I. INTRODUCTION: “INTEGRATION,” “BEST,” AND INSTITUTIONAL CONTINUITY

The reports that appear earlier in this collection establish three important conclusions: (1) that ABET’s engineering accreditation criteria, first articulated in EC 2000, redefine and broaden what counts as engineering knowledge, that is, as knowledge that is pertinent to the effective practice of engineering, (2) that the humanities and social sciences (HSS) are an important component of this knowledge and consequently are essential for achieving the EC 2000 outcomes, and (3) the HSS are only likely to make their intended contribution to achieving the EC 2000 outcomes if the engineering curriculum is integrated in the sense of making clear, explicit, and useful connections between the HSS and the remainder of the engineering curriculum. The curricular objective that is served by integrating the engineering curriculum in this way is to help engineering students gain an understanding of the wide range of factors and constraints that shape the process of engineering and also the effective use of engineering products in the real world, and the ultimate outcome intended by this objective is better engineering, both in design and application.

Although “best practices” is a frequently used term in discussions about curriculum, it hardly ever refers to practices that are demonstrably the best as measured against a set of objective or quantitative standards. Rather, the term is usually used to refer to exemplars that successfully capture specific curricular objectives. As such, they serve two purposes: (1) to clarify the curricular objective and (2) to serve as departure points and guides for curriculum designers who are pursuing the objective in question.

At one level, a great deal has been done to develop innovative courses and other educational activities that provide an integrated HSS-engineering experience for students. For many years during both the pre-EC 2000 and post-EC 2000 periods, individual faculty as well as small groups have discovered the potential of an integrated approach and undertaken ad hoc activities to link HSS and engineering content for their students. In other words, there is no shortage of models of what can be done. However, at most schools where these activities have occurred, there is a lack of a comprehensive template or foundation that informs and pervades the entire engineering curriculum and also a lack of institutional commitment that makes integration an explicit curricular objective for departments, schools, and colleges and that assures that both the foundational template and integrating curricular components continue through time. In this sense, all engineering schools need a programmatic approach that helps keep the overall picture and the patterns for making connections alive and present.
The following pages provide some exemplars of the comprehensive and continuing integration of the HSS into engineering education. Because engineering is taught in institutions of greatly varying size, mission, and resources, we offer first an approach to assessing integrative success that reaches across institution type and scale. We then present a range of models for integrative teaching that take into account those variations.

II. DEFINITIONS AND INDICATORS OF INTEGRATION

Before moving to a set of exemplars of the integration of the HSS into engineering education, some observations should be made about the concept of integration used to develop these. First and foremost, it is a working concept. As such, it may not encompass every actual instance of successful integration, and it may not exclude every absence or failure of integration. However, we believe that it is adequate to the task of identifying instances of integration that are both evident and successful, i.e., exemplars.

One approach to clarifying a concept is to develop a definition. The following one captures the core meaning of “integration” as used to shape the set of exemplars below. “Liberal and technical education are integrated within the engineering enterprise if and only if both the liberal and technical faculty engaged in this enterprise (1) recognize the fundamental importance and value of liberal learning not only in the education of engineers but in engineering design and practice and, moreover, (2) develop and implement the engineering educational experience so that students understand the integral contribution that liberal learning has made to their education and will make to their professional practice.” Note that while this definition neither specifies nor rules out particular types of courses or curricular experiences, it does rule out a common approach to liberal learning for engineering students, namely, sending them off without guidance to other areas of the university to take whatever humanities and social science courses fit their schedules and then never incorporate what students learn in their subsequent engineering courses.

Another approach is to develop a set of criteria for distinguishing between an integrated HSS-engineering educational experience and one that is not. The following criteria were utilized to select the exemplars in this report. In large part these criteria will be relevant regardless of the size or structure of the integrative project.

1) Integrated curriculum planning is supported on an ongoing basis by the institution:
   – both HSS and engineering faculty are involved and carry equal weight in discussions and decisions
   – the HSS faculty include people who have knowledge of engineering practice and the contexts in which engineers typically function
   – the planning group has institutional support that allows continuity over time and adequate resources in the present
   --the institution has a comprehensive plan for liberal education that provides a coherent, integrated HSS-engineering experience for all engineering students
2) Identifiable points in the curriculum where an explicit connection is made between the HSS and engineering:
   – a single course would not be adequate, but the entire curriculum need not be integrated for the program to be characterized as integrated
   – the connections are made in different types of courses, i.e., predominantly engineering, predominantly HSS, explicitly interdisciplinary, capstone design courses, etc.
   – the connections are made at different stages in the students’ education

3) Distribution of the teaching burden for the integrative elements of the curriculum:
   – both technical and HSS faculty contribute to instruction, that is, teach courses in which the connections are made

4) Student and faculty awareness of the integrated character of the curriculum:
   – the faculty and students involved understand and can articulate (in circumstances such as interviews) the rationale for taking an integrated approach to engineering education; the specific ways in which the curriculum makes connections; and the extracurricular mechanisms through which students can make connections of their own

5) In cases where the HSS courses taken by engineering students must also meet the institution’s general education requirements:
   – general education requirements are compatible with integration of the HSS courses into the engineering educational experience

6) The engineering curriculum provides students with project or problem-based learning experiences in which they must draw on their liberal learning to achieve a successful result, and students consistently are able to do so. (Cf., EC 2000, Criterion 4.)

These criteria are meant to be indicators that particular courses, programs, educational experiences, or curricula do indeed integrate the HSS and engineering education in the sense used in this report. An instance that meets the definition of integration given above undoubtedly also will meet some combination of these indicators, whereas an instance that fails to meet any of them undoubtedly also could not satisfy the definition. As such, the indicators not only help identify instances of successful integration, they also provide dimensions along which an institution could move in order to achieve integration.

III. ELEMENTS FOR INTEGRATION: LEARNING EXPERIENCES AND OPPORTUNITIES

Reference was made earlier in this report to a large array of courses and other educational activities that have been developed to integrate liberal and technical learning for engineering students. Although many of these might not be exemplars of integration, perhaps because they represent the effort of “lone HSSers” or “lone engineers,” or perhaps because there is no institutional commitment to continuity, they do provide models of the elements from which an
integrated engineering curriculum could be built. Before moving to a set of exemplars, this section will give some examples of these elements.

A set of disclaimers would be appropriate at this point. The research on which this section is based was not exhaustive, nor is the taxonomy by which the examples are organized. Moreover, the integration perceived by the project team might not be claimed by the originators. Finally, the examples provided are not intended to be the most successful examples of each approach that might be found, but rather to suggest some of the challenges and solutions associate with each type of approach.

A) Modules in Engineering Courses

Engineering faculty often include HSS-based modules in their engineering courses. This ranges from the informal practice of inviting an HSS colleague to give a guest lecture to more formal practices such as building a block of content and work into the course syllabus. The HSS content of this type of activity typically is either communication or professional ethics. Engineering faculty generally recognize the importance of effective communication and professional conduct in the practice of engineering, so much so that some will redirect time and content within their courses toward these objectives. Such modules can be part of an institutionalized program of integration, but more frequently they are efforts of “lone engineers” to provide some integration to an otherwise disjointed HSS and technical engineering curriculum.

