The University of Michigan
College of Engineering
Curriculum Committee

Agenda
February 11, 2003
1:30-3:30 p.m.
GM ROOM
Fourth Floor Lurie Engineering Center

1. Approval of Minutes from January 28, 2003 Meeting
2. First Year Review Report – Gary Herrin
3. Professional Outcomes – Jeanne Murabito
4. HU/SS Proposed Revisions – Jeanne Murabito
5. ME Thermal/Fluids/Heat Transfer Sequence – Discussion
6. IOE Sample Schedule – Gary Herrin
7. Proposal for New SGUS Program in AOSS – Sample Schedule
8. EE Degree Program Changes -- Discussion
9. Course Approval Forms

University of Michigan
College of Engineering
Curriculum Committee Meeting
Tuesday January 28, 2003
1:30-3:00 p.m.
Lurie Engineering Center GM Room
Minutes

Armin Troesch called the meeting to order at 1:45 p.m.

Members Present: A. Troesch, V. Chung, J. Fessler, W. Hansen, G. Herrin, J.Holloway, G.Hulbert, H. Peng, S.Montgomery, R. Robertson S. Takayama

Members Absent, P. Friedmann (AERO), S. Pang, P. Samson (AOSS), G.Tyson (EECS)

Guest: Bill Kuhn

The minutes of the last meeting were approved

Proposal for New SGUS Program in AOSS – Perry Samson

A handout of the new SGUS Program in AOSS was included in the meeting packet.
Bill Kuhn, a graduate program advisor was filling in for Perry Samson who was out of town. Perry wanted to see if the Committee had any major objections regarding this Proposal. Bill said that the main reason students are interested in SGUS is that it is a faster way to get a master's degree.
Discussion.
Armin Troesch said that the documentation is sufficient and quite through.
Susan Montgomery said that in the past a template was asked for (sample schedule or sample program). Armin added that typically when people propose programs they lay out a sample program. The idea behind that is to make sure that the pre-requisites are achievable prior to actually taking the class. Bill said that would be o.k. They would like to move this along as soon as possible, and present this at the next meeting. Jeanne Murabito this has to be turned in by the Thursday prior to the next meeting.

HU/SS Definitions and Exceptions

Armin Troesch said the HU/SS handout has an inconsistency in the definitions and exceptions. LS&A has classes that are identified with the designation HU *or* SS. The program advisors are asking what to do with the apparent contradiction. One interpretation is that these are somewhat in order of priorities, so if a course is designated with HU/SS that takes precedent over subsequent listings within the Program. Jeanne Murabito said that the BS as far as the LS&A designation means that the course may be used towards the 60 approved credits required for the BS degree. Armin asked if the Bulletin wording should be changed so this would become clearer.

Motion to change HU/SS requirements at least for number 3 so that it includes words to the effect of: Number 3 courses not covered by Number 1 above are designated. The implication is that HU and SS take precedent over the other designation.
Armin asked for a motion to approve this change.
This was moved and seconded:
Motion Carried (approved)

ENG 195 – Discussion

Armin Troesch received an e-mail from Guy Meadows (who teaches one of the sections of ENG 195) that the leader (Semyon Meerkov) was deciding to step down. Armin asked if the Committee should decide if Engineering 195 should be continued, not continued or change. Armin asked for Gary Herrin to give a brief description of the course. Armin said that if the Committee wants to keep the course he will craft a letter to the Dean for Undergraduate Education to continue the program.
It was decided that it wasn't critical to make a decision right away.
Gary said that the College should critically evaluate this course annually and consider changing the status of the course from an elective to a requirement.

Course Approvals

Armin Troesch called for a motion to approve the following course modifications. This was moved and seconded:
Motion Carried (approved)

EECS 306	Modification – Changing Pre-Requisites from EECS 206, EECS 215 and Math 216 to Math 216, EECS 206 and (EECS 215 or EECS 314)
EECS 452	Modification – Changing Pre-Requisites from EECS 212/316 or EECS 306 to EECS 212/316 or EECS 306 and EECS 280 (or graduate standing)

Adjournment: Motion to adjourn was made and seconded
Motion carried (approved)

Next Meeting
Tuesday, February 11, 2003
1:30-3:30 p.m.
GM Room-LEC

Engineering 100, 101, and 195: Findings and Recommendations

Report of the First Year Courses Review Committee to Dean Levi Thompson

13 December, 2002

Submitted by

Miriam Adam, TECH COMM
Robert Beck, NAME
Mary Anne Carroll, AOSS (Chair)
Cinda-Sue Davis, WISE
H. Scott Fogler, CHEM E
James Holloway, NERS
Dale Karr, NAME
Lisa Payton, SLAS

including contributions from
Diann Brei, ME
Deborah DeZure, CRLT

Administrative Support by Beverly Roberts, Leslie Conn, and Barbara Walunas

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Appendix B. Engineering 101

Appendix C. Engineering 195

Executive Summary

I. Charge to Committee and Review Process

Dean Thompson asked the First Year Courses Review Committee (FYCRC) to focus on three first year College of Engineering courses: ENG 100, ENG 101, and ENG 195. The Committee was asked to determine the degree to which objectives for these courses are being met, assess how well the courses meet the needs of our freshmen, critically examine the quality of instructional content and delivery, and identify or develop ideas for improving the quality of the courses.

The FYCRC met weekly during W2002 and F2002. Meetings were initially devoted to learning about the College's first year program and the current offerings of ENG 100, ENG 101, and ENG 195. The FYCRC then drafted a summary of preliminary findings. This effort was followed by discussions regarding what format and material might be adopted for an improved ENG 100 offering. The FYCRC also considered materials provided by Gary Herrin regarding other institutions' first year programs, and options that might better meet first year program goals.

II. Conclusions and Recommendations

A. Following review of the information and materials considered, the FYCRC reached the following general conclusions:

1. Technical communications is not adequately integrated throughout UM's undergraduate engineering degree programs.
2. It is not unusual for UM engineering students to graduate with poor writing skills. This conclusion stems from reports from both employers and alums.
3. The first year program's objective of providing a common experience for first year engineering students has not been met.
4. First year courses are not valued by department administrators and faculty teaching upper-level courses.
5. Department and possibly College administrators do not fully appreciate the effort required on the part of instructors of these first year courses.
6. The current level of resources for the first year program is not adequate.
7. The first year program's objective of providing appropriate training in computing is met for some but not all students.
8. Only those students who are uncertain regarding the choice of engineering major, and thus explore the various disciplines, receive exposure to all areas of engineering. Other engineering students graduate without an adequate knowledge of engineering disciplines.

B. Following detailed review of the current offerings of ENG 100, ENG 101, and ENG 195 and consideration of a variety of options for first year program courses:

1. The FYCRC recommends that the College seriously address its undergraduates' inadequate writing skills. The Committee agreed that an entirely different approach to written communications is required, one that involves feedback from graders and rewrites by students until assignments are submitted in a suitable form.

2. The FYCRC recommends that first year courses be better linked with upper-level engineering courses.

3. The FYCRC concludes that the current offering of ENG 100 does not adequately meet student needs or first year program goals and recommends that it be dropped from the curriculum, completely overhauled, or replaced by a differently formatted course (or courses).

4. The FYCRC enthusiastically recommends that the current offering of ENG 100 be restructured, adopting a case study format following the successful recruitment of a course champion or co-course champions, e.g., Robert Beck and Dale Karr.

I. Introduction

A Charge to the Committee from Dean Levi Thompson

Focusing on College of Engineering first year courses ENG 100, ENG 101, and ENG 195, the review should:

- determine the degree to which objectives for these courses are being met;
- assess how well the courses meet the needs of our freshmen;
- critically examine the quality of instructional content and delivery;
- identify or develop ideas for improving the quality of the courses.

The following questions might be considered:

- How well do the courses prepare the students for Math 105?
- Is C++ the right language for ENG 101?
- How well is Communication Across the College (CAC) working?
- How well do the courses prepare the students for technical communications, in particular written communications?
- Are our students getting adequate information to decide on an engineering career?

(Deans Thompson and Herrin will benchmark UM COE first year courses against those at other institutions.)

B Review Process

The First Year Courses Review Committee (FYCRC) met weekly during W2002 and F2002. As several of the Committee members had previously had no involvement with one or more of these courses, meetings were initially devoted to learning about the College's first year program and the current offerings of ENG 100, ENG 101, and ENG195. With this goal, meetings involved invited presentations followed by questions and open discussion and review and discussion of course evaluation materials.

