LABORATORY EXPERIENCE & SAFETY GUIDELINES

The purpose of these guidelines is to place the various laboratory experiences within the context of the general ECE Department program objectives, to help the student attain the objectives of the program laboratory courses, and to inculcate in the student an ethic that ensures maximum safety at all times.

Introduction

Mission

The mission of the University of Detroit Mercy, requires that we provide an education that "seeks to integrate the intellectual, spiritual, ethical and social development of students."

In the context of a professional electrical engineering education, this means that our students must simultaneously grasp the theoretical foundations of the science behind the evolution of electrical, electronic and information technologies, and develop the humanities-based intellectual paradigms necessary to understand their corresponding social implications.

ECE Department Program Goals

The Bachelor of Electrical Engineering (BEE) program at the University of Detroit Mercy seeks to produce undergraduates who lead and serve the communities of Detroit, the Great Lakes region, and the nation. Students who successfully complete the BEE program are able to develop and use electrical and electronic technologies in creative and powerful ways, and to articulate the nature of the technological forces shaping society as well as think critically about their associated cultural impacts.

STATEMENT OF EE & RMSEw/EE PROGRAM EDUCATIONAL OBJECTIVES

The following list presents the specific EE & RMSEw/EE Program Educational Objectives. ABET defines Program Educational Objectives (PEOs) as "broad statements that describe what graduates are expected to attain within a few years of graduation."

The graduates of the EE & RMSEw/EE programs are expected, within a few years of graduation, to:

1. Demonstrate by successful professional engineering practice and/or pursuit of advanced engineering degrees, technical proficiency in engineering fundamentals;
2. Excel in the practice of engineering through effective communication, collaboration and teamwork, lifelong learning, and creative engineering problem solving; and,
3. Contribute to the engineering profession and to society in a manner consistent with the Jesuit and Mercy traditions, which include leadership and service within a strong moral and ethical framework

Discussion

These objectives present an integrated view of the attributes that we expect our graduates to demonstrate. During the creation of these objectives, all involved constituencies

expressed belief in the importance of knowledge, its application in practice, and the value of a commitment to leadership and service. To clarify our intent it is useful to explore these objectives in somewhat more detail.

- *Objective 1* highlights the importance of basic theory, which serves as a foundation for the electrical engineering discipline, in the appreciation of engineered products and systems. Analog and digital electronic circuit design, communication, electromagnetic field and control theory, mathematics, chemistry and physics will continue to constitute the core of the electrical engineering discipline. These comprise the theoretical foundation upon which all the modern electrical engineering developments are based. However, as is always the case with engineering curricula, the measure of success is in the practical application of concept in context. The context for new graduates may be either further study at the graduate level or professional practice. Success of our graduates in both realms of endeavor serves to indicate that the proper balance between theory and practice is being achieved.

- *Objective 2* while related to Objective 1, emphasizes more specifically our constituent's belief in the importance of the *practice* of electrical engineering. Implicit in this objective is the importance of solid communication, teamwork, and a commitment to lifelong learning, which are enabling skills and characteristics for *effective performance* in the context of engineering practice.

  The Electrical Engineering program at the University of Detroit Mercy has over the years (since 1911), distinguished itself by focusing on both engineering design and practice. In the late 1960's the program instituted a four course sequence in engineering design beginning in the freshman year, and culminating in a capstone design experience in the Senior year, a structure similar to the one which exists today (currently we have a 4 year rather than the previous 5 year program). The program today remains based on a design-oriented philosophy which enables students to not only grasp the theoretical concepts, but to apply those concepts in practical situations. This design approach manifests itself through: 1) the practice of design and project-oriented experiments in the laboratories which encourage creative solutions to engineering problems, 2) an intensive two-semester senior design course sequence which currently works to field entries in the International Ground Vehicle Competition (http://www.igvc.org/deploy, and 3) a mandatory integrated cooperative experience which ensures that all engineering students receive approximately a year of practical training.

- *Objective 3* speaks to those broader qualities which, consistent with the University's mission and vision, we seek to impart. When we specify a *specialized competence*, we express the expectation and hope that our graduates, in addition to being technologically literate, demonstrate critical thinking, and have the compassion, understanding, and moral conviction to provide leadership and service, witnessing to the charisms of our founding orders, the Jesuits and Sisters of Mercy. The Sisters of Mercy give us a tradition of service that compels

us to be sensitive to the needs of the disenfranchised and concerned with fundamental social justice. Similarly, discernment, one of the central principles of Jesuit spirituality, requires political insight, personal integrity, and wisdom.

The adoption of such characteristics is ultimately a personal choice which cannot be coerced. However the University works to provide an environment conducive to reflection on these choices. The institutional commitment to these characteristics is evidenced by its long standing policy of hiring faculty and staff who support the mission and witness to it in the conduct of their courses and their lives. Additionally, the liberal core comprises 29 credits of the approximately 130 required for graduation and offers preparation in a broad range of liberal disciplines. Finally, administrative policies emphasize the treatment of faculty, staff and students with dignity, as well as a commitment to provide students with extraordinary access to the faculty (e.g., 8 or more office hours per week are common).