Communication

An example would be adding a writing task to a technical course and giving class time to a writing instructor to give a lecture or conduct a workshop about the type of writing involved in this task. The Technical Writing Cooperative at MIT is an instance of this approach. Technical writing faculty work with the faculty in engineering courses to define communication tasks that fit naturally into the courses, deliver classroom work in the particular communication skills involved, and provide feedback to the students about their communication work. (See http://web.mit.edu/writing/writereq/PhaseII/coops.html.) Note that these Coops are part of an institutionalized writing requirement that is undergoing change (see the Writing-Across-the-Curriculum section below).

Professional Ethics

A tremendous amount of case material has been developed for engineers to use in their courses to educate students about the professional dimensions of engineering practice. See, for example, the Online Ethics Center for Engineering and Science at Case Western Reserve University (http://www.onlineethics.org), which includes not only many cases and links to other engineering ethics Web sites but also material on how to use ethics cases in engineering courses.

The Center for Study of Ethics in the Professions at the Illinois Institute of Technology (IIT) also makes a wide variety of professional ethics materials available on-
line. Of particular note is a long-running summer workshop run by Center in which engineering faculty learn how to develop professional ethics modules and inject them in an integrated and natural way into any level of engineering course. (See http://www.iit.edu/departments/csep/.)

B) Courses

The greatest amount of work to integrate the HSS and engineering education probably has been done at the course level. The examples included here will be divided into three categories: (1) courses taught by faculty in the humanities and social sciences areas of the institution to shed interpretive light on science, engineering, and/or technology and their impact on society; (2) interdisciplinary, usually team-taught courses with both substantial liberal and substantial technical content; and (3) engineering design courses that require students to draw on their liberal learning in a substantial way. Each of these types of course might be used as components of comprehensive and continuing integrated engineering educational experiences, as are some of the examples below, but they are presented here without their institutional contexts. (The examples of HSS Courses and Interdisciplinary Courses are from the “Science, Technology, & Society: Curriculum Newsletter of the Lehigh University STS Program & Technology Studies Resource Center,” Stephen H. Cutcliffe, Editor, which is a treasure trove of course syllabi and STS program information. See http://www.lehigh.edu/~insts/newsletters.htm for subscription, contact, and back issue information.)

HSS Courses

“Science, Technology, and Values” at the Rochester Institute of Technology explores the effects of science and technology in society, analyzes the relationship between science and technology, examines how each has come to play a major role today, and looks at how science and technology have affected and been affected by our values. The objective of the course is to introduce students to a range of issues associated with the interactions among science, technology, and society. (See Appendix A for the course syllabus.)

“History of the Space Program” at Texas A & M University takes a thematic rather than a survey approach. It explores the history of the American space program from the 1940s to the present, and its objective is to place the technological accomplishments of the space program, including the paths not taken, into the cultural, social, military, and political context that shaped and was shaped by the space program. (See Appendix B for the course syllabus.)

“Environment, the Public and the Media” at Lehigh University also takes a thematic approach, but its focus is a current science and technology related issue rather than a past technological development. The objectives of the course are; (1) to introduce students to a broad range of current environmental issues and the complex interplay of scientific, technological, social, political, and valuational factors that characterizes them; (2) to explore the parameters and limitations of media reporting about these; and (3) to
explore the potential of the field of environmental risk communication to impact this reporting. (See Appendix C for the course syllabus.)

**Interdisciplinary Courses**

“AIDS and Society” at the University of California, Davis, although not strictly speaking a course focused on engineering or technological processes, nevertheless demonstrates an interdisciplinary approach to joint liberal and technical learning. The course provides an integrated overview of AIDS by considering the interplay among biological, cultural, economic, historical, and social psychological issues. Its objective is to help students equally understand the scientific and health-related dimensions of AIDS and the associated ethical concerns in the context of variables such as gender, ethnicity, and sexual orientation. There is substantial health and biological content, as well as substantial HSS content. (See Appendix D for the course syllabus.)

“Ethics in Engineering” at North Carolina State University represents a case-based approach to engineering ethics. Although the formal organization of the syllabus does not make it obvious that the course has substantial technical content, the analysis of actual cases of engineering design and application necessarily involves the scientific and engineering principles that are involved, and students will consequently need to draw upon their engineering knowledge and skills in addressing these cases. Moreover, the complex interweaving of technical and non-technical factors in these cases means that the act of analyzing them is simultaneously an act of integrating HSS content with engineering content. The same is true of many other case-based engineering ethics courses. (See Appendix E for the course syllabus.)

“Sustainability Perspectives in Resources and Business” at Miami University of Ohio is an upper division course that draws substantial content from scientific, technological, business, and HSS areas. The objective is to provide students with the interdisciplinary conceptual framework and the multidisciplinary set of analytical tools that are necessary for including sustainability as an integral component of evaluations of technological processes and products. (See Appendix F for the course syllabus.)

**Engineering Design Courses**

The freshman introduction to engineering course in Smith College’s Picker Engineering Program is entitled “Designing the Future,” and it is a project-based design course that is structured to introduce students simultaneously to engineering design, the ethic of social responsibility, and the elements of critical thought in engineering. One of the projects that is used in the course is TOYtech (Teaching Our Youth Technology). In this project, students design gender-neutral toys that teach children about technology. A full description and assessment of TOYtech is given in Borjana Mikic and Domenico Grasso, “Socially-Relevant Design: The TOYtech Project at Smith College,” *Journal of Engineering Education* (Vol. 91, No. 3, July 2002), pp. 319-326.
There has been a long history of engineering faculty integrating HSS content into capstone engineering design courses in order to make them more “real world” and, consequently, better learning experiences for students. Many examples can be found in the *Journal of Engineering Education* and its predecessor publications, as well as in the Proceedings of the Annual Conferences of the American Society for Engineering Education (on-line for 1996 to the present at http://www.asee.org/conferences/).

A recent instance of an integrated capstone design project is “Plant and Facilities Design” at Kettering University. This course has been structured to achieve seven EC 2000 outcomes that are seen as “difficult,” including Criterion 3 f, h and j. The course syllabus has specific learning components and outcomes for each of these.

**f – An understanding of professional and ethical responsibility**

1) Projects must demonstrate conformance to the Americans with Disabilities Act. Students must sit in and utilize wheelchairs on a hilly campus, for better understanding of disability issues. Students review their design with a disabled representative of a local advocacy agency (the students’ awareness of disability issues is greatly increased at this session).

2) Students watch the PBS NOVA series video “Super Bridge,” which covers the construction of the Clark Bridge over the Mississippi River. In particular, the video demonstrates the ethical dilemma and contractor deliberations of expensive structural rework done during construction. Students are required to analyze and determine if they agree with the resolutions reached in the video, and what alternatives there may have been.

3) Two case studies (required reading/analysis/discussion) involving design and ethics responsibility: Henry Petroski’s analysis in *American Scientist*, “Vanities of the Bonfire,” on the collapse of the Texas A&M University Bonfire, and the design of a new local high school which discriminated against disabled persons while still meeting all requirements of building codes.

**h – The broad education necessary to understand the impact of engineering solutions in a global and societal context**

1) A workshop is held with representatives of the Kettering University architect-engineer, who reviews ongoing university building projects and the issues involved with agencies such as the local zoning board, the central community redevelopment agency, the state Department of Natural Resources (the campus is located on a major river), and national energy efficiency requirements. Student projects are reviewed versus these inputs.

2) Student teams are required to contact a variety of persons and organizations for global project input, including the university President, the local zoning office, the ultimate users of the facility including members of the immediate business community and the general public, and professional or commercial entities with structures similar to the team’s. Internet communication with suppliers and other parties is required.
A knowledge of contemporary issues

1) Kettering University recently received a donation of several parcels of land with environmental issues. Students are familiarized with the issues involved in site remediation and the negotiations ongoing with the donator, a major industrial corporation, particularly as to where their building may sit on this land.