The following individuals met with the Committee:

Date	Name	Presentation On
020129	Gary Herrin	CoE First Year Program and First Year Eng. Courses
020205	Bob Beck	ENG 100
020212	Dale Karr	ENG 100
020212	Matt O''Donnell	ENG 100
020212	Susan Montgomery	ENG 100
020219	Cinda-Sue Davis	ENG 100
020219	Deb DeZure	ENG 100
020219	Kurt Hill	(discussion participant)
020219	Mechy Barcia	(discussion participant)
020315	Gary Herrin	ENG 195

020315	Semyon Meerkov	ENG 195
020319	Gary Herrin	ENG 101
020319	James Holloway	ENG 101
020326	Ken Powell	ENG 101
020416	Darryl Koch	PTP and student prep for ENG 101

Course evaluations and alum survey results, provided by Lisa Payton, were also reviewed, and additional input was provided via e-mail by Pat Hammett and Bruce Karnopp.

Following our information gathering effort, we drafted a summary of initial findings for ENG 100, ENG 101, and ENG 195, which can be found in Appendices A, B, and C, respectively. This effort was followed by discussions regarding what format and material might be adopted for an improved ENG 100 offering, one that could be considered as a prerequisite for upper-level engineering courses and that provided a common experience for first year students. As well, the Committee considered materials provided by Gary Herrin regarding other institutions' first year programs, and options that might better meet first year program goals.

We note that the First Year Courses Review Committee did not attempt to review the first year program in its entirety, i.e., stakeholder needs, program goals, and resource allocation were not closely evaluated.

II. Summary of Findings and Recommendations

A. General Conclusions

1. Technical communications is not adequately integrated throughout UM's undergraduate engineering degree programs.

2. It is not unusual for UM engineering students to graduate with poor writing skills. This conclusion stems from reports from both employers and alums.

3. The first year program's objective of providing a common experience for first year engineering students has not been met.

4. First year courses are not valued by department administrators and faculty teaching upper-level courses.

5. Department and possibly College administrators do not fully appreciate the effort required on the part of instructors of these first year courses.

6. The current level of resources for the first year program is not adequate.

7. The first year program's objective of providing appropriate training in computing is met for some but not all students.

8. Only those students who are uncertain regarding the choice of engineering major, and thus explore the various disciplines, receive exposure to all areas of engineering. Other engineering students graduate without an adequate knowledge of engineering disciplines.

B. Engineering 100 Introduction to Engineering

B.1. Findings

- Upper-level engineering courses are completely disconnected from ENG 100. The course has inadequate visibility and demands on participating faculty are ill understood and appreciated.

- Individual faculty interests determine the students' project for the semester and thus the course focus; hence, students in different sections do not have a common experience.

- Students frequently select their section based upon schedule rather than interest. Many grow frustrated when this results in their having to focus on an engineering discipline in which they are not interested.

- If entire course content - including project focus - were to be set, identifying interested faculty would be difficult

- Resources currently allocated are insufficient
  - Too few GSIs
  - Too many students in recitation sections
  - No common space in which to meet
  - Insufficient credit for participating faculty

B.2. Recommendations

The FYCRC recommends that ENG 100 be vastly revised or replaced by a differently formatted course (or courses). The Committee recommends the following actions:

- Define more-detailed objectives and clarify engineering outcomes.

- Link objectives and outcomes to upper-level engineering course needs.

- Establish uniformity – common content – across all sections of the course.

- Focus on basic skill development during initial weeks with projects starting later.

- Formally appoint a course coordinator.

- Identify a "Course Champion" to serve as course coordinator.

- Ensure that all faculty teaching the course agree on common content, objectives, and outcomes.

- Routinely assess degree to which course objectives and outcomes are being met.

- Ensure that all departments give adequate credit to faculty teaching this course (equivalent to 1.5 traditional courses for the current format)

- Change course structure.
  - sections meet 3 times/week for 1 hour
  - 2 - 3 hr laboratory once/week
  - Encourage students to conduct all project activities during lab sessions. This will reduce difficulties that student teams have finding times to meet outside of class and allow more opportunities for team coaching and for team / project problems to be identified and dealt with in a more timely manner.

- Allocate additional resources.
  - ENG 100 "den" and laboratory
  - 20 students max in recitations or labs

Alternate formats for first year course offerings are recommended in Section E.

The FYCRC agreed that the current offering of Eng 100 does not meet student needs or first year program goals and recommends that it not continue to be offered unless an improved format can be implemented and significant additional resources are allocated on an annual basis.

C. Engineering 101 Introduction to Computers and Programming

C.1. Findings

- Uniformity across sections of the course taught by different engineering faculty is aided by:
  - a well developed and detailed set of educational objectives
  - cognizant faculty acting as course coordinator
  - the small number of instructors

- Preparation / background in computers/programming is highly variable among ENG 101 students.

  - the material and pace are appropriate for many students but above or below the abilities of a significant number

- Failure rates among women and under-represented minorities are around 15%.

- Students need significant contact time with faculty outside of class.

- Managing and supervising GSIs and graders requires a significant additional time commitment on the part of faculty.

- Resources/Budget
  - Current resource allocation and teaching credit do not reflect the greater level of effort and commitment required on the part of faculty.
  - Originally designed and budgeted for 880 students per year with a budget of about $400k, the course was expanded to 1200 per year without a change in budget; it has consequently run in deficit since the expansion.
  - Decisions resulting in the reduction of staff and the hiring of graders in W2002 resulted in an increased faculty workload and significant delays in grading student assignments.

C.2. Recommendations

The FYCRC agreed that the current offering of ENG 101 is generally well received and meets the needs of many students. The Committee recommends that it continue to be offered with the following modifications:

- Employ a better metric to determine which students need additional training prior to taking ENG 101.
  - Have students take a placement exam to determine skill level.
  - Validate the utility of the placement exam.

- Ensure that students needing additional preparation are enrolled in suitable programs
  - For example, failure rates for under-represented minorities are significantly decreased for those students who participate in the MEPO Professional in Training Program.

- Consider multiple tracks as a way to better meet the needs of students with significantly different preparation /backgrounds in computers and programming.

- Formally appoint a course coordinator.

- Provide resources to address course needs and ensure that the course coordinator and participating faculty are given teaching credit commensurate with level of effort.

D. Engineering 195 Selected Topics in Engineering

D.1. Findings

- Each week is devoted to a particular Engineering field.

- Lectures are given by senior faculty from each Department.

- Two lectures are given weekly and provide:
  - a general description of the field, including
    - intellectual and technological foundations
    - job opportunities
    - course requirements

  - a specific problem (with homework assignment), including
    - problem formulation
    - methods for solution
    - practical applications

- Enrollment
  - Winter 2001 147
  - Fall 2001 162
  - Winter 2002 82
  - Fall 2002 165

- Challenges/Unresolved Issues
  - Matching difficulty of problem sets to level of students
  - Incorporating ethics, environment, and problem-solving
    - opportunity to introduce these critical features during earliest exposure to Engineering and enable students to understand the associated impacts for all disciplines
  - Should the course be required?
    - requiring the course would enable students who have selected their majors based on limited information and/or parental models to rethink their decision
    - requiring the course would ensure that all students would gain a basic understanding of the range of engineering disciplines
  - Identification / continuity of adequate resources
    - support for GSIs
    - teaching credit for participating faculty

D.2. Recommendations

The FYCRC recommends the following changes:

- Critically evaluate the course annually and reconsider the question of changing course status from an elective to a requirement.

- Provide resources to address needs for additional GSIs, ensure that the Course Coordinator and participating faculty are given teaching credit commensurate with effort level.

E. Alternate Formats for First Year Course Offerings

E.1. Laboratory Format for ENG 100

The Committee considered a 4 Credit laboratory course with weekly 2-hr lecture/recitations and 3- to 4-hour labs. The course would consist of 4 or 5 experiments or hands-on construction projects. Topics covered would include basic problem solving, uncertainty, probability, and measurement techniques. This course would have an integrated technical communications component that includes laboratory reports, summaries of experiments for higher management, and PowerPoint presentations.