General Laboratory Objectives

The objectives of the laboratory courses are:

* To supplement the theoretical knowledge dealt with in the lectures with practical illustrative applications.

* To provide design experience which supplements the design methodologies presented in the lecture courses.

* To develop a good laboratory technique.

* To develop good teamwork practices.

* To acquire a facility in writing and presenting engineering reports.

Overview of Laboratory Facilities and Expectations for Course

Part of the first scheduled laboratory session for each course will be devoted to an examination and explanation of the laboratory and its equipment. The particular experiments and design projects as well as the grading criteria used to evaluate performance will be presented in a laboratory syllabus distributed during this first session.

Safety rules and suggestions

Safety has become an important consideration in industry and is of special concern to the engineer, both in the design of experiments and the manner of their execution. The following suggestions reflect common practice and are recommended for your serious consideration. Failure to observe safe practices, resulting in accidents, is sufficient cause for immediate dismissal from the laboratory course with a grade of "F".

- Haste causes many accidents. Work deliberately and carefully and verify your procedures in as much as they impact safety as you go along.
- Exercise special care when working with moving machinery (such as an engine dynamometer or prototyping equipment) or live circuits (with hazardous voltages).
- When making connections, as far as possible, connect to the power source LAST; when disconnecting, disconnect from the power source FIRST.
- Check cords for cracks, loose plugs, and frayed ends, and never use a cord that appears to have any of these defects.
- Be careful to keep metallic accessories of wearing apparel or jewelry out of contact with live circuits, and loose articles of clothing out of contact with rotating machinery.
- Avoid working with wet hands. Wet (or even sweaty) hands provide increased electrical conduction and can therefore increase the possibility of electric shock.
- Never defeat protective devices such as fuses and circuit breakers.
- If you notice any unsafe conditions, report them immediately to your instructor, and do not work on any defective equipment until it is fixed.
- Become safety conscious because this has implications beyond your grade or your job.

Laboratory Procedures

The experiments in the Electrical & Computer Engineering Laboratories will be performed by students in lab groups. Each group should designate a representative or leader who will be in charge of signing out equipment, and organizing and assigning the tasks necessary for successful lab completion. When possible, a different leader should be chosen for each laboratory assignment. Please take special note of the following laboratory requirements.

1) In those laboratories where it is required (the ELEE3870/5087- Embedded systems laboratory for example), there shall be a preliminary report prepared for each experiment by ALL MEMBERS of the group. This pre-lab report should contain solutions to all assigned problems (circuit designs, commented program code etc.). It need not be typed, but it should be neat, legible, and well-structured. It is understood that these preliminary solutions may not be the same as your final results presented in the full lab report. The pre-lab will not be graded, however, failure to submit (or complete) the pre-lab report at the **beginning** of the lab period will result in a reduction of your lab grade for that experiment. Each group member shall submit this report to the instructor for approval prior to the performance of any laboratory procedures.

2) Lab attendance is mandatory. Attendance means presence at the beginning of each assigned lab and until dismissed by the instructor. If you are absent for a lab, or are deemed to be absent by the instructor because you left the room for

substantial portions of the lab, you will be given a zero for that particular experiment. If you finish your assignment early, you are expected to report to the instructor so that you may assist other groups with their work.

3) There is to be absolutely no consumption of food or beverages by any students in the lab.

4) If there is any piece of equipment at your station that is malfunctioning, bring it to your instructor's attention immediately and tag it with a note describing the nature of the problem. If you are not satisfied with the availability of equipment, connecting wires, components, etc., bring it to the instructor's attention.

5) After you complete the experiments (each of the assigned problems) you must show the instructor the results obtained and get his/her approval before leaving the lab. It is recommended that you perform any calculations that are required before leaving the lab, so that in the event that your results are incorrect, you have the opportunity to repeat the relevant portions of the experiment or consult with the instructor.

6) Before leaving the lab at the end of the experiment, clean up the area where you worked. Shut down all electrical systems and put away all components, wires, etc., that you may have used. All signed-out equipment should be returned to the proper location in the store room.

Reports - Introduction

The engineering report is an important part of most engineering assignments. It is the presentation of precise information on a specific subject to a certain reader or readers and deserves special care and effort and consideration in its composition. A poor report is a bad reflection on what otherwise might be excellent laboratory work, while an excellent report explains and evaluates all laboratory work.

The following discussion represents guidelines in preparing a good report. A good reference for this task is "The Complementary Roles of Laboratory Notebooks and Laboratory Reports," McCormack et al, IEEE Transactions on Education, February 1991, pp. 133-137. In conjunction with the information provided here, you will be developing your own special lab report template based on the specific task and interaction with the instructor.
Particular attention should be paid to good English, correct grammar, spelling, and punctuation. These are important considerations that are essential in creating a good report.

Clarity, impersonal and interesting construction, variation of sentence structure, as well as conciseness, should be attained. Engineering and other scientific reports should be written factually in the **third** person.