2) Sick building syndrome, ADA and equal access requirements, and low emissions equipment requirements have been added to the class.

3) After September 11, 2001, a segment has been added utilizing Christopher M. Foley’s article “Why They Fell” in *ASEE Prism*, examining to what extent building engineers can and should consider catastrophic events such as the attacks on the World Trade Center in the design of the building structure.

By incorporating EC 2000 Criteria 3 f, h, and j into students’ background learning and their final design product, the course not only integrates HSS and technical content, but it also explicitly makes the case that both are essential for successful engineering design and application. (See [http://www.asee.org/conferences/caps/document2/2002-643_Paper.pdf](http://www.asee.org/conferences/caps/document2/2002-643_Paper.pdf) for detailed course information and assessment.)

**C) Experience Outside the Classroom**

Engineering educators have long recognized the value of co-operative education (co-op) programs and internship experiences for their students, and there is a growing realization that in today’s global society study abroad can help students develop professionally as well as personally. These insights can be incorporated into courses that take engineering students outside of the academic setting. For example, courses might include a practicum in which students would work for a corporation, government entity, or non-governmental organization. There, they are likely to witness policy formation as it engages expertise of many kinds, or simply the inevitable logistical complexity of executing engineering tasks. Or, courses about other countries might include a trip abroad, where engineering students would encounter new cultural discourses first hand. In both cases, students are likely to obtain a foundation for grasping the essential comparative nature of HSS inquiry, as well as its importance in successfully navigating the global context of engineering practice. By way of example:

**Travel abroad** – Rose-Hulman Institute of Technology has instituted a program of courses which combine on-campus study with a short overseas trip. Students spend 16 class hours on academic course work on a particular country and then take a ten-day trip to the foreign country with their instructor, either during Spring break or at the beginning of summer. Academic reading about the country is done before the trip. During the trip the instructor then lectures extensively on site and students keep a journal. After the trip, students meet again as a class for several hours and complete a term paper project. (See Appendix H for the relation of this program of courses with Rose-Hulman’s overall approach to integrating the HSS in engineering education.)
Practicum – The McBride Honors Program at the Colorado School of Mines includes the Practicum during the summer following the junior year. The goal of the Practicum is to put students into situations where they can observe firsthand management and decision-making processes of the kind that will challenge them in their professional lives. Practicum options include an internship with a corporation, government entity or non-profit or travel abroad to an area of the world that the students have studied the previous semester. Currently, the areas on the study abroad rotation include China, Chile, Turkey, Southeast Asia, Brazil, and South Africa. Travel is subsidized by the program. (See Appendix J for the place and role of the Practicum in the overall Honors Program.)

International projects – Worcester Polytechnic Institute has emphasized project-based learning for several decades, and this has taken on a substantial global dimension in the past four or five years. All students are required to complete three major projects: (1) the Interactive Qualifying Project (IQP) which explores issues at the intersection of science, technology, and society via a project that addresses a significant multi-dimensional social problem; (2) a humanities and arts project called the Sufficiency that involves a study of history, philosophy, art and music for the purpose of enriching students’ professional and personal lives; and (3) the Major Qualifying Project (MQP), a professional-level design or research project that gives students hands-on exposure to the kinds of work assignments they will do after graduation. The Global Perspective Program adds an international turn to these projects by sending students for seven-week stays at residential project programs in other countries. While at these sites, students complete one of the three required WPI projects, often for an on-site sponsor (such as a government agency, a professional organization, a museum or a corporation). They complete research and preliminary work before traveling off-campus, then complete their project, write a report, and make a presentation to their sponsors before returning to Worcester. The experience brings students face-to-face with another culture in a powerful way, and for students who complete their IQP or MQP at one of the international sites, cross-cultural knowledge and understanding become part of the integrated HSS and technical basis that is applied to solving the project. Over the past five years, the number of students participating in the Global Perspective Program has increased threefold to more than 500 students per year (out of an undergraduate population of 2,700). (See http://www.wpi.edu/Academics/Depts/IGSD)

Internship Programs—The University of Virginia’s Washington Internship Program, which is operated in conjunction with the Massachusetts Institute of Technology Washington Summer Internship Program, provides rising third-year students with the chance to see how policy is made, how it affects the industry they are involved in, and the larger context of which science and technology are a part. The students are provided with housing shared with MIT students and a stipend that allows them to participate in unpaid policy internships in a range of settings including the offices of senators and representatives, the Office of Science and Technology Policy, the National Academy of Engineering, and non-profit
organizations. The students receive course credit for participating in the program, which begins with a preparatory seminar the spring before their internship. During the summer, they participate in a speaker series and other group activities with the MIT interns, complete a research paper focusing on a policy topic, and prepare a short reflective paper (For detailed information on the program, see http://www.tcc.virginia.edu/about/c&p/WashIntern/index-.html.)

Co-Curricular Activities --Clarkson University has taken a co-curricular approach to providing students an integrated engineering experience outside the classroom with its Student Projects for Engineering Experience and Design Program (called SPEED). SPEED consists of a cadre of multidisciplinary project teams. Student participants come from all majors and all four class years. Substantial funding from a combination of major corporate sponsors and endowment, strong faculty advising, and a permanent SPEED support staff assure continuity from year to year. Although all of the team projects demand an integration of a range of technical content, not all also require an integration of HSS content. Nevertheless, several projects do bring HSS, business, and technical knowledge together, e.g., the Environmental Remediation Project, which has a policy dimension as well as a significant communication requirement, and the Solar Car Project, which has a team technical writer and includes public relations and marketing along with project design, fabrication, and testing. (See http://www.clarkson.edu/speed/index.php)

IV. EXEMPLARS OF INTEGRATION

The following exemplars all take an institutionalized approach to integrating the HSS into engineering education in the sense that they provide students with an educational experience that is part of a continuing academic program. Beyond this shared characteristic, the exemplars are as varied as the colleges and universities from which they are drawn. Some are more comprehensive than others in terms of the numbers of students who benefit from them and the portion of the overall curriculum with which they are concerned. All of them provide models that could be adapted and, in some cases combined, to construct a comprehensive program. As with the elements for integration listed in Section III, the exemplars will be grouped by general approach.

A) Comprehensive Curriculum Designs for Engineering Degree Programs

Engineering curricula have long required humanities and social sciences courses for engineering students, although until EC 2000 the expectation was only that students would achieve a generalized “breadth and depth” outside science, math, and engineering. However, EC 2000 articulates more specific learning outcomes for students’ HSS educational experiences, as noted in the White Paper that has been included in this collection of reports. Moreover, the EC 2000 criteria invite an integrated approach to the HSS in engineering education. The following group of exemplars pursues this integration within students’ required HSS courses.
The University of Virginia combines a structured program of HSS course work with an undergraduate thesis project to give students an integrated HSS-engineering experience. The integrative core of the HSS curriculum is provided by four interdisciplinary required courses taught by the Division of Technology, Culture, and Communication (TCC), an interdisciplinary HSS faculty within the School of Engineering and Applied Science. All courses in the program are interdisciplinary and blend elements of effective communication, engineering ethics, and the social and historical contexts of engineering, science, and technology. The required freshman course emphasizes communication abilities, provides an orientation to engineering as a profession, and sets up an integrative framework that helps students see how the elements of their education come together. A required sophomore course chosen from a group of designated electives deals with the relations between technology and human needs and aspirations, and with the social dimensions of technology-related problems. Two senior courses, Western Technology and Culture and The Engineer, Ethics, and Society, provide the context for an undergraduate thesis that is jointly advised by TCC and technical faculty and serves as the students’ capstone engineering design or research experience. The thesis functions as a case study in the full range of issues raised in the TCC curriculum. In addition to the four required TCC courses, students have three HSS electives and three unrestricted electives, which allow students to take advantage of the university’s strong College of Arts and Sciences or to pursue a minor. (See the next section for a description of minors and Appendix G for a full description of the University of Virginia’s program.)