E.2. Case Studies Format for ENG 100

The Committee considered a 4 Credit course that meets weekly for three 1-hour lectures and one 1-hour recitation. Four case studies in different engineering disciplines (e.g., chemical, mechanical, electrical, nuclear) would be covered in depth each semester. Each case study would be led by faculty (or a faculty team) having expertise in the relevant discipline(s), and the same faculty would lead their case study in all sections. The option to bring a member of the team or the individual originally responsible for the case under study to campus to meet with students should be explored. As well, the Committee suggests that a range of cases be studied (including engineering failures, problems surmounted, novel or exceptional designs or fixes, and unexceptional but successful fixes) and that there be a focus on kinds of thinking, team building, risk taking inhibitors, group work, brainstorming,, and skills development.

The Committee envisions that the College would provide support for the generation of each detailed, written case study, e.g., a course development grant consisting of summer salary or partial summer salary plus funds for graduate assistants. The "contract" would guarantee that the engineering content in each case study would cover agreed-upon engineering basics (e.g., problem solving, uncertainty, statistics, risk and cost to society analysis, and engineering economics), with the content to be determined by assessment of student needs and relevance to upper-level engineering courses.

The Committee believes that first year program courses require a greater degree of interactive teaching and notes that proper feedback on written assignments requires a significant effort. The Committee recommends that sufficient funds be allocated to the Tech Comm component of the course funds for the appointment of a sufficient number of graders (perhaps English Department Graduate Students, e.g.) in order to require students to submit rewrites and to provide students with iterative feedback until written assignments are submitted in a suitable form. The Committee recommends that assignments include both written work and oral presentations and that a mix of individual work and teamwork be required for both. With assignments based on each case study, the Committee felt that exams might not be required.

The Committee notes that startup expenses for this format would be high and that there would be an on-going expense associated with the recommended personal attention on grammar and writing skills.

E.3. Replace ENG 100 with 3 Credit Tech Comm Course and Return 1 Credit to Departments

The Committee believes that a focus on communication skills, in particular grammar and writing, is badly warranted and that this course would be a start towards addressing students needs. The Committee also considered that departments would welcome the returned credit.

E.4. Replace ENG 100 with 2 Credit Tech Comm Course and 2 Credit Department-Specific Introduction to Engineering Course (Possibly w/ ENG 101 Changed to a 2 Credit Course)

The Committee considered this option to represent a continued focus, at current levels, on communication skills and an opportunity for departments to provide an introductory course tailored to each engineering discipline. The Committee recommends that students be required to take two such introductory courses to obtain some breadth outside of the major. As well, a reduction to 2 Credits for ENG 101 with a focus on Matlab only would allow the College to retain a total of 8 Credits for first year engineering courses.

E.5. Replace ENG 100 with a Required, 3- or 4-Credit Version of ENG 195 and, if 3 Credits, Return 1 Credit to Departments

The Committee agreed that all engineering students should have at least an introduction to all engineering disciplines at some point during their 4 years at UM. While ENG 195 has been very well received by the students who have elected to take it, the Committee notes that we do not know how the course would be received should it be taken by all first year students. Nonetheless, the Committee at this point believes that a similar format would be appropriate for the expanded course. The new course would include coverage of environmental issues, ethics, and a focus on grammar and writing skills (with a requirement of 2 – 3 term papers). The Committee believes that first year program courses require a greater degree of interactive teaching and notes that proper feedback on written assignments requires significant effort. The Committee recommends that funds be allocated for a sufficient number of graders (perhaps English Department Graduate Students) to provide students with such feedback. The Committee notes that while the year-to-year offerings may not have content in common, the engineering content would be common for each term if the same material were taught in all sections. The Committee suggests that recitation periods be used to develop skills in teamwork, problem solving, and brainstorming.

The Committee notes that there would be an on-going expense associated with the recommended personal attention on grammar and writing skills. In the event that the new ENG 195 is offered as a 3 Credit course, the Committee expects that departments will welcome the return of 1 Credit.

E.6. Replace ENG 100 with a 2 Credit Tech Comm Course and a 2 Credit ENG 195 course

While E.5. suggests a format that integrates technical communications with an introduction to engineering disciplines, this option provides for separate 2 credit courses. The Committee considered this option to represent a continued focus, at current levels, on communication skills and an opportunity to expand ENG 195 to include environmental and ethical issues.

III. Recommendations

❖ *The FYCRC recommends that the College seriously address its undergraduates' inadequate writing skills. The Committee agreed that an entirely different approach to written communications is required, one that* *involves feedback from graders and rewrites by students until assignments are submitted in a suitable form.*

- *The FYCRC recommends that first year courses be better linked with upper-level engineering courses.*

- *The FYCRC concludes that the current offering of ENG 100 does not adequately meet student needs or first year program goals and recommends that it be dropped from the curriculum, completely overhauled, or replaced by a differently formatted course (or courses).*

- *The FYCRC enthusiastically recommends that the current offering of ENG 100 be restructured, adopting a case study format following the successful recruitment of a course champion or co-course champions, e.g., Robert Beck and Dale Karr.*

Appendix A. Engineering 100

A Current Course Objectives

- To provide an experiential introduction to engineering through project-based work in an engineering discipline, appropriate for first-year students and undertaken by student teams.
- To introduce students to the basics of written, oral, and visual communication.
- To provide experiences in team building and teamwork.
- To introduce student to the role of the engineer in society and professional responsibilities/ethics.
- To introduce environmental and quality concerns in the engineering profession, including the concept of "whole life design" for recycling and environmentally conscious engineering decision-making.
- To introduce students to the acceptance and analysis of risk in engineering design and manufacturing.

B . Current Course Outcomes

Students will be able to

- begin to identify, formulate and solve engineering problems.
- demonstrate increased technical knowledge and awareness of key concepts in engineering and science.
- gain specific instruction and experiences in qualitative engineering problem research and information retrieval.
- understand the range of skills needed in engineering.

- begin to identify, formulate and solve engineering problems.
- demonstrate increased technical knowledge and awareness of key concepts in engineering and science.
- gain specific instruction and experiences in qualitative engineering problem research and information retrieval.
- understand the range of skills needed in engineering.

- employ the fundamentals of technical, oral, and visual communication.
- produce a basic technical report and oral presentation.
- understand that technical communication has multiple audiences and purposes and describe those audiences and purposes for their reports and oral presentation.
- begin to identify, formulate and solve engineering problems.
- describe the social and economic impacts of their engineering project and/or of given case studies.
- describe the environmental implications of engineering decisions on their project and/or on given case studies.
- become more aware of the responsibilities engineers have as professionals.
- gain specific skills for effective team organization, participation, and leadership.
- function as a team member using standard meeting and team building habits.
- have an initial, positive experience in cooperative learning.

C. Introduction/Current structure

C.1 Combined Engineering and Technical Communications

C.1.a Pros

- Modern engineers conduct their work through teams and Tech Comm is a natural component of an introduction-to-engineering course.
- Takes the place of English 124/125, providing our first year students an "engineering experience" on North Campus.
- Engineering communication skills presumably not deliverable in an LS&A composition class.
- Intensive writing assignments "anchored to an intellectual focus within a discipline".
- The course is viewed as an effective vehicle for Technical Communications.

C.1.b Cons

- Course has too many goals and combining Tech Comm with Engineering (or Tech) content adds considerably to the total.
- Tech Comm dominates in the minds of the students (it viewed as a "Tech Comm" course).
- Adds to the feeling (real and imagined) that the course is disjointed.
- Need Tech Comm recitation instructors with Tech background.
- There is no "feeder program" for technical writers.

D. Evaluation

D.1 Context

In February 2000, Gary Herrin, Assistant Dean for Undergraduate Education, asked CRLT to review all the available documentation related to ENG 100. In July 2000 and, again in February 2002, CRLT reported their observations and recommendations incorporating input from the following sources:

- 1998-2001 course evaluations
- Midterm student feedback sessions (conducted by CRLT)
- Meetings with ENG 100 faculty teams and CRLT
- Input from ENG 100/101 faculty retreats held in 2000 and 2001
- Interviews with CoE faculty, staff, and administrators (conducted by CRLT)

Although there has been a marked improvement in the course evaluations and faculty self-reports over the past few years, the course continues to have several ongoing challenges that impede its success as a productive and positive experience for first year engineering students and their instructors.

