Development of Interdisciplinary Curricula and Labs in EET/MET/CET

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Abstract: This paper discusses the development of Interdisciplinary Laboratory experiences between Electrical Engineering Technology (EET), Mechanical Engineering Technology (MET), and Civil Engineering Technology (CET) programs at Alabama A&M University. The activities have grown partly from curriculum changes to the EET and MET programs to develop a four-course/four-semester sequence in the junior and senior years to foster interdisciplinary learning. The projects have produced benefits in each of the programs for both students and faculty. The students obtain an appreciation of how practical problems require skills from a variety of disciplines and the importance of their contribution to the success of the team. The team dynamics have improved the communication between the faculty and has led to increased faculty collaboration in other areas.

Keywords: Interdisciplinary, team, projects.

INTRODUCTION AND BACKGROUND

The Electrical Engineering Technology (EET) and Mechanical Engineering Technology (MET) programs in the Department of Technology at Alabama A&M University implemented a coordinated curriculum change during spring semester 2005 in response to findings of an ABET accreditation visit during fall semester 2004. *Multidisciplinary Teaming* was the central theme of the change and led to a revision of the program objectives for the EET and MET programs. Subsequently, it has impacted courses, labs, and faculty professional development.

The revised program objective for graduates of the EET and MET programs is:

> *Graduates of the program can solve practical engineering problems in a multidisciplinary team environment using modern software, hand-tools, and equipment representative of that used by industry. They can demonstrate a clear understanding of project management, quality, risk, cost, ethical, social and global issues by incorporating these into their solutions which they can effectively communicate both verbally and in writing.*

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INTERDISCIPLINARY CURRICULA

The EET and MET students share five common courses during the last four semesters of their degree program, Figure 1.

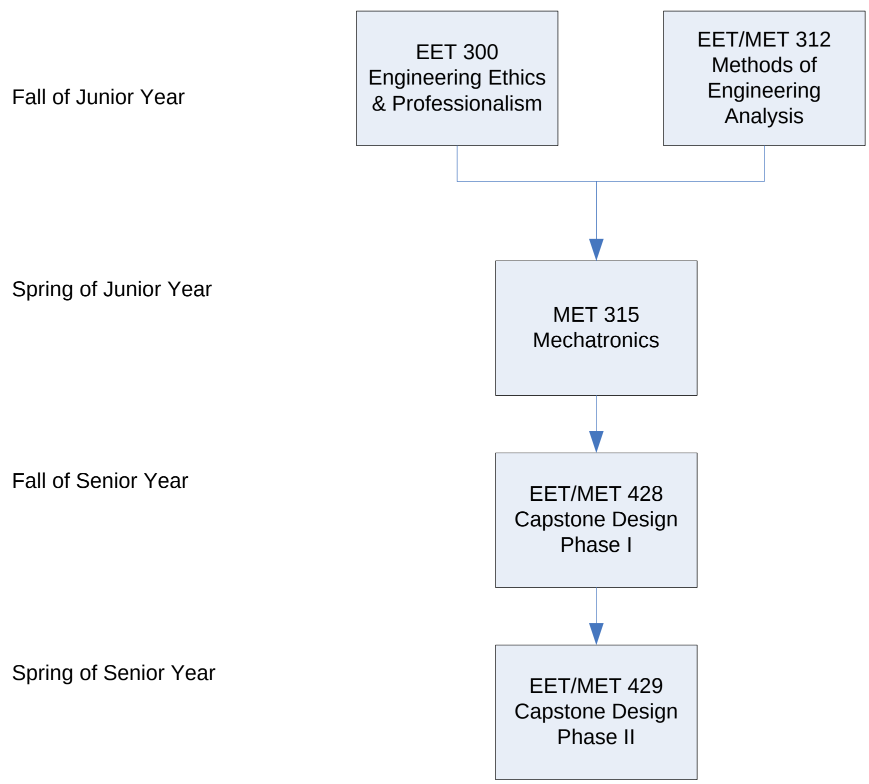

Figure 1 – EET/MET common course sequence.

Students build team skills as they study ethics and professionalism in EET 300 during semester 5. EET/MET 312 Methods of Engineering Analysis teaches students to apply Excel® and Matlab® to practical engineering problems including applied differential equations, probability, and statistics. The Mechatronics class in semester 6 introduces the students to multidisciplinary hands-on projects. This course is team-taught by EET and MET faculty and currently uses the laboratory instrumentation/automation and the USFIRST.ORG competition as the basis for the projects. An expected outcome of this course is for the students to have successfully completed the design, build, and testing of one or more electromechanical devices under the leadership and direction of the faculty.