Rose-Hulman Institute of Technology has restructured the distribution requirements for its engineering students’ required humanities and social sciences courses so that they reflect EC 2000 Criterion 3. After an introductory Rhetoric and Composition course, students take two courses in each of four categories: Rhetoric and Expression, Global Studies, Self and Society, and Values and Contemporary Issues. These parallel the EC 2000 Criterion 3 learning outcomes that encompass effective communication skills, the background for understanding the impact of engineering in a global society, professional responsibility, and knowledge of contemporary issues. (See Appendix H for a full description of Rose-Hulman Institute of Technology’s program.)

Clarkson University has taken a different path to alignment of its required humanities and social sciences courses with the EC 2000 Criterion 3 learning outcomes. The general education program for all students has been revised in a process that has drawn equally on Clarkson’s strategic vision and EC 2000, and the humanities and social sciences faculty have revised their courses in order to align them with the new general education objectives. The result is a set of interdisciplinary thematic courses in which HSS concepts and perspectives are used to explore issues at the intersection of technology, society, and professional practice. As members within the broader Clarkson community, engineering students experience a set of HSS courses related to their profession and its impacts. (See Appendix I for a full description of Clarkson University’s program.)

One significant distinction among the three program structures described above is that the University of Virginia program imposes structure on only a part of the HSS/elective curriculum.
The Rose-Hulman program is required of all engineering students, and the Clarkson program mandates a structure for all of the required HSS coursework taken by all students including engineering students.

Engineering degree programs can also be designed to provide a comprehensively, even unremittingly, integrated HSS-engineering educational experience. The curriculum designers take integration to be a prime directive and then build the curriculum from the ground up to achieve it. Any or all of the elements of integration and programmatic approaches discussed above might be used, and the result is an educational experience in which HSS and technical concepts, perspectives, and methods are interwoven together in such a way that graduates of the curriculum perceive and practice engineering in a broader and richer context than graduates from traditional engineering programs.

Smith College’s Picker Engineering Program aims to prepare its students to bridge the boundaries between the HSS and the scientific and technical base of engineering in the pursuit of socially responsible engineering design and application. The approach adopted for realizing this aim has three aspects: (1) an HSS requirement that is unusually deep and rich in terms of engineering curricula, (2) a core of interdisciplinary courses that connect HSS content with engineering concerns, and (3) the inclusion throughout the four years of the curriculum of design projects that emphasize social responsibility and community involvement. (See Appendix K for a full description of the Picker Engineering Program.)

The curriculum of the new Franklin W. Olin College of Engineering in many ways breaks the mold for engineering education and rebuilds it with extensive use of multidisciplinary teaching teams and integrated learning experiences that are about half course work and half projects. In many ways the Olin curriculum represents a limit for integrated curriculum design and administration, and few, if any, institutions could choose to emulate it. Nevertheless, valuable lessons about an integrated approach to liberal learning within engineering education can be learned by examining this program and its underlying philosophy. (See http://www.olin.edu for further information.)

**B) Clusters, Concentrations, Minors, and Double Majors**

A number of institutions offer clusters of courses, concentrations, minors, or double majors that integrate HSS and technical content and that are available to engineering students as a coherent set from which they can elect their HSS courses. These clusters, concentrations, minors, and double majors offer the students who choose them the opportunity to pursue particular interests or add distinctive strengths to their degree programs. Because these offerings are not required of all students, they do not guarantee that all students have an integrative educational experience; however, they can add integrative depth and value to degree programs.

The “AIDS and Society” and “Sustainability Perspectives in Resources and Business” interdisciplinary courses (discussed above in Section II.B) emanated from this approach at the University of California, Davis, and Miami University of Ohio, respectively.

The Science and Society Program at the University of California, Davis, is an interdepartmental teaching program administered by the College of Agricultural and
Environmental Sciences that offers students throughout the campus the opportunity to discover the connections that link the social, biological, and physical sciences with societal issues and cultural discourses. Course work examines discovery processes in relation to societal values, public policy and ethics, including issues associated with cultural diversity. The Science and Society teaching program serves students of all majors, including engineering, by providing a coherent set of interdisciplinary courses that address broader social issues associated with post-college practice within the area of the major. (For detailed information about the program, including a list of course descriptions, see http://registrar.ucdavis.edu/UCDWebCatalog/PDF/SAS.pdf.)

The Center for Sustainable Systems Studies (CSSS) at Miami University of Ohio encompasses research and public service activities in addition to a teaching function. The Center was established to achieve a synthesis of natural science, engineering and recent commitments by business to sustainable development. Its objectives include:

- Facilitating inter-divisional courses on sustainability for students in business, natural science, engineering, design and natural resource fields.
- Expanding the scope of research on sustainable development through external funding, publications, sustainable business planning and resources development.
- Creating a focus through which industry leaders and scholars from other Universities can come to Miami for seminars and conferences.

As with the Science and Society program at UC Davis, the CSSS at Miami of Ohio provides a coherent set of integrating interdisciplinary course experiences for all students, including those in engineering. (For detailed information about the program see http://www.sba.muohio.edu/csss2/.)

The University of Virginia offers three interdisciplinary minors that provide an integrated HSS-engineering experience. Although designed with the needs of engineering students in mind, these minors are open to all undergraduates. The Minor in Technology Management and Policy prepares students to assume leadership roles through an interdisciplinary course of studies that includes economics; science, technology, and public policy; the product-development life cycle; and case studies that examine the interaction of technology, management, and policy issues in a specific context. The Minor in the History of Science and Technology, offered in conjunction with the history department, allows engineering students to develop a more in-depth understanding of the historical, social, and intellectual contexts of the engineering profession. The Minor in Technology and the Environment provides students with a more sophisticated understanding of the relationships between technology and the environment and includes technological foundations coursework in either civil engineering or environmental science complemented by courses in environmental planning and policy; history of technology and the environment; and management and economics.

Rensselaer Polytechnic Institute’s Program in Product Design and Innovation (PDI) is a double major program in which students complete the requirements for both an engineering major (in Mechanical Engineering & Science, Engineering Science, or Building Science) and the major in Science, Technology, and Society. The core of the PDI program is the design studio that students take every semester in which technical, aesthetic, economic, ethical, cultural, and political strands are woven together in a product design experience. For example, PDI Design
Studio III uses the design of educational technology to further students’ knowledge of: (1) the social aspects of design, including ethnographic techniques of data gathering, social dimensions of technology, the social identity of users, and participatory design; (2) information technology design, particularly electronic circuits and software; and (3) designing a cognitive interface. The objective of PDI is to prepare students to become innovative designers who can integrate contemporary technologies with changing social contexts to produce next-generation advanced product designs. (See http://www.rpi.edu/dept/sts/pdi/intro.htm for a full description of PDI, including an extended essay by the program’s originators about its objectives, methods, components, and expect outcomes.)