The following is a summary of the observations and recommendations:

D.2 Strengths

- Engineering and technical communications faculty involved with the course are highly regarded as instructors and scholars;

- incoming enrollment profile reflects highly capable students;
- a stable enrollment of approximately 1,000 students are required to take this course during their first year;
- a clearly articulated set of broad objectives and outcomes for the course;
- learning objectives tied to CoE Curriculum 2000 guidelines and ABET outcomes;
- several years of experience with the course;
- large budget (relative to other courses);
- a capable and committed administrative champion and advocate for the course (Assistant Dean Gary Herrin).

D.3 Challenges

Evidence from recent student evaluations and faculty feedback suggest that ENG 100 is improving and that some of the problems from earlier years have been reduced or redressed. Nonetheless, several systemic challenges persist and reveal inherent flaws in the design and staffing of the course. This does not diminish the significant achievement of the faculty who worked assiduously to improve ENG 100. The model itself may be problematic and unable to sustain the weight of multiple and competing objectives. Many, but not all students, acknowledge on their student evaluations that they learned a lot about technical communications (both oral and written) and teamwork and that their faculty were highly effective, even outstanding. Nonetheless, many students did not like the course and all too often indicated that the course reduced rather than ignited their interest in engineering.

The challenges fall into seven broad areas: 1) curriculum; 2) instructional methods; 3) assessment of student learning outcomes; 4) communication and collaboration within and across faculty teams; 5) staffing; 6) course coordination; and 7) orientation and development opportunities for faculty. Most of the issues listed below continue to be cause for concern.

D.3.a Curriculum

- Outcomes, with the exception of technical communications, are not consistent across the sections; this may lead to gaps in skill development for some students and, therefore, diminish the value of the course in the eyes of non-ENG 100 faculty;
- purpose and value of the course is not clear to students or faculty;

- the content, with the exception of technical communications, in several sections is too advanced for an introductory course and often assumes knowledge of material students may not have had exposure to;

- students are coming in with expectations that the course has a poor reputation and is viewed primarily as a technical communications course;
- students are often registered in sections focused on topics that do not interest them;

- section topics are often highly specialized with projects students do not like (Note: Prior to 1999, projects were not sufficiently hands-on. Most, but not all, of the projects are now hands-on. The reverse engineering projects appear to be highly successful and well liked by students);

- co-curricular aspects of the course have not been developed; there are, for example, few out-of-class opportunities to augment the learning;

- too many objectives to accomplish them all; some of the challenges include:
  - ➢ objectives are not clearly stated (each set of instructors defines the technical engineering content differently so there is no common set of learning outcomes);
  - ➢ ethics and environment are explicitly stated as objectives for the course yet they are not stressed in most of the sections;
  - ➢ writing and speaking are well taught and students are effectively developing these skills; teamwork skills, however, are neither consistently nor appropriately taught and supported (negative group experiences are common);
  - ➢ some students would prefer ENG 100 to be an introduction to the engineering disciplines (now provided in ENG 195 as an elective);
  - ➢ website support for ENG 100 has been inconsistent across sections and is generally under-utilized as an instructional tool;
  - ➢ unable to locate appropriate textbooks that include the engineering content as defined by individual faculty (texts that have been used have had mixed reviews from both students and faculty);
  - ➢ based on the open-ended comments on student evaluations, ENG 100 does not engender love of the discipline; rather, it turns some students from engineering.

D.3.b Instruction

The instructional challenges have been addressed over the past few years diminishing the most acute problems, particularly among faculty who have been teaching the course for several semesters. While progress has been made, it is important for instructors to continue to be aware of these challenges. The issues cited below reflect the low ratings of the course in the past:

- Technical engineering content was not well calibrated to the needs and skills of incoming first year students (students reported the following: felt lost; inability to understand; denied sufficient opportunities to ask questions during the lectures; the material and tasks were too advanced; and the pace of presentations was too rapid);

- technical engineering and technical communications elements were not well integrated (students felt they were taking two unrelated courses);
- prevailing delivery method was straight lecture for extended periods of time when the preferred learning style of most incoming students requires active engagement and interaction in class;
- assignment designs were often flawed without clear expectations for the tasks or explicitly stated criteria for evaluation;
- lack of academic support for several sections of ENG 100 (AELRC offered some support).

D.3.c Program Evaluation and Assessment of Student Learning Outcomes

With few common course objectives, particularly for technical engineering content and processes, it has been difficult to ascertain across sections whether students are achieving the outcomes for which this course was designed. Self-reports from faculty within sections indicate that the majority of students are mastering the required content and skills, but relatively little is known about the status of student learning across sections. There are no common assessment tools, no common set of criteria for projects, and no common reporting mechanism about student learning.

In 1999, three classes of alumni (1989, 1993, 1997) were surveyed by the College (34% response rate). Alumni were asked to rate how important certain competencies and attitudes were to their professional experiences and how well they felt the undergraduate program at UM prepared them in these areas. The largest gaps between levels of importance and preparation exist for the non-technical competencies. These data strongly support the need to more effectively develop these skills in students.

Competency	Important	Prepared	Gap
Math, science, engineering skills	78.3%	89.8%	(11.5%)
Design and conduct experiments	51.0%	53.0%	(2.0%)
Engineering problem solving skills	89.2%	79.8%	9.4%
Design a system, component or process	70.8%	49.4%	21.4%
Understand social, economic and environmental impact of work	48.5%	18.8%	29.7%
Function on a team	92.5%	59.5%	33.0%
Appreciation for the ethical values of being a professional	71.1%	37.3%	33.8%
Communication skills	95.8%	41.8%	54.0%

D.3.d Communication and collaboration within and across ENG 100 faculty teams

Students complained that their team instructors were not well organized, gave inconsistent and contradictory information, and were not functioning like a team. Faculty were viewed as independent lecturers rather than team teachers with joint responsibility for all elements of the course. This issue seems to be under control as faculty teams work more closely together on course planning and delivery and evaluation of student learning.

There was also a need for more communication and collaboration across sections. The individual sections functioned independently and there was little opportunity to share ideas and resources, compare and build curricula, provide mutual support for instructional challenges, or orient newcomers to the course. The faculty retreats and team meetings with Gary Herrin have helped, but appointment of a course coordinator could bring more consistency to the sections and promote ongoing sharing across sections.

D.3.e Staffing

The recitation sections were often staffed by non-engineering instructors and this created challenges for students who needed assistance with technical material. To address this need, sections were staffed with engineering GSIs or lecturers with technical backgrounds. At the same time, the faculty reduced the difficulty of the technical content. The use of engineering GSIs to staff the discussion sections, however, was very costly. To address the budget issue, fewer GSIs were used to staff recitation sections. Technical communications lecturers are less expensive, but they do not have the background that the engineering GSIs offer. Further, U-M does not have a graduate program for technical communications that can serve as a feeder to staff ENG 100, so it is an ongoing challenge to find instructors.

D.3.f Course Coordination

To promote consistency across sections and ongoing support for faculty, the course needs a designated course coordinator. The coordinator for this course and each of the other first year course coordinators should report to Gary Herrin. Responsibilities would include (but not limited to):

- Anticipate and identify issues that need to be discussed by ENG 100 faculty and external parties;
- conceptualize, plan and implement an infrastructure to support the course and its faculty and students;
- provide an orientation for new faculty;
- provide ongoing oversight and development for instructors;
- direct assessment efforts both for student learning outcomes and program evaluation;

- write grants and build the program into a national model for first year courses in engineering;

- coordinate course materials (including reviewing and ordering texts);

- coordinate requests for space (facilities are an ongoing problem given its objectives for team projects);

- work closely with CRLT to design instructional support experiences for faculty.

D.3.g Faculty orientation and development

This course is unlike any other course taught in the College of Engineering and it is unlike any course most faculty have taught before. It involves first year students with unique developmental needs, skills and attitudes. The course content is new and demanding. It is team taught with two disciplines requiring careful planning to ensure integration and equity among the partners. To effectively prepare and support faculty, it is important to orient new faculty and provide ongoing development for continuing faculty to encourage communication and collaboration across sections.