EET/MET 428 and 429 Capstone Design Phase I and II are designed to move the leadership and control of the project from the faculty to the student. In Phase I the students are teamed with faculty mentors who assist them in selecting a project. The students are initially given specific instruction in how to manage and document their project. By the end of semester 7 it is expected that the student be fully in charge of the project with the faculty mentor serving as advisor. The student must build and demonstrate their project during semester 8.

INTERDISCIPLINARY LABORATORIES

The faculty, graduate and undergraduate students from the EET, MET, CET programs have worked together to develop laboratories for Robotics, Mechatronics, Pneumatics, Programmable Logic Controllers (PLCs), Hydraulics, Computer Networks, AC/DC Motors, Material Testing, and Structural Testing are the main areas of skill development that are covered. Projects and laboratories were designed to incorporate and develop skills from the various mentioned disciplines in a collaborative environment. It is the belief of the department that partnership and collaboration between inter-disciplinary areas is important because it provides students with a more global view. In addition, collaborative design and laboratory projects provide a perfect environment to simulate real-world jobs. The above mentioned projects were designed to foster relationships among the disciplines and provide more opportunities for technology students to participate in collaborative projects, as well as to familiarize them with industry methods. In addition to interdisciplinary collaboration, the projects and labs encouraged integration of teams, with interaction between students from the first-year to graduate level. Early stages of this collaboration can be seen in some of the senior technology design projects that included students from EET, MET, and CET.

PROJECTS AND COURSES

Discussed below are some of the projects in more detail namely upgrading the Satec® Universal Test Machine with PLC controls for tensile tests in metallic, composite, and concrete materials. Undergraduate and Graduate students from EET and MET disciplines upgraded an outdated Universal Test Machine (UTM), Figure 2, from a manual mechanical test system to a computer automated system.

Figure 2. Universal Test Machine (UTM)

The original manual hydraulic valves and controls were replaced with an electronically controlled directional flow valve to control the direction and speed of travel and an electronically controlled pressure relief valve control the maximum load applied to the article under test, Figure 3.

Figure 3. New electronically controlled hydraulic components.

The students used a laptop computer, Figure 4-A, USB-based analog to digital (A/D) converter Figure 4-B, and LabView® software to interface to the hydraulic valves to control the operation of the system. The stress and strain outputs that operated the original X-Y pen-plotter were diverted to the data acquisition module for collection by the computer.

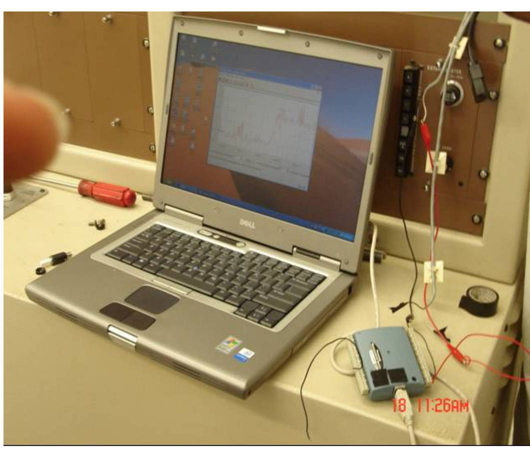

Figure 4-A. Laptop Data Storage.

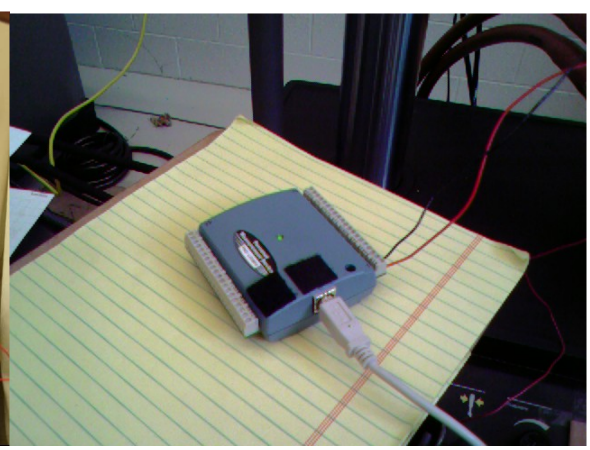

Figure 4-B. (A/D) Converter and USB cable.

An extensometer, Figure 5-A, measures stress on the specimen under test and outputs this analog information to the analog to digital converter for data storage as shown being setup in Figure 5-B.

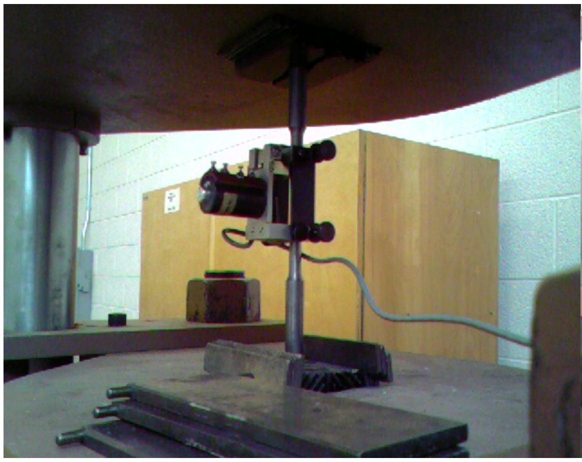


Figure 5-A Extensometer Figure 5-B Extensometer Setup

An alternative design using a PLC unit, Figure 6, and ladder-logic was also developed to give EET students experience with both forms of process control.