**C) Honors Programs for Engineering Students**

There is a potential danger in establishing an engineering honors program, namely, officially labeling one group of students as the “good engineers” and the rest as “not so good.” To avoid this, honors programs for engineers can be located in the “borderlands” between engineering’s core technical concepts and methods and more peripheral components of engineering curricula. This makes the enrichment of engineering students’ HSS experience a likely candidate for an honors program, and if the enrichment includes the integration of HSS concepts and methods with technical content, then the honors program will provide its students with a comprehensive integrated engineering educational experience. The honors programs described here provide a comprehensive experience for the students who participate in them, enjoy ongoing institutional support, and exhibit continuity over time in the sense that their continued existence does not depend on the support of a few key faculty or administrators. They also employ strategies that could be adapted successfully for an entire engineering student population.

The McBride Honors Program in Public Affairs for Engineering Students at the Colorado School of Mines features a series of seminars that provide students with an intensive experience with HSS concepts and methods and their application to the issues of a technological society. An off-campus Practicum experience places students in a real world setting to which they can apply what they have learned in the seminars in order to better understand the complex dynamics of business and society. The learning objectives of the program include skills, knowledge, and values. (See Appendix J for a full description of the McBride Honors Program in Public Affairs for Engineering Students at the Colorado School of Mines.)

The Benjamin Franklin Scholars Program at North Carolina State University is a five-year dual degree program that adds a degree in the humanities and social sciences to students’ engineering degree, with specially designed interdisciplinary courses that integrate the concepts and methods of the two degree fields. (See http://www4.ncsu.edu/~jherkert/bfs.html for additional information.)

The Honors Program at Clarkson University has a student composition that reflects the student body as a whole – predominantly engineering, but with students also from business, science, and humanities and social sciences fields. Students take a series of Honors seminar courses in their freshman through junior years that integrate HSS and technical concerns in the
mode of the McBride Honors Program, but with the additional aspect that the students come from both HSS and technical majors. The linchpin for this course work is a problem-based team learning experience in the sophomore year that focuses on developing an interdisciplinary solution to a real problem at the science, technology, and society interface, and both the teaching team and the student teams have a multidisciplinary composition. For example, the problem for Fall 2002 was to conduct a feasibility study of implementing alternative energy production technologies on the Clarkson campus or in the surrounding area. In their senior years, students write a thesis and make a public presentation based on original research done under the guidance of a faculty mentor. (See http://www.clarkson.edu/honors/index.php for additional information.)

D) Across-the-Curriculum Approaches

Across-the-curriculum programs take the approach of incorporating HSS content, most frequently communication or ethics, into technical course work rather than presenting it in dedicated HSS courses. Incorporation of ethics might take the form of discussions of the ethical dimensions of existing engineering course content, for example, or the introduction of ethics modules into technical courses, and incorporation of communication might be as simple as holding students in technical courses accountable for the quality of their communication, for example, or conducting in-class communication workshops in technical courses. The HSS content sometimes is prepared for engineering instructors by or in conjunction with HSS faculty, but across-the-curriculum programs also sometimes provide training for engineering faculty. Across-the-curriculum programs also use workshops and “guest” teaching by HSS faculty in technical courses. The central premise of the across-the-curriculum approach is that it demonstrates to students that HSS perspectives and methods are not matters to be intellectually compartmentalized, but rather are integral to all technical work, both in class and after graduation.

Ethics-Across-the-Curriculum (EAC)

One variable in EAC approaches is the organizational level at which they are institutionalized: engineering department, engineering school, or entire institution. Another variable is whether only engineering courses are involved, rather than courses from all disciplinary areas.

The Department of Civil and Architectural Engineering at the Illinois Institute of Technology integrates professional ethics into many of its technical courses, including Structural Design, Construction Planning and Scheduling, Construction Cost Estimating, Architectural Engineering (Building & Energy Design), Transportation Planning, and Systems Engineering, as well as IIT’s distinctive Interprofessional (IPRO) design courses. Students in these courses have reading assignments about ethical issues (case studies, journal articles and web site information), and class time is dedicated to open-ended discussions and problem-solving sessions about these. Students utilize their ethical background in their course assignments and projects. For example, public safety is presented as a prime directive for physical facilities, and students consider cases that demonstrate the dependence of safety on the proper coordination among design
engineers, fabricators, contractors and inspectors. Approximately half of the department’s faculty have participated in the EAC training workshop that is conducted by IIT’s Center for Study of Ethics in the Profession (cited above), and they not only constitute a core faculty group for teaching the department’s EAC courses but also provide resident EAC expertise for their departmental colleagues. (See http://www.iit.edu/~ce/ and http://www.iit.edu/departments/csep/eac/post_workshop/Ethics_CAE_IIT.pdf for information about the department and for a presentation about its EAC program, respectively.)

Although not an engineering school, Utah Valley State College has a mature and fully developed institution-wide EAC program that involves all types of courses in students’ curricula. The program has three main components: first, a required ethics core course for all students; second, an active on-campus faculty development program that not only prepares faculty for introducing ethics into courses throughout the curriculum, but also develops materials and provides support for doing so; and, third, a Center for Studies of Ethics that conducts an extensive set of ethics-related co-curricular events and experiences. Nothing about the program would preclude engineering colleges and universities from implementing a similar program, since it primarily relies on the infusion of ethics throughout the curriculum, as well as campus co-curricular activities, rather than adding courses. The program demonstrates what can be done when an institution makes a major commitment to an ethics-across-the-curriculum approach. (See http://www.uvsc.edu/ethics/eac.html for more information.)

*Writing-Across-the-Curriculum (WAC)*

The “Undergraduate Professional Communications Program” in the School of Electrical and Computer Engineering at Georgia Institute of Technology combines required course work in writing – a two-course composition sequence in the freshman year and a technical communications course in the junior year – with four writing intensive laboratory or design courses distributed across the sophomore, junior, and senior years. Students are supported via both a non-virtual physical writing laboratory and a virtual on-line writing laboratory. (See http://upcp.ece.gatech.edu/about/index.html for more information.)

MIT’s “Writing Requirement” was mentioned above in the discussion of the Technical Writing Cooperative. Beginning with the Class of 2005, this has been expanded into a university-wide “Communication Requirement” that includes oral and visual communication in addition to written. This “requirement” comprises a communication-across-the-curriculum program that blends communication intensive courses in the humanities and social sciences with communication intensive courses in students’ majors. (See http://web.mit.edu/commreq/ for more information.)
V. Policies, Infrastructure, and Support

The kind of integrated engineering education described in this set of reports must be designed and implemented by talented and dedicated faculty who have good reasons to make long-term commitments to the intellectual and organizational challenges of integrated engineering education. The expertise and experience that are required cannot be developed overnight and are not likely to be developed by people who pursue HSS education for engineering students as a part-time or temporary business. Substantial faculty investments are required, and although faculty who are motivated to make these investments believe they are very much worth making, there must be institutional support.

One of the most pressing issues faced by HSS faculty who teach engineering students concerns the professional status of the faculty, more specifically, whether the faculty have the professional status and opportunities for professional development that they would enjoy if their teaching and research focused on their own disciplines as does the work of their departmental colleagues. This concern is exacerbated for faculty whose funding comes largely or primarily from schools or departments of engineering, who have an additional concern about reasonable autonomy in deciding what to teach and the resources (time and others) to pursue research and publication programs that may not be directly relevant to engineering education.