E. Issues

E.1 Introduction

A number of issues were brought to the attention of the FYCRC, including resources (number of GSIs, size of recitation sections, common course-devoted space, team skills coaching), staffing (identification of interested faculty, motivation for faculty, course load/credit), project (optimal number, focus), and student experience (course selection - schedule rather than interest-driven, project focus varies section to section; utility for selection of major, utility to upper level engineering courses)

E.2 Common Experience / Materials

A significant issue for ENG 100 is its lack of visibility in the degree programs of the College. ENG 100 is not a prerequisite for any course within any discipline of engineering, and in consequence is practically invisible to the departments. This strange state of affairs, in which a core first year course is not visibly built upon in later courses, is a result of both the history and organization of the course. The technical content of each section of the course is built around the project selected by the primary technical faculty instructor, and so differs greatly from section to section. The technical communications component of the course is more uniform from section to section, but few faculty can concretely outline what the students learn in this aspect of the course. The modes of presentation of the technical communications content also vary widely from section to section (including lecture time in some sections, but not in others).

It is tempting to suggest identifying common technical material that should be covered in all sections of ENG 100. Later courses within a student's curriculum could then reliably build upon this. But there is some concern that this would severely constrain the design projects that might be undertaken, and perhaps dampen the enthusiasm of the technical faculty teaching the course, and leave many students disinterested because their project is remote from their intended major.

Recommendation
At the very least a systematic information campaign should be undertaken to publicize to the faculty as a whole the capabilities that students who complete ENG 100 have.

E.3 Project Focus

The Committee feels that the faculty-determined projects are the primary cause of the inconsistent content of ENG 100. Although the Tech Comm part of the course is the same section to section, as noted above, the engineering content varies widely. This largely results from sections defined by faculty-determined projects. Currently, each faculty member chooses his/her project, with little or no coordination between the sections, and the engineering content that is taught in each section is selected to meet the needs of the projects. For example, there is a wide discrepancy between the engineering content of a course based on mechanics and a course with a project on web based radio.

The engineering content of ENG 100 should be developed before any projects are defined. Learning the selected content is then one of the primary goals of the course. The required engineering content should be selected based on the interests and needs of the students and usefulness to follow-on engineering courses across the College. The common engineering content would then be used in the development of projects. Projects could be predefined before selection of the teaching faculty or faculty could be selected with the understanding that they will select a project that would use all of the prescribed engineering content or use one of the predefined projects.

E.4 Project Number

One of the main criticisms from students for ENG 100 is that they work on projects in which they are not interested and/or that are not related to their chosen field. There are three different solutions that were discussed on this topic. The current model has one project that tries to incorporate a variety of themes, e.g., electrical, mechanical, chemical, etc.; it might be strengthened by offering different modules. Another solution is to have specialized sections devoted to one of the specific topics. A third solution is to have multiple projects- each with a different topical theme.

E.4.a. A Single, Discipline-Specific Project

One of the major problems of ENG 100 is matching the term project to the interest of the students. For example, students in electrical engineering have not become excited about working on projects in other disciplines, e.g., chemical or mechanical engineering. In fact, in many cases this mismatch of projects and disciplines coupled with a lack of knowledge that students are expected to carry and use in upper-level courses have caused many students to be come quite negative about ENG 100.

One potential solution is for each section of ENG 100 to have a term project related to an individual discipline or combination of disciplines. For example, there could be projects and sections is the areas of

- Thermo, material and chemical sciences (engineering)
- Fluids
- Computer and electrical
- Environmental
- Structures
- etc/other

The flavor of the section and the term project should be identified well ahead of course registration time so that the students could choose their section and corresponding project. However, it will be important that central themes for the course be more clearly identified and adopted by all sections. The benefits to this approach are high motivation and interest on the part of the students for their project, leading, ideally, to a more positive outcome. The disadvantage to this approach is that students would not get exposed to a broader sense of engineering nor work with others with different perspectives. In addition, there are difficulties in scheduling that will need to be overcome.

- Pros
    - Students would have projects more attuned to their interests.
    - Students could work in teams with similar interests.
- Cons
    - Students would not get exposed to the broader sense of engineering and this is one of the few rare opportunities for them to get this.
    - Students would not get the opportunity to mix with others with different perspectives,
    - It is prohibitively complicated as regards scheduling.

E.4.b. Multiple Projects

In this option, student teams would work on 2 to 4 mini-projects focused on a topic such as electrical, mechanical, chemical. These projects would be approximately a month long.

Potential activities include:

- An open design problem statement is given to the students
- They are given a few lectures to give them the necessary background to develop concepts.
- They are given a week to conceptualize different solutions and select one to develop.
- They are given a short period of time (about 2 weeks) to develop the solution – perhaps even build a simple proof-of-concept (if simple kits can be developed that would reduce much of the work)
- At the end, all the mini-projects could possible integrate into a full system aiding in bringing together coherency of the topics. An example would be a chemical module designed to delivery power, a mechanical component that transforms that power into useful motion and an electrical component that controls that motion. Each could be developed independently of the others, but brought together at the end for a bigger purpose such as a powered boat, car, etc. that could be tested against standard criteria or compete against others.

The advantage is students get a greater breadth of material with the potential for greater interest and motivation. They will have multiple opportunities to practice the design process, demonstrating to them that the process is universal across disciplines and giving them several opportunities to practice the primary principles. It would also give the teams a chance to rotate, giving the students an opportunity to work with more of their classmates. The disadvantage is that it will be more difficult to go into depth in any one area, so the complexity of the project may need to be simplified and supporting kits with "black-box" units may need to be developed to insure success.

E.5 Technical Communications and Team Management

Communications, critical thinking, and problem solving are ideally taught in a project focused course where students are engaged in the process of solving or communicating a problem, weighing and testing alternative solutions, brainstorming, as well as making and implementing decisions. It is crucial to capitalize on a student's engagement and model efficient strategies.

E.5.a Technical Communication Issues

- There is a need for a clear set of course objectives and desired outcomes.
- There is a need to demonstrate that technical communications, problem solving strategies, design concept, team management, basic science, etc. are all aspects of the engineering process; deficits in any area(s) will affect the overall outcome. This conviction must be modeled for students.

- Technical communications has become synonymous with writing and oral presentation. Yet the range of material covered by Tech Comm instructors goes well beyond composition and presentation. Topics include:
  - design concept
  - scientific vs. engineering methods
  - ethics
  - systems thinking
  - critical thinking
  - problem solving strategies
  - logic and logical fallacies
  - teamwork
  - team organization and management
  - graphing, schematics, diagrams
  - basic statistics
  - applications: Excel, PowerPoint, etc.
  - resources
  - testing and analysis
  - engineering subject mediator

- The Tech Comm instructors play numerous roles:
  - Instructor: teach academic skills and format
  - Guide: act as liaison in new, unfamiliar academic environment and culture, clarify academic expectations, standards, and measurement
  - Mentor: help students develop confidence in individual identity, encourage diversity and awareness of stereotypes
  - Mediator: monitor, intervene, and counsel in team management and conflict resolution
  - Counselor: identify students in need of academic or psychological support, make referral and pursue progress

  ENG 100 recitation instructors often constitute the only adult support system for incoming freshmen. They are frequently called upon to help students overcome ethnic, racial, and gender stereotypes, social isolation, and academic or intellectual deficits.

- Experienced instructor vs. GSI

- Need for full-time instructors with experience teaching in higher-level institutions, preferably with experience in business, industry, research, and publishing, and with background in technical communications. Many of the present faculty come with a mixed background in the sciences or engineering and liberal arts.
- Use of regular faculty will help to alleviate the discontinuity resulting from constant turnover in GSIs, lack of teaching experience or lack of proficiency in technical communications.
- GSIs lack work experience, formal background in communications, pedagogy or engineering outside their specialty. They have limited backgrounds in developmental issues or gender and minority issues that impact students. GSIs play an important role as mentors, but many lack the professional experiences, perspective, confidence, and conviction that students expect of the adult support in their lives. GSIs, because of their own lack of experience or knowledge of available resources, do not identify students in trouble and thus do not refer them to appropriate services.
    - Since recitation sections are traditionally taught by GSIs, students often mistake their instructors or the recitation sections as less important. ("I didn't realize you're a real teacher; I thought you were just a GSI.")
- There is no formal introduction or training available for new staff, nor a framework for passing institutional knowledge from experienced instructors to new ones. New instructors complain of operating in a vacuum, regarding course and engineering objectives.
- Classes have been increased from 20 to 25 per recitation section. This effectively increased the grading load and coaching hours and reduced the individual contact and assignment. Instructors are often left to fend for themselves when it comes to material development.
- Increased class size together with 20% reduction in the recitation positions means Tech Comm faculty must assume a larger teaching load to maintain a full time position. Low wages and lack of resources for material development undercut faculty morale.
- In addition to compensation and workload, there is the perception of a lack of commitment to the Tech Comm program on the part of the College. Faculty cite administrative policies as evidence of this, as well as faculty attitude outside of ENG 100. Students often perceive Tech Comm faculty as a distant country cousin to Engineering, and of substantially less worth than basic science courses. Instructors perceive themselves as working against negative attitudes from their colleagues as well as students.