Abbreviations and special expressions should be used with caution. When used, these expressions should be limited to standard ones, with which prospective readers are familiar.

All reports shall be printed on standard 8.5" by 11" paper, using one side of the sheet only. The pages of the report shall be securely fastened together WITHIN AND TO THE COVER by means of through (not clip type) fasteners and numbered consecutively.

Final Laboratory Reports

A report for each INDIVIDUAL experiment and design shall be prepared and submitted to the instructor by each group. It is expected that the report writing responsibilities will have been distributed amongst the group members.

Final report form:

Some of the elements listed below may not apply to a particular laboratory assignment or a particular class. You should include all sections which provide a meaningful contribution to the report (or all those required by the laboratory instructor).

TITLE PAGE

The title sheet shall give the number and title of the experiment, the course designation, the group members' names, the date or dates on which the experiment was performed, the date the report is due, and the date it is handed in. The name of the instructor shall be placed in the lower left corner.

ORIGINAL INSTRUCTION SHEETS

If the lab handout contains a large expository section, it need not be included here. However, the handout sheets that specifically present the problem to be addressed or the experiment to be undertaken should be included.

OBJECT OF THE EXPERIMENT

This section shall state the immediate purposes of the experiment in brief, complete sentences. For example, you could indicate what is to be learned in this experiment, what physical principles are to be investigated, and/or what hardware or software is to be designed.

PROCEDURE

This section shall include the list of the experimental activity, arranged in an order planned to provide the most convenient and efficient conduct of tests in the laboratory. Included in this section should be a list of the corresponding observations expected. If the laboratory has multiple exercises or sections, there should be multiple procedure sections. Also, if a detailed procedure is provided in the laboratory handouts, this section should merely summarize the procedure rather than repeat verbatim that which has already been stated.

WIRING DIAGRAMS AND MECHANICAL SCHEMATICS

This section includes all the diagrams. The wiring diagrams shall show all of the connections including switches, fuses, components, and on and off board connectors. It is not uncommon to produce two sets of diagrams: the first would be a symbolic representation of the interconnection of all of the circuit's electronic and electrical components, and the second would be an IC level connection diagram which directly matches the physical layout of the circuit, and includes all device pinouts. These diagrams shall be neatly drawn and lettered in ink or hard pencil. If possible, diagrams and schematics should be produced with the university's computer facilities provided in the department computer labs (using Microsoft Visio for example). Below each diagram shall be placed a figure number and a descriptive title indicating the part of the experiment for which it was used.

In cases where the laboratory work requires programming, the lab reports must include complete, fully documented listings of each program written and tested. Each program must include a fully descriptive header as described in class. Also, flow charts should be included to make the program logic plain.

TABULATED DATA AND RESULTS

The observed and calculated results of the laboratory tests shall be arranged in tabular form on these pages. Each table should bear the number, title, and date of the experiment, plus a descriptive statement. Where calculations involve intermediate stages, the intermediate results must also be tabulated.

SAMPLE CALCULATIONS

Following the tabulated results shall be the typical sample calculations. There shall be at least one calculation for each result and intermediate step presented. Each sample calculation shall be shown in complete detail, including formulas written in symbolic form, with symbols defined, and in each case shall refer to the corresponding tabulated results.

RESULTS SHOWN GRAPHICALLY

Under this heading shall be placed all the curves or timing diagrams derived from the results or used in deriving the results where applicable. Good plots are a necessary component of a good report. The curve sheets shall contain sufficient identification to be completely intelligible as an entity, as they are sometimes abstracted from the report and used individually. Good lettering or typing is necessary. Titles and headings should be arranged for most convenient reading when filed in the report (portrait form is generally better than landscape). For most satisfactory results, plots should show a sense of balance and proportion.

For each curve plotted, there MUST be a set of tabulated data and results. Other descriptions or data relating to the curves may be added as subtitles, notes or tabulations where required for clarity.

Discussion of Results

The results and conclusions shall be thoroughly **discussed** and **explained**, not merely described. Any apparent discrepancies between the results and the theory shall be reconciled in this discussion. The observed accuracy of the tests and the possible sources of error should also be discussed. Students are expected to discuss problems or difficulties encountered, how they were overcome, and what lessons were learned. This applies to both hardware and software endeavors. For example in a programming exercise, students should discuss the debugging process: what did not work, how did you discover the fault and how was it remedied.

Wide latitude is allowed in form and content, for here, the student displays his/her knowledge of the subject under consideration and, in addition, demonstrates his/her ability to apply the fundamentals of the language arts he/she has previously studied. In the engineering world, a fluent and accurate application of the language arts is indispensable to success.

The use of reference material is encouraged; indeed, it demonstrates awareness and initiative in the student. However, when quoting from or paraphrasing a reference book, paper or web document, do not attempt to disguise this fact or make it appear as original work. Clearly state the name of the reference source, the page number, etc., and demonstrate its relationship to the material being discussed.

Answers to questions

Following the discussion of results shall be placed a list of the answers to any questions included in the instruction sheets. If the questions have been answered in the discussion of results, give page number and paragraph references.