“Best practice” in this area entails providing HSS faculty who become engineering educators with professional reward incentives for investing in and becoming involved in engineering education. These incentives include, but are not limited to, issues such as:

- tenure and promotion criteria and procedures that reward involvement and achievement in engineering education
- reasonable continuity of funding and job security
- providing the resources (in terms of time and travel funding) that will allow faculty to maintain a sort of “dual” career track in which they maintain a foothold in a particular field while also participating in one or more communities of scholars concerned with engineering education
- reasonable levels of professional autonomy in defining curricular objectives and the means for attaining them within the framework of the accreditation criteria

Beyond personnel and resource policies and the underlying attitudes that these reflect, there must be formal institutional processes that assure continuity of programs through time and across particular faculty. Otherwise an institution’s efforts in integrating HSS and technical content for engineering students will be fragmented, inconsistent, and inconstant. Programs need formal “champions” who are responsible and accountable, support staff, funding, and institutional commitment from the top as well as faculty buy-in. In one way or another, all of the programs in Section IV have these.
VI. BIBLIOGRAPHY AND RESOURCES

In keeping with the general tenor of this report, no claim is made that the following list of references and resources is either complete or exhaustive. However, it will provide entry points for exploring the integration of the HSS into engineering education.

**HSS and Engineering Education**


**Ethics in Engineering Education**


Selected Web Sites:
Center for the Study of Ethics in the Professions at Illinois Institute of Technology. http://www.iit.edu/departments/csep
Murdough Center for Engineering Professionalism at Texas Tech University. http://www.coe.ttu.edu/murdough/default.htm
Online Ethics Center for Engineering and Science at Case Western Reserve University. http://www.onlineethics.org
American Society of Civil Engineers Ethics Web Site. http://www.asce.org/aboutasce/ethics.html
Institute of Electrical and Electronics Engineers Ethics Committee Home Page. http://www.ieee.org/organizations/committee/ethics
APPENDIX A: “SCIENCE, TECHNOLOGY, AND VALUES” COURSE
ROCHESTER INSTITUTE OF TECHNOLOGY

This course explores the concepts and effects of science and technology in society, analyzes the relationship between science and technology, examines how each has come to play a major role today, and looks at how science and technology have affected and been affected by our values. This course also considers the environmental aspects of science and technology. Science and technology are often assumed to be value free, yet people, guided by individual and societal values, develop the science and technology. In turn, the choices people make among the opportunities provided by science and technology are guided by their individual values. (Offered quarterly) Class 4, Credit 4. Instructor: Franz Foltz
office: Al 10 phone: 5-5368
office hours: MW 2-4 and by appt. e-mail: fafgsh@rit.edu

Texts:

Course Reserves:

About the Course:

The purpose of this course is to introduce you to some of the modem ideologies of science, technology and the environment, to challenge and reconsider those ideologies, and to explore how scientists and technologists conduct their work. We will examine how the values of modern and postmodern American society influence science and technology and, in turn, how science, technology, and the environment help shape our values and our culture. You will have the opportunity to investigate the ethical, social, economic, environmental, and political questions raised by scientific and technological developments. You will be able to identify your own values,
the values of late twentieth-century America, and the role of science and technology in our value
system.

My philosophy for teaching is that the classroom is a place to explore ideas and not a
place where a lecturer provides the answers. I see myself as just one participant in a group. Of
course, I have to evaluate you, so I do have a slightly different role in the class. However, I
emphasize that we are all participants, so I expect everyone to attend every class and to actively
participate.

**On Responsibility:**

1) It is your responsibility to have done the reading assignment prior to class.
2) It is your responsibility to participate in the class discussion. I believe that for a course to be
successful all the participants, instructor and students, must work together. I believe that people
learn from discussing a topic and not by having the answers spoon-fed to them.
3) It is our responsibility to provide a positive environment for class discussion. There are very
few “right answers.” I will never claim to know all the answers. As a human I have specific
opinions on many issues that will differ from your own opinions. I have learned that arguing over
an issue will never change anyone's opinion. To do this:
   a) Listen when someone else is talking.
   b) Comment and critique a view but never criticize a person.
   c) Whenever you have a question ask it.
   d) Talk civilly and do not yell.
4) It is my responsibility to make sure the entire course is a positive experience. If you are having
a problem come and see me.

**About your grades:**

Grades will be based on one essay, two take-home exams, and a final paper. The
contribution of each to your final grade will be:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essay</td>
<td>5</td>
</tr>
<tr>
<td>Midterm/Final Take-home Exams (3@25)</td>
<td>75</td>
</tr>
<tr>
<td>Attendance and Participation</td>
<td>20</td>
</tr>
</tbody>
</table>

**The Essay:**

The essay is due on day 12/13, and will focus on what technological innovation or
scientific discovery you believe you will have the greatest impact on the twenty-first century.
(There is no correct answer.) Include why it will be the most important and what social impacts it
may have. What ideas or technologies may have led to this one? What impact will it have on your
personal life?

Your papers (essay and take-home exams) should be typed, doubled space, using standard
fonts and normal font sizes of 10-12 point (elite or pica), with standard 1 inch margins. Please
use a spell checker.
Take-Home Exams:

There will be three take-home midterm/Final exams. For each, I will give you a set of essay questions and you will select 2 to answer, individually, and have a weekend to respond to them in long essay form. This exam should be between 4 and 6 pages long.

Attendance and Participation:

You may miss two classes without any penalty. Beginning with the third absence and each additional absence you will lose one percentage point from your final grade. I also reserve the right to give a pop-quiz based on that day’s readings, using these points, if the class fails to keep up with their reading assignments.

Policy on Academic Dishonesty:

Student-teacher relationships are built on trust. For example, students must trust that teachers have made responsible decisions about the structure and content of the courses they teach, and teachers must trust that students have honestly completed the assignments, which they submit. Acts that violate this trust undermine the educational process because they contradict our very reason for being at RIT.

Discussion of ideas is actively encouraged in this class. However, the papers you write and the work that you do on the exams must, in the final account, be uniquely your own.

Tentative Syllabus:

I. Technology and Society

9/10 Introduction and Overview of Course;

9/12 Can Science & Tech Solve Our Problems? Weinberg, Mesthene, and McDermod in Teich, pp. 36-43, 61-70, 71-80
    Hardin, “Tragedy of Commons” (Res.)

9/17 Science, Technology, and Politics
    Sclove and Winner in Teich, pp. 103-120 and 150-68
    Technology as Progress and Tragedy
    Leo Marx and Florman
    pp. 3-12 and 50-58

9/19 Women, Minorities, and Technology
    Schumacher, Jenkins, and Wajcman in Teich, pp. 83-89, 121-36, and 137-49

9/24 What is Technology?
    Discussion of first assignment

First Assignment due: What will be the most important tech or scientific discovery of the 21st century?

9/26 Film: Modern Times (Chaplin)
    Brave New World, chaps. 1-7

10/1 Brave New World, chaps. 8-end
    (Take-home Exam ONE out)

II. The Practice of Science

10/3 The Norms of Science v. Watson’s View
    Merton, “Four Norms” (Res.)

10/8 VIDEO: Nobel Legacy: PART ONE (PBS)
    The Double Helix, chaps. I - 10
    (Take-home Exam #1 due in class)

10/10 VIDEO: Nobel Legacy: PART TWO (PBS)
    The Double Helix, chaps. 11 - 20

10/15 WHAT IS SCIENCE?
    The Double Helix, chaps. 15-29

10/17 Film: Double Helix: Life Story (BBC)

10/22 Feminist Science
    Fee, “Feminist Science” (Res.)