- Curriculum development, materials development, and shared resources
    - There is the feeling among a number of instructors that a lack of cross section dialogue may contribute to a duplication of efforts, both in respect to technical and Tech Comm subject matter.
- Grading:

- The lack of a unified grading policy further supports the perception that Tech Comm is not an integral part of Engineering. The Tech Comm grade is generally reported separately. It normally represents a lesser portion of the total grade (typically 25 – 35%). Technical and Tech Comm grades are handled on different copies of the same report, often employment different grade sheets. In extreme cases, Tech Comm instructors have reported being pressured into raising grades that do not match technical grades. This seriously undercuts the message being sent to students.

- Writing assignments
  - The report is the basic document in engineering. The organization and format employed in the report are highly functional and have very real and practical implications for project management. Conventions, such as the executive summary, in addition to providing findings and solutions, help to eliminate ambiguity and clarify assumptions by defining the operational envelope. For many students, ENG 100 is the first encounter with the concept of operational envelope. The pains students express in connection with learning to write executive summaries has little to do with writing skill and everything to do with critical skills. Students have never before been asked to define and scope out a problem with all its attendant constraints, both explicit and implicit. This is not a skill acquired passively from reading or listening; it requires the student to be engaged in the actual process by doing.
- Best practices
  - Effective acquisition of verbal skills requires immediate feedback. The learning environment should be responsive and highly interactive, the same type of environment that assures rapid acquisition of a second language. Learning skills, especially thinking and communication skills, are best accomplished in a set up that can provide rapid feedback. One reason is that this type of learning involves "unlearning" old strategies and assumptions before new ones can be internalized. In addition, providing students with a variety of opportunities to learn, test, and validate strategies is crucial to effective learning.
- Time constraints
  - The initial weeks require intense instruction and exercises in the engineering and communications fundamentals necessary to tackle the project. Since only one recitation section is available per week, students often receive only 2 – 3 meetings dedicated to communication within the first half of the semester. The balance of the time goes to other subjects related to the project. Although lectures cover whatever cannot be presented in discussion section, the format is of limited effectiveness.
- Continuity
  - Not all technical communication issues or formats can be covered in the span of a single semester. However, if some consensus could be achieved regarding the Tech Comm objectives for students over the 4-year undergraduate program, it would be easier to provide students with some perspective on the material they concentrate on in ENG 100. Integrating ENG 100 objectives into 4-year objectives would also

provide students with a better understanding of how present topics, such as the argument, differ from topics being taught later on in the overall curriculum.

- Facilities
  - There is need for a "war room". A large room dedicated each semester for the use of the 500 ENG 100 students would reinforce a sense of solidarity. It could simultaneously provide a place for teams to meet and a place for instructors to interact with students. It would also provide a place for instructors to observe teams in action.

E.6 Resources and Delivery

Regarding administrative issues, there are suggestions for increased numbers of GSIs, for increased space for lab projects and for fewer students per recitation or lab. These suggestions would of course be helpful for the students but carry substantial costs.

The delivery of ENG 100 varies considerably from section to section and could be generally improved. A faculty course coordinator could, it is often suggested, enhance the delivery of ENG 100 and facilitate increased uniformity across the sections. Other common suggestions include a project "bank", mandatory midterm evaluations, and, as discussed above, an increased visibility or linkage with upper division courses. Not all the objectives of the course have a corresponding question on the course student evaluation form; the course evaluation forms should be revisited to be sure the right questions are being asked. There is also a need for identifying or clarifying the "intangibles" of the first year engineering experience that ENG 100 provides for students.

E.7 Preliminary Recommendations (April 2002)

- Appoint a course coordinator.
- Orient and mentor new faculty and provide ongoing development opportunities for continuing faculty.
- Clarify technical engineering outcomes and develop appropriate curricular materials.
- Develop a bank of ENG 100 project options for new faculty to use or adapt.
- Conduct pre- and post-assessments to determine student aptitudes, needs, expectations, and skill development.
- Require all sections to conduct midterm student feedback sessions.
- Develop academic support services for students with a focus on the needs of international students.
- Develop an active co-curricular course infrastructure to support all sections (social events, trips, speakers, physical space for gathering, etc.).

- Restructure the course to two one-hour lectures and one three-hour lab.
- Encourage an interactive classroom environment to increase student engagement and learning.
- Develop a consistent set of course instructors who will stay with the course over time (long learning curve).
- Conduct a formal assessment of the course in three years.

F. A Potential New Course Structure

As the list below shows, there are many options for a course structure. However, the Committee feels that the engineering content should be determined first. Numerous discussions have shown that one of the major problems with the present course is the lack of consistent engineering content. The technical communications part of the course is consistent from section to section. The lack of consistent engineering content is the result of the projects being professor driven. The availability of professors to teach the course is first determined. Then the professor teaching the course defines the project and finally the engineering course content follows from the scope of the project. The Committee feels that this is backwards. The engineering content for all of the sections should be decided first, the project or projects defined, and finally the teaching faculty selected. An alternative would be to select the faculty with the understanding that they will either use the predefined project(s) or develop a new one(s) based on the agreed upon engineering content.

Various course structures were discussed. It should be noted that the course structure should not be separated from the course content since faculty from the College of Engineering will eventually have to teach the course. If the course format and/or content are beyond the expertise of the available faculty there will be problems. For example, forcing an electrical engineering professor to teach beam theory might be problematic since electrical engineers do not normally take a strength of materials course. A summary of possible course structures follows:

1) Develop a pure techcom course and give the remaining Credits back to the departments for their introductory courses. This option avoids many problems, but gives freshman the impression that communications is not an important part of their engineering education.

2) Minimal change to the present format. The Committee feels that the present one-hour recitation should be change into a 3-hour lab section. This would allow students the opportunity to have team meetings in class and to have more help and guidance in the project work. The primary disadvantage is more student contact hours for the GSIs, but this is somewhat offset by the need for fewer office hours. PROS—this is a known format and will require essentially no work to implement; the faculty seems to like the individual projects in their area of expertise; the students get to examine in depth a particular engineering problem. CONS—lack of consistency in engineering content between sections; no engineering content that can be built on in subsequent courses; an individual student might have no interest in the project area.

3) The format proposed in 2) but with uniform engineering content in all sections. The projects would be defined so that they would be appropriate for the assigned engineering content. PROS—the problems of no uniformity to the engineering content would be eliminated. CONS—difficult to find faculty who would be comfortable teaching the assigned projects; does not address the problem of individual students having to work on a project in which they have no interest.

4) The format proposed in 2) but each section has a flavor (i.e. mechanics, electrical, chemical). PROS—students would work in their area of interest; follow-on courses could rely on the engineering content IF the student was in the appropriate section. CONS—scheduling would be a nightmare; students would not get an introduction to the different engineering disciplines, however, they would get an in-depth look at a particular discipline and that might be more important.

5) The format proposed in 2) with uniform content but the one large project would be broken up into three smaller projects. Each project would be in one of the major areas of engineering (mechanical, electrical, and chemical) and take one month of the course. The projects could be unrelated in which case different faculty could be brought in for each new area. Three faculty could thus rotate through the sections and teach in their area of expertise. Another possibility is to have projects that build on one another. In this case the projects would have to be ordered and it would be difficult to rotate faculty. However, if the projects were "canned" and since the engineering content would be very basic, this might not be too much of a problem for most faculty. Diann Brei has developed a sample syllabus that is attached. PROS—format gives uniform content that subsequent courses could build on; introduces students to all the major areas of engineering. CONS—projects would have to be developed and chosen carefully; students would not get an in-depth look a single area of engineering.