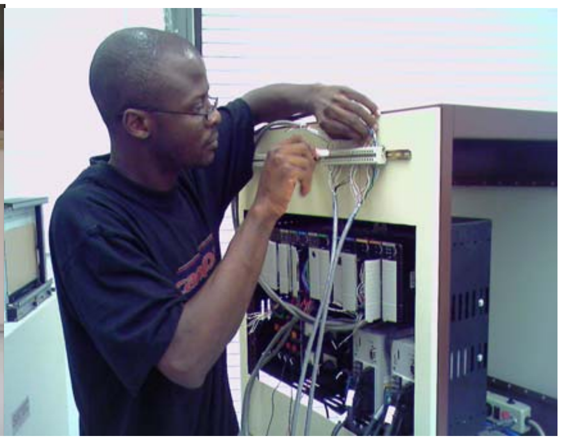

Figure 6-A PLC Unit Figure 6-B PLC interface cable connection

This upgrade was done entirely by students under guidance from graduate assistants and the interdisciplinary faculty. This project also served as an interdisciplinary Capstone Design project for two EET and one MET seniors.

Undergraduate students from CET, EET and MET disciplines conducted tensile tests as part of an on-going research project. If a material is to be used as part of an engineering structure that will be subjected to a load (e.g. the support for a bridge, the pavement in a highway), it is important to know that the material is strong enough and rigid enough to withstand the loads that it will experience in use. As a result, tensile tests have been developed for testing the response of materials to external forces such as tension (pulling apart), compression (squeezing) or torsion (twisting).

The concrete and composite materials were prepared and tested by CET, EET, and MET students, Figure 7. The students also worked together to conduct the analysis of the data.

Figure 7-A. Concrete specimen. Figure 7-B. MTS machine used for tests.

The faculty and students worked together to develop and build a long-duration concrete slab and beam test fixture, Figure 8.

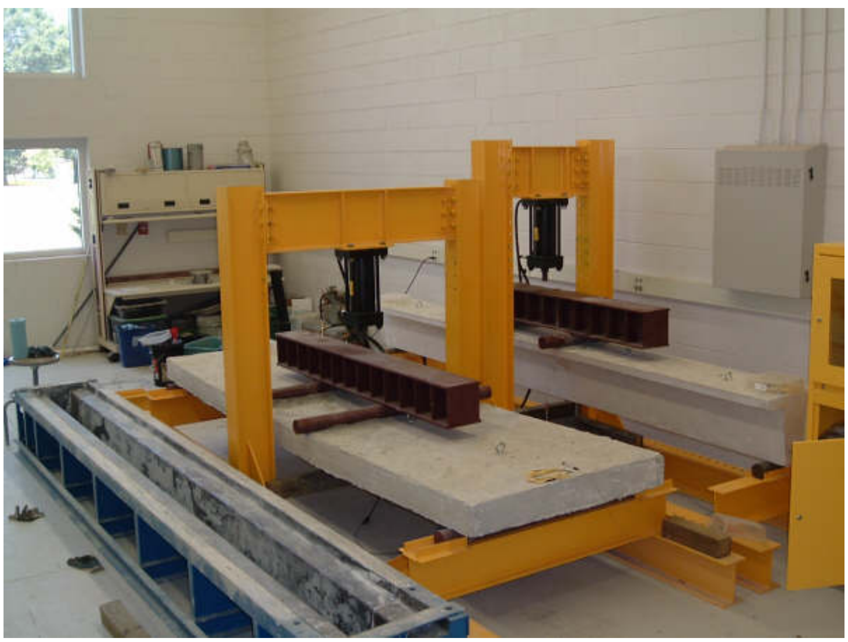

Figure 8. Long-duration concrete beam test fixture.

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CONCLUSION

Student and Faculty response to the collaboration on various projects has been extremely positive. No formal study was conducted of student opinions of the significance of the projects. However, informal discussions with students and judging by the number of students requesting to work on interdisciplinary projects as part of their senior project; it appears that students find this interesting and rewarding. A formal study of this is currently underway in the department. The projects have encouraged more discussion of concepts as they are presented. The concepts no longer exist as isolated cases, but rather are parts of a whole. The department has seen an increased level of student interest. The number of faculty participating on the same research projects has also been on the rise.

REFERENCES

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