10/24 VIDEO: Frontline: Genetics (PBS)
    Weinberg in Teich, pp. 215-23
10/29 Genetics Discussion
Charo in Teich 224-39
(Take-home Exam TWO out)

III. The Environment
10/31 What is the Environment?
“Climate Change” (Res.)
Ecotopia, pp. 1-90

11/5 VIDEO: The American Experience: Rachel Carson (PBS)
Merchant “Death of Nature” (Res.)
(Take-home Exam #2 due in class)

11/7 Global Change
(Take-home Exam THREE out)

11/12 ECOTOPIA
Ecotopia, pp. 91 -end

11/14 Science, Tech and the Environment
Take-home Exam #3 due 11/19 in my office by 5 pm

STV Sample for Midterm One

Choose two of the following four questions. Your answers to each question should be typed two to three pages (over 2 pages and on the third) and the total (both questions) should be around 5 pages double-spaced, using standard fonts and normal font sizes of 10-12 point (elite or pica), with standard 1 inch margins. Please use a spell checker. Reference all class materials used. (i.e. Winner says _)

(1) Did Huxley really think of the “Brave New World” as a utopia, or was he describing a dystopia? Support your claim with at least two examples from the reading. Of all the major characters in “BNW,” whom do you think Huxley most related to? (Whose voice was Huxley's voice?) Again support your claim with at least two examples from the reading. Why did he make the motto of the “BNW” 4 “Community, Identity, and Stability?” What did each of these terms actually mean in the “BNW?” What meanings would each of these terms have in our world today?

(2) Both Chaplin (“Modern Times”) and Huxley (BNW) portrayed technology as dehumanizing. Which other authors support the idea of technology as dehumanizing? (Connect Chaplin and Huxley to at least three other readings.) Give two examples from each (MT and BNW) of technology dehumanizing and explain how the other authors would support Chaplin and Huxley’s portrayal of technology. Be sure to explain what dehumanizing means. (How do these examples show technology as dehumanizing?)

(3) Begin with Winner’s idea of “technology having politics” from his essay in the Teich book. What does he mean by this statement? How does he believe values and technology are linked? Be sure to define both technology and values (in your own words.) Which other authors would support this view? (Refer to at least three other readings.) Which ones would not? (Refer to at least three additional readings) Explain why each author would take this view. DO NOT USE A DICTIONARY! Use your own definitions (Hint: look at Winner piece.)

(4) Define Technology in your own words (At least a paragraph and DO NOT USE A DICTIONARY, USE THE READINGS). Which of our various authors/videos (about 17 of them) provided support for your definition. (Who would agree with your definition and why would they agree with it?) Were any “not useful” for your definition? Give an example of a technology (not discussed in class.) Using your definition analyze the technology and show how at least six of the authors support your definition of technology.
This course will explore the history of the American space program from the 1940s to the present from a variety of perspectives. Our major concerns will be the cultural, social, military, and political factors shaping—and shaped by—humanity's first step to the stars. We definitely will not ignore the technological accomplishments, but place them in context, including the paths not taken.

Readings

*NASA Guide to Doing Research at NASA*.
*NASA Pocket Statistics*.

Grades

10% the 3-year launch analysis
20% two book critiques
10% website critique
20% draft and
20% final term paper
10% presentation
10% class participation.

Coherency, grammar, and spelling do count. All papers are due at the start of class and lose credit for lateness. The final paper is due when the final is scheduled.

This course requires participation from everyone. If you are absent from class, you will not receive credit for participating. Since your colleagues will attend your presentations, you should respect them with your presence at their discussions.

If you have any learning disabilities or other potential problems, please let me know at the start of the course. I strongly encourage you to participate in class. Ask questions (the only foolish question is the one not asked). If you do not understand something, ask—quite likely you are not alone.
Three-Year Launch Analysis

Pick three years in three decades (e.g., 1958, 1968, 1978) and, using the NASA Pocket Statistics and other sources, analyze the American launches in a 3-5 page report. What patterns, differences, similarities do you find? What accounts for them?

Book and Website Critiques

These 2-5 page critiques discuss the content and address such questions as: What questions does the author raise? Is the argument clear and convincing? How is the material organized and managed? What types of sources did the author utilize? What is the audience?

You will do a critique of Wolfe, McCurdy or Chaisson, and also a book of your choice, which you will clear with me in advance.

Research Paper

This paper should be approximately 15-25 pages (excluding bibliography) and based on primary and secondary sources. I expect to read at least one draft, as will a classmate. A list of possible topics is attached at the end of the syllabus. The 15-20 minute presentation will be based on the term paper and will be followed by questions.

Weekly Assignments

**Week 1**

Introduction & Historiography

Early interest in space flight

World War II

Read: Exploring..., “Prelude to the Space Age,” I, 1-16

McDougall, Part I

**Week 2**

Pre-Sputnik Proposals & Sputnik

Cold War as motivation


McDougall, Part II, Chapter 6

**Week 3**

Creating U.S. Space Programs

Civilian or military? Fast or moderate pace?

Forging NASA

Read: Exploring..., II, 16-22; IV, 1-9

McDougall, Chapters 7-10

3-year analysis due September 16

**Weeks 4-6**

Kennedy & Manned Space Flight

Unmanned exploration

Military frustration and triumph

Read: Exploring..., III, 4-16; IV, 10-11

McDougall, Parts 4-5

Wolfe

Wolfe critique due September 23

Website critique due October 2

Research Day, October 5

Paper themes and book choice due October 9

**Weeks 7-9**

Post-Apollo NASA: Where Do We Go from Here?
Space shuttle and space station
Commercialization and Star Wars
Read: Exploring,, III, 17-42; IV, 11-16
McDougall, part 6
McCurdy
Research days: October 14, 16
McCurdy critique due October 21
Book critiques due October 23
Paper draft due October 28

Weeks 10-11  The Future Is Here, Again
Revolutions in observations
Looking in: Earth
Looking out: The universe
Read: Exploring,, IV, 17-20
Chaisson
Chaisson critique due November 4
Classmate paper critique due November 9

Weeks 12-14  Paper Presentations

POSSIBLE PAPER TOPICS

Origins of U.S. space programs
National security issues
Militarization of space, actual & proposed
The railroad and the space program
The Cold War and the Space Race
Manned vs. unmanned flight
International programs-cooperation or competition?
The future: "Star Trek" or "Blade Runner??
The mystique and political economy of space
Commercial space-the communism of space
(always on the horizon)

Space stations
Reaction to Sputnik
Space and literature/science fiction

Space and film
Biography (e.g., Werner von Braun, Gus Grissom)
Program or institution history (e.g., Project Apollo, Johnson Space Center)
Projects that never took off (e.g., Dyna-Soar)
Failure of alternative approaches (e.g., shuttle alternatives, paragliders)
Component history (e.g., computers, space suits)

Texas and space
Interest groups
Utopians in space
SCOPE OF THE COURSE

Eyes are burned by air pollution. Shellfish are tainted by agricultural runoff while fish become more scarce worldwide. Some urban water supplies may be unsafe. Skin cancer risks may be increased because of a hole in the ozone layer. The Earth may be getting warmer due to climate changes. These environmental issues and many others face everyone, and decisions have to be made concerning them – both personal and governmental.

The way the mass media report about these issues is important for both short-term and long-term decisions made by individuals, industries and governments. Information about environmental issues reaches most Americans through the mass media – newspapers, magazines, radio and television. Some environmentally concerned citizens gain additional information from more specialized magazines and books focusing on nature, conservation, hunting or fishing and from the World Wide Web. They also attend meetings of environmental organizations. Wherever the information comes from, it has some impact on people and their actions.