Final note: The Committee briefly discussed engineering content that would be useful to all students and would allow for engineering analysis and detailed projects. The techcom content of the course would not change from the present. Possible areas include:

- the design process
- engineering economics
- statistics
- uncertainty and risk
- controls and feedback in engineering systems

Lecture and Recitation Schedule for a Three-Project Course

Developed by Diann Brei

Date	Topic	Chapter

Jan. 8 Class Logistics
Jan 10 Design Processes

DL Organizational Issues/Team formation/Personality & Learning Index

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Jan 15 Customer Specifications (QFD)
Jan 17 Case Study – Economic Factors

DL Set Teams, Team Dynamics and exercise, discuss power module project and start project 1. power (chemical??)

Jan 22 Concept Generation and Creativity
Jan 24 Concept Selection/ Decision Theory
DL generate QFD metrics for project – power performance, economic, size, weight, technology risk, etc to power source problem,
tech com ? – write specification document –assignment

Jan 29 Case Study – Power/Energy Principles-overview to different ways, basic concepts (current, voltage???, chemical???)
Jan 31 Design of Experiments

DL Creativity exercise – think up all the different forms to get power in, review power/energy equations, assignment – evaluate based on metrics and down select to feasible sources. Write a recommendation document

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Feb 5 Case Study – Power/Energy –equations/modeling, etc. anything else needed for project
Feb 7 Statistical Analysis

DL Give them a training on how to use some of the very, very basic lab equipment – measuring with calipers, measuring power, etc. Review power concepts.
Assignment : Given a set of potential energy sources (chemical, electrical, combustion (?? Or analogy)), design a simple experiment to evaluate it based on our QFD metrics – (so measure size, weigh it, measure power, etc.). writing assignment – experimental procedure – hypothesis to be tested, methodology, etc.

Feb 12 Environmental Issues
Feb 14 Ethics

DL Run experiments and analyze data, write a report on final recommendation for energy source based on findings.

Feb 19 Functional decomposition -Overview to system design and breakdown of common subsystems

Feb 21 Basic Electrical Principles – V= IR

DL Give out motion control project (powered by energy source), Team reformation, Assignment –Decompose the motion project into primary functions using functional decomposition principles discussed– power supply (already done), electrical system (could be electrical motor or electrical control), mechanical system (transform into motion want or controlled motion). Get them to break it into two separate projects – one a motor control project (electrical) and then mechanical transmission project (mechanical). Will work first on motor control then mechanical one. transfer customer specs into engineering specs on QFD (revisit in this context) for each box or do this as you go- just motor for right now???

Feb 26 Spring Break

Feb 28 Spring Break

DL No Labs

Mar 5 Electrical Motors-

Mar 7 Control Circuit principles

DL Start motor control project. Get in lab and make a motor work (with the power supply selected from last time??? Or new selection???). Start to design simple control circuit to turn on off (or more complicated like variable speed for an obstacle course???). Design a controller (simulate it simulink or some package??? If so will need to teach package and how long will that take???) practicing concept generation, selection, etc. Write up design and propose a test plan. Try to work in and revisit the steps of the design process discussed earlier in semester.

Mar 12 Control Circuit

Mar 14 Other electrical – like sensors or switches – what will they need for project???

DL Start to build up circuit and get motor working (simple switches??? Or sensors??? If so is a lecture needed)

Mar 19 Mechanics Principles – Forces and Moments

Mar 21 Mechanic Principles – FBD, etc .

DL Start third project – mechanical transmission. Revisit QFD for mechanical in terms of eng. Specs. Start to design the overall system through conceptualization. Main thing is how in space given will integrate all the different components and determination of loads on transmission – what is torque in from motor – what do they want out – leading to transmission ratio

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Mar 26 Dynamics (v= rw, Power = T*w or F*v) – only what they need for project
Mar 28 Case study – mechanical transmission (gear, belt, or chain???- using dynamics what is transmission ratio)

DL With specs from last week - model transmission system and select a radius (from standard available sizes) could have for gears, belts, etc.

Apr 2 Mechanical lectures needed for project
Apr 4 Mechanical Lectures needed for project

DL build transmission system (or assemble it) and test it off standard equipment, start to integrate it with rest of system

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Apr 9 Integration issues – putting the parts together, loss mechanisms, etc?????
Apr 11

DL integrate complete system – control circuit, power, transmission along with other black box kit stuff and start to test/debug

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Apr 16 test projects or do as the final???.

Project 1: Power source project. Explore various ways to supply power, understand basic power/energy equations, practice the design process to down select through modeling and experimentation to a power supply (that unknown to them will be used later for their motion project.) This will be a focused project on a component but can bring in many different areas since many different ways to generate power, which can be discussed in lecture giving an overview of several fields.

Project 2: Motion Project. Based on the available power from the source – design some widget to create motion based on a simple dc electrical motor. This can be a car, boat, machine, etc. But basic underlying principle is that there is a motor that needs to have some control to it and some simple mechanical transmission that transforms the output from the motor into useful motion. This is a system design and should be broken into two sub project that come together at the end and integrated with Project 1 for some grander purpose.

Subproject 2 a: Motor Control. This project will teach basic electrical design principles and motors. Basic idea is to develop a simple circuit that will control a motor (or it could also be a sensor based system) in a designated way (based on the bigger project). For example it may be to turn on the motor and let it run a set time and then stop so that the "car" can go accurately a set distance and stop. This can be done with circuits, switches, sensors and the exact goal can change per semester – accurate stop, quickest, farthest, etc. This may come before or after mechanical (b) section depending on what makes more chronological sense. In this project they would design this subsystem independently (like a black box) with a defined input (the power from the power source) and a desired output (the motion plan). They will build up on a small breadboard the circuitry and test that it works with the motor properly and measure the motor characteristics under increasing load (get the torque/speed curve).

Subproject 2 b: Mechanical Transmission. Motors seldom give out the power in the form needed mechanically and usually needs to be transformed through rotary transmissions (gears, belt, chains, cams, etc) or linear (power screws, etc.). I would stick with rotary and the basic equations are pretty simple based on power (already covered) and dynamics (v= rw). In this project, they are given the input (from the motor experiments – torque and speed curve) and they have some desired output – accurate distance, quick, farthest, etc – can vary each semester. They have to model and pick from standard sizes (maybe around 3 or 5) of pre-made transmission (like a belt sheave) and then assemble it all together and test it.

At the end, all the projects should be integrated together and tested. This is a good place to talk about integration issues, loss mechanisms, etc.

Appendix B. Engineering 101 – Introduction to Computers and Programming

Engineering 101 has been taught since Fall 1997, and is used to satisfy the first year computing requirement for most students in the College of Engineering.

A. Current Course Objectives

- To introduce students to algorithmic thinking in their approach to solving problems
- To teach students to implement algorithms in ANSI C++
- To teach students to implement algorithms in Matlab
- To have students apply their knowledge of elementary physics and calculus
- To provide students with a foundation on which to base their later applications of computers to engineering

B. Current Course Outcomes

Students will be able to

- design algorithms to accomplish clearly specified tasks
- display knowledge of ANSI C syntax and semantics
- display knowledge of Matlab syntax and semantics
- successfully implement clearly stated algorithms in C++
- successfully implement clearly stated algorithms in Matlab
- engage discipline specific instruction in computing

C. Content

The course focuses on solving problems by algorithmic means, and uses both C++ and Matlab to implement algorithms. The balance between the use of C++ and Matlab is roughly 5 to 2. The course has a well developed and detailed set of educational objectives organized according to Bloom's taxonomy. These objectives help to establish uniformity between sections of the course taught by different engineering faculty. These can be viewed online at http://www-ENG 101.engin.umich.edu/Objectives.

D. Placement

All entering first year students in the CoE are required to take ENG 101, or else to place out of it (without credit) by virtue of a high score on the CS Advanced Placement Exam, or by passing an CoE placement exam administered during summer orientation.

Either ENG 101 or EECS 183 are required of students transferring from LS&A to the CoE; generally such transfer students are asked to take ENG 101, but students in the LS&A CS program who have already taken EECS 183 are also considered to have met the requirement.

E. Course organization and administration

ENG 101 is generally taught by three faculty from the CoE in a combination of large lecture sections (150 – 220 students) and smaller lab sections (25 students). Assisting the faculty is a cadre of GSIs. The cognizant faculty member (James Holloway) also serves as an informal course coordinator and provides overall guidance and intellectual direction to the course, helps to ensure some level of uniformity, organizes GSI hires and helps ensure that the course has the necessary resources.

F. Assessment

Both instructor and overall course evaluations have averaged about 4/5. Feedback from students and faculty generally indicate that students improve their ability to approach problems algorithmically. There is no systematic study relating later student accomplishments to their experience in ENG 101.

