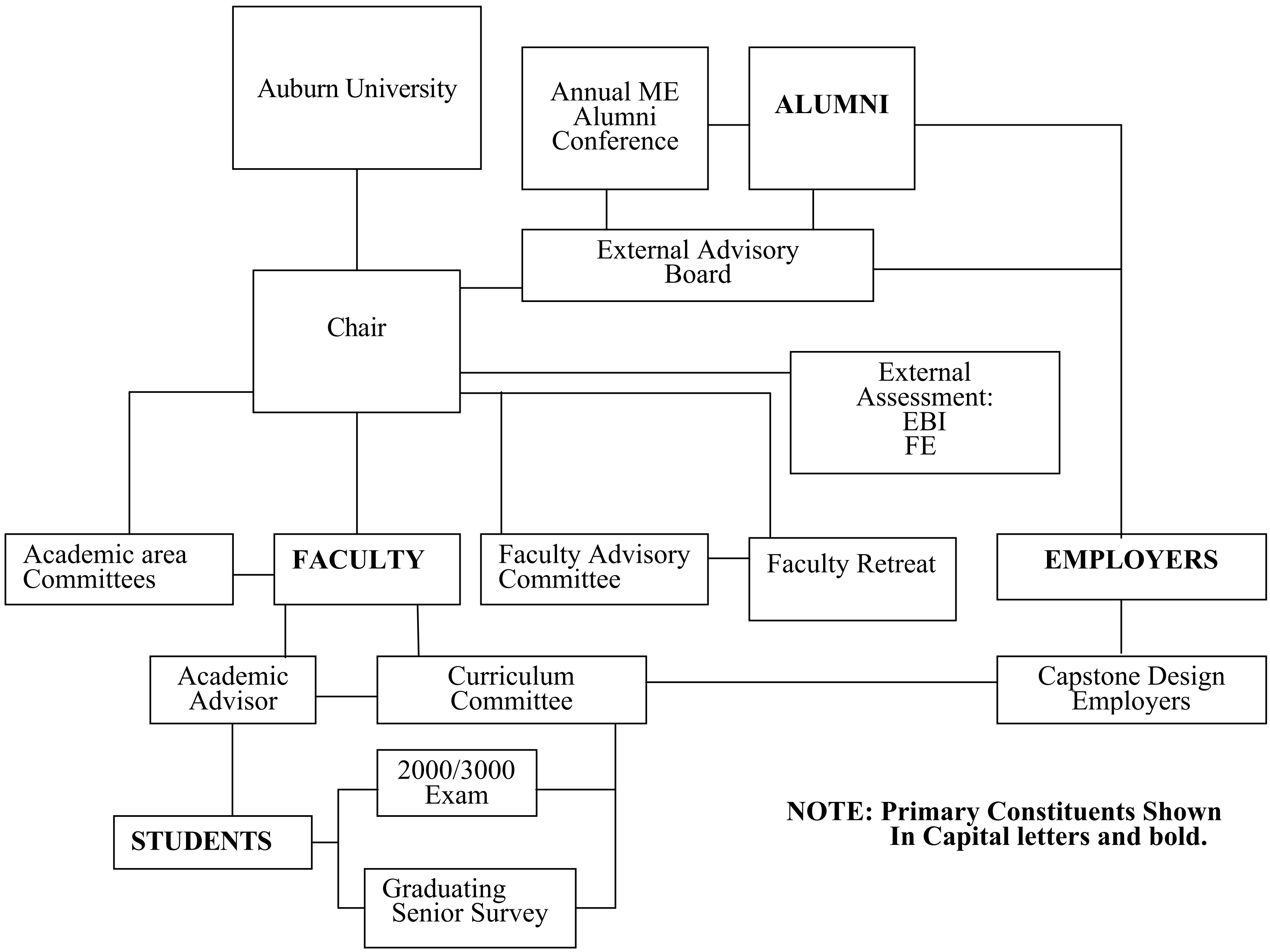
- The *faculty, students, alumni, and advisory board* felt the curriculum needed more "hands-on" courses earlier (*faculty)* in the curriculum to motivate students and increase retention. Introduction to Mechanical Engineering, ENGR1110, was added to satisfy this need. In fact all required engineering courses were moved to earlier in the curriculum to allow achievement of the necessary pre-requisites for a full academic year of capstone design.

- The humanities and social science content includes a course in Ethics which was changed to allow students to take Business Ethics *(faculty, alumni, industrial sponsors.)*.

- The design content of the curriculum was enhanced and communication skills were further emphasized (*all constituents)*.

In summary, semester conversion afforded an opportunity to use the constituent interactions to advantage, as diagrammed in Figure A4.1, Constituent Interactions and Academic Decision Making in the Mechanical Engineering Department and is explained more fully in section B.2 Program Educational Objectives.

Figure A4.1 Constituent Interactions and Academic Decision Making in the Department of Mechanical Engineering.



4.2 *Improvements in Facilities:* The Departmental offices are all located in Ross Hall. Unfortunately, laboratories are still scattered in Ross Hall and three other buildings: L-building, Shop building, and Wilmore Laboratories Building. The primary undergraduate laboratories are located in Wilmore Laboratories and Shop Building. Wilmore Laboratories has undergone a thirteen million plus dollar renovation since the last site visit by ABET. Wilmore laboratories are shared with Chemical Engineering and Materials Engineering. It is truly a state-of-the-art facility housing some 50 Mechanical Engineering graduate students, undergraduate car teams' lab, senior capstone design lab, and an undergraduate engineering education research lab (LITEE). Some seven other research labs are used to support undergraduate research. Ross Hall, shared with Chemical Engineering, is scheduled for a complete renovation estimated to cost thirteen million dollars beginning January 2005. This will bring some incredible new facilities to Mechanical Engineering including a state-of-the-art 60-seat computer lab and an 80-seat classroom both fitted with the very latest classroom electronics. Also already in the architectural planning stage is a fifty million dollar transportation building that will house two research labs for mechanical engineering which will involve both undergraduate and graduate students. Construction on this building is planned for early 2005. As a part of the transportation complex, a second phase of the building is planned. This will consist primarily of a new ME complex, which will allow us to consolidate most of the department in one building. The other part of the second phase is a microelectronics lab. The second phase is estimated to cost fifty million dollars and should be complete before the next regular ABET visit in 2010.

4.3 *Impact of Engineering Fee and Totty Endowment:* The University initiated an Engineering Fee for all students beginning in 1996, which is currently set at $8 per semester hour. In addition the estate of John Totty made a one million dollar endowment to the Department for undergraduate education. All of these funds are earmarked for improvements in laboratories, computing equipment, and other requirements for program enhancement and have had a significant and positive impact on facilities for students within the Department. Equipment can be purchased to support new activities (e.g., for new courses) or to add to or update existing equipment. Student projects and travel and other similar needs are also supported. Table A4.2, Laboratory Equipment and Computing Equipment Expenditures in the Department, shows the funds awarded to the Department and how they were used to improve the program.

4.4 *Computer Usage Throughout Curriculum:* Significantly increased and continuous use of computers was introduced into the curriculum. Matlab and Solid Edge are covered in the freshman course MECH1110 Introduction to Mechanical Engineering. This software and additional software such as Mathmatica, Algor, and Labview are then used in almost every subsequent course throughout the curriculum. The Department has a standing committee of faculty to ensure sufficient hardware and software updates are maintained.

5. Contact Information

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Table A4.2 Laboratory Equipment and Computing Equipment Expenditures in the Department

Fiscal Year	Funding Source	Class Upgraded (Required or Elective) (R) or (E)	Equipment Purchased	Funds
2001	College of Engineering gift funds	MECH 4440/4450 (R) For Automotive Certificate	Chassis dynamometer	$11,000
2002	College of Engineering gift funds	MECH 4440/4450 (R) For Automotive Certificate	Milling machine Tig welder Data Acquisition system Computers	$22,000
2003	College of Engineering gift funds	MECH 4440/4450 (R) For Automotive Certificate	Engine lathe Small engine dynamometer Additional tig welder Shock dynamometer	$25,000
2001	Laboratory Fee/Totty Endowment	MECH2120,3130,3220+General Program support for Computer Applications (R)	22 Dell Computers with 21 inch monitors along with all required software licenses	$80,000
2002-2003	Laboratory Fee/Totty Endowment	MECH 6810 Mechatronics (E)	Electronic kits	$2,000
2001	Laboratory Fee/Totty Endowment	MECH3050 Measurement Lab (R)	Data Acquistion Hardware for 5 stations Plus various sensors, hardware hookup, Plus 4 computers with Lab View	Approx $12,000
1998-2004	Industrial Gift/Totty Endowment	MECH4240,4250 (R)	Materials, supplies, components	Estimated $100,000
2001	Returned Overhead/Totty Endowment	MECH4240,4250 (R)	CNC Machine Center	Approx. $100,000