This course has three purposes. First, it will introduce you to a broad range of environmental issues facing the world, our nation, our state and our local communities. Second, it will explore the parameters of environmental journalism and how the media report about complex environmental issues. Third, it briefly will look at the field of environmental risk communication and the role the media and others play in how people evaluate risk.

CLASS SESSIONS

This class will meet Tuesday and Thursday from 10:45 am to noon. These sessions primarily will be class discussions, with a minimum of lecturing. Your participation in class discussion will be an important part of this course and your grade. You will need to be prepared by doing the assigned readings and attending class. More than three absences, whether excused or unexcused, will lower your final grade one letter.

Since late arrivals disrupt discussions, two late arrivals will count as an absence. Leaving and returning to the classroom during discussions also is disruptive and, if you do so, it will count as a late arrival. So come to class prepared to stay the full time and come on time.

READINGS

Selected readings in five books are required for the course:


*Media and the Environment*, edited by Craig LaMay and Everette Dennis, Island Press
*Nature's End*, by Whitley Strieber and James Kunetka, Warner Books


*Earth in the Balance*, by Al Gore, Plume Press

The first and second books are out of print, have been copied and can be purchased as one package at Campus Communications, across from Malines Hall. The third book also is out of print and copies will be given to you for the semester's use when you deposit a $20 check made out to Lehigh University with the Journalism Department; when you return your copy, you will get the check back. You MUST return this book in order to pass the course!! The fourth and fifth books are available in the bookstore. Several other readings will be on reserve in Linderman Library. Reading assignments for the course are near the end of this syllabus.

You also are required to look several times a week at both of the following daily environmental news websites: World Environment News by Reuters News Service at www.planetark.org/news/ and Environmental News Network (ENN) at www.enn.com. The first is about international environmental issues and the second focuses primarily on U.S. environmental news. You will not be able to get into the subscriber package of ENN (unless you try the 30-day free trial), but you will see the main news and the headlines for the subscriber package. What you read in these two websites should add to your knowledge for discussion of environmental issues in the class.

**ASSIGNMENTS**

This is a four-credit course and will require work both as an individual and occasionally as a team member. Your team activity will be done outside of class as part of the requirements for the fourth credit at a time to be agreed upon by team members. Since this is also a Writing-intensive course, you will be required to write a minimum of 30 pages.

Major assignments will include 1) a book report on *Nature's End*; 2) a team report on *Earth in the Balance*; 3) an analysis of newspaper coverage of environmental issues; and 4) a term paper on an environmental issue of your choice and an analysis of how well the media covered it. Work on the term paper will start midway through the semester with selection of an issue and preparation of a bibliography; there will be a brief written half-way report as well as the final oral and written report.

In addition to these assignments, students will be responsible for leading discussions and generating questions on various readings. There will be a midterm exam but no final exam. A schedule of written assignments and tentative due dates is at the end of the syllabus.

All papers must be typed or printed, double spaced, and must be corrected for spelling and grammar. Assignments should be turned in on time to receive the maximum possible grade. Papers turned in up to one week late will lose one letter grade. Papers turned in after one week lose two letter grades and so on. ALL ASSIGNMENTS MUST BE TURNED IN TO PASS THE COURSE.
GRADES

Grades will be calculated as follows:

- Book Report (Nature’s End) 10%
- Group Report on Gore’s book (team grade) 10%
- Midterm 15%
- Newspaper Analysis 15%
- Other Short Assignments 5%
- Term Paper 30%
- Classroom Participation 15%

Junior writing certification will be a separate evaluation and will not enter into calculations for the letter grade. Individual conferences on writing problems will be held with students after a few writing assignments have been turned in. One or two writing clinics also may be scheduled. If you know you have writing problems or if you just want to improve your writing skills, don’t wait for a scheduled appointment. Come to see me as soon as possible.

PROFESSOR AND OFFICE HOURS

I am Sharon Friedman, Professor and Director of Lehigh’s Science and Environmental Writing Program and its Environment and Society Minor. My office hours are Monday from 9:30 a.m. to noon and Tuesday and Thursday, 1-3 p.m. in B9, at the far end of the basement of University Center (near the vending machines). Other times are by appointment. My office phone is 8-4179; e-mail address is smf6. I frequently work at home on Wednesdays and Fridays and you can call me there at 610- 868-7692. I faithfully read my e-mail every day except Saturday (everyone needs a day to rest!), so you can always get me there. Please contact me or come to see me if you have any questions or problems.

TENTATIVE COURSE OUTLINE & READING ASSIGNMENTS

8/28  Introduction – What are Environmental Problems?

8/30  Perceptions and Attitudes in Environmental Affairs
   Reporting Handbook, Chap. 1; Watersheds, Introduction; Risk Perception Handout. Start reading Nature’s End (due 9/26)

9/4   International Environmental Problems (Video)
   Watersheds, Chaps. 2 & 9

9/6   How to Use the Internet, WWW and Nexis/Lexis
   Watersheds, Old Chap. 3 (Chernobyl) & new Chap. 3

CLASS IN RAUCH, ROOM 70

9/11  Computer Search: Developing Countries’ Environmental Issues
   Watersheds, Chapters 4 and Old Chapter 9 (North-South)

CLASS IN UNIVERSITY CENTER C06
9/13  International Environmental Issue Discussion  
Watersheds, Chap I and handouts/websites

9/18  National Environmental Issues (Video)  
Watersheds, Chaps. 6 & 8

9/20 National Environmental Issues Discussion  
Watersheds, Chaps. 5, 10 and Epilogue

9/25 Discussion of Nature’s End  
Nature’s End (entire book)

9/27  Computer Search and Discussion: Climate Change Issues  
Watersheds, Chap. 7 & Climate Change handouts/websites

CLASS IN UNIVERSITY CENTER C06

10/2-4 Group Reports: Gore’s “Global Marshall Plan”  

10/9  Pacing Break

10/11 What is Environmental Journalism?  
Handbook, Chaps. 2 & 3; Friedman, Two Decades, pp. 17-28 (Back of Handbook)

10/16 Environmental Journalism Techniques  
Handbook, Chap. 4 and Handouts

10/18 Midterm Exam

10/23 Environmental Writing Styles  
Handbook, Chaps. 5 & 7

10/25 Newspaper Analysis

10/30 Advocacy versus Traditional Reporting  
Ryan, Network Earth, pp. 81-89; Detjen, Traditionalist’s Tools, pp. 91-101; LaMay, Heat and Light, pp. 103-113 (All in back of Handbook)

11/1-6 Environmental Coverage Problems  
Handbook, Chap. 6, Dennis, In Context, pp. 55-64; Smith, Greens and Greenbacks, pp. 157-169; Wirth, Market for Change, pp. 171-178 (All in back of Handbook)

11/8 Environmental Journalism Backlash  
Environmental Backlash Handouts
11/13  Risk Communication
        Risk Communication Handouts


12/4  Final Report Media Coverage Discussion

12/6  Class Review

**TENTATIVE WRITTEN ASSIGNMENT SCHEDULE**

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<tr>
<th>Assignment</th>
<th>Due Date</th>
<th>Required Pages</th>
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<tr>
<td>Intl. Report &amp; Questions for Discussion</td>
<td>9/13</td>
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<td>based on <em>Watershed</em> Chaps., Video &amp; Computer Search