Failure rates are generally around 10%, although failure rates among women and under-represented minorities are around 15%. The failure rate for under-represented minorities is significantly decreased for those students who participate in the MEPO Professional in Training program.

G. Issues

G.1. Programming Languages

The choice of programming language(s) used in ENG 101 is based on two factors: 1) is there probable later need to use the language within the CoE, and 2) quality of the language and availability of good implementations for a wide variety of computer platforms. The choice of language is not strongly coupled to the course objectives, which could be met by using many different general purpose programming languages. However, the curriculum of the CoE requires some stability and uniformity in this choice, so that later courses can depend on students being familiar with specific language(s).

ENG 101 serves as the first programming course for students in computer science and computer engineering, so it is important that it prepare these students for their first course discipline course in EECS 280 – this latter course is taught in C++. C++ provides a good general purpose language for implementing algorithms, and some of the best compilers for the language are freely available for every computer platform. Matlab is too special purpose a language to use for the entire course, and would not meet the needs of students in computer science and engineering.

Instructors currently switch the implementation language from C++ to Matlab approximately 3 – 4 weeks before the end of the term. This is generally abrupt and disruptive, but Matlab is used in a number of courses within the CoE, so the basic introduction to it in ENG 101 is useful, and the current bi-lingual course is deemed a reasonable compromise.

G.2 Instructor effort

Instructors generally find ENG 101 to require a significant effort, especially if they give of their time to the students. Students in ENG 101 work extremely hard and need significant contact time with their instructors outside of class. First year students who arrive at a faculty member's office are usually at "the teachable moment" and generally should not be turned away. Significant additional burden arises in managing and supervising GSIs and graders. GSIs and graders are not from the faculty member's department, and are generally physically remote.

G.3. Cost

The CoE has generally been perceived as expensive to run. Originally designed and budgeted for 880 students per year with a budget of about $400k, the course was expanded to 1200 per year without a change in budget; it has consequently run in deficit since the expansion. Most of the cost is in GSI salary and tuition. In Winter 2002 the GSI staff was reduced and graders hired. This has been problematic – faculty workload was increased and significant delays in grading student assignment ensued.

G.4 Computing across the curriculum

The CoE's Curriculum 2000 recommended a computing across the thread that would bring computing into each term of a student's program. It is not clear if this has been accomplished in the various CoE programs, or how such efforts relate to ENG 101.

H. Preliminary Recommendations (April 2002)

- Employ a better metric to determine which students need additional training prior to taking ENG 101.
    - Have students take a placement exam to determine skill level.
    - Validate the utility of the placement exam.

- Ensure that students needing additional preparation are enrolled in suitable programs
    - E.g., failure rates for under-represented minorities are significantly decreased for those students who participate in the MEPO Professional in Training Program.

- Consider different tracks as a way to better meet the needs of students with vastly different preparation /backgrounds in computers and programming.

- Formally hire a course coordinator.

- Provide resources to address course needs and ensure that the course coordinator and participating faculty are given teaching credit commensurate with level of effort.

Appendix C. ENGINEERING 195 Selected Topics in Engineering

A. Background/Purpose:

ENG 195 was started by Professor Semyon Meerkov to accomplish two goals: First, to expose students to all twelve engineering disciplines available at the College of Engineering and, thus, help undecided students to select a major. Second, to teach fundamentals from each discipline by formulating and solving one of the central problems available in the field and, thus, provide the students with some knowledge in every engineering discipline.

CoE has offered presentations on the majors prior to ENG 195 as well, but student attendance had been low. ENG 007 had experimented with providing some materials on the engineering disciplines and this material was highly valued by students in the course. With the demise of that pilot experiment, the time was ripe for ENG 195.

The course was first offered during Winter 2001. The course was repeated during Fall 2001 and Winter 2002, all with substantial enrollment, signaling student interest in this elective.

ENROLLMENT for ENG 195

Term	Number of Students Enrolled
Winter 2001	147
Fall 2001	162
Winter 2002	82

B. Organization/Structure

Each week of the semester is devoted to a particular engineering field, and two lectures are presented. The first one provides a general description of the field, including its intellectual and technological foundations, job opportunities, course requirements, etc. The second lecture is devoted to a specific problem from this discipline, including the problem formulation, methods for solution, and practical applications. Based on the second lecture, homework assignment is made. Both the first and the second lecture follow templates, which are similar for all disciplines included in the course.

All lectures are given by senior faculty from each Department at the College of Engineering (see the list attached below); for more information see the course website:

http://www.engin.umich.edu/class/eng195/

C. Strengths:

- Provides brief but meaningful introductions to each of the engineering disciplines/departments.
- Compelling faculty presenters from across the disciplines who can convey their love and commitment to their disciplines as well as their expertise (their thinking in the disciplines).
- Based on student evaluation data, students liked the coverage of the course (covering all the engineering disciplines) and the multi-disciplinary format of the course. Students also indicated they would recommend it to other students who were undecided.
- ENG 195 is offered at a timely point in their undergraduate experience when they are trying to decide upon a major field of study that has significance to their career trajectory.
- The content serves to correct popular misconceptions and preconceptions about some of the engineering disciplines and introduces areas that are unfamiliar to many students.
- ENG 195 is an extremely important course to those students who have chosen to be engineers and are trying to decide which discipline to choose. Even for the students who have already picked a discipline, the course gives them a broader engineering prospective by allowing the students to understand the different disciplines in the College of engineering. The course also enables some of the smaller departments to showcase their disciplines.

D. Challenges/Unresolved Issues:

- Problem sets were too difficult when the course was first implemented, but over time the problems are more appropriate to the level of incoming students.
- Could add ethics, environment, and problem-solving to the template addressed by each speaker introducing these critical features to students from their earliest exposure to engineering and enabling them to see how they impact the full array of disciplines.

E. Should the course be required or elective?

Based on student evaluation data, students indicated that they would strongly recommend the course for undecided first year students, but were less convinced they would recommend it to students who have selected their major. While student input indicates that the course should remain an elective (intended primarily for undecided first year students), there are compelling reasons to suggest that it might be useful to require it of all students:

1. Students change majors (often more than once). This course would enable students who have selected their majors based on limited information or parental models to rethink their decision

2. All students would benefit from having at least a basic understanding of the range of engineering disciplines, the types of issues they address, etc. There is no other place in the curriculum where they are systematically exposed to this material.

F. Budget/Funding for the Course

ENG 195 has been taught for the past 3 terms with dwindling resources. During the first and the second offering, a GSI was provided by CoE. During the third offering, no support was provided. In all three offerings, the faculty taught this course on a volunteer basis.

The Committee feels this course provides a great service and should be reviewed with the idea of establishing it as a 3 Credit course. It should also receive funding commensurate with a 3 credit course to serve students and provide an optimal learning experience.

G. Preliminary Recommendations (April 2002)

The Review Committee concurs that ENG 195 is an important course, serving a critical function for a significant portion of first year students in CoE. Based on the data available to date, we recommend that ENG 195 should be offered every year during both Fall and Winter terms using the model developed by Dr. Meerkov.

The Review Committee realizes that the course could benefit all students but was not ready to recommend that it be required of all students at this time. The course should be carefully evaluated each year and the question of moving its status from an elective to a requirement could then be reconsidered.

The Course should be supported by CoE, providing course credit to the Course Coordinator to organize and coordinate the speakers and provide the ongoing structure, supervision, and planning needed to ensure ongoing quality.

Instructors who present the disciplinary presentations should also be remunerated for their efforts using a formula appropriate to their investment of time.

H. List of Participating Faculty W2002

ENG 195 TEAM (Winter 2002)
(in the order of their appearances in the course)

Professor Semyon M. Meerkov
Professor Fawwaz Ulaby, Vice-President of the University of Michigan
Professor Guy A. Meadows
Professor Ronald Gibala
Professor Andrzej S. Nowak
Professor Ronald Gilgenbach

Professor Perry J. Sampson
Professor H. Scott Fogler
Professor Pierre T. Kabamba
Professor Matthew O'Donnell
Professor Katta G. Murty
Professor Panos Y. Papalambros
Professor Herbert G. Winful
Professor Elliot Soloway
Mr. Scott Garberding, Plant Manager, DaimlerChrysler
Professor James J. Duderstadt, President Emeritus of the University of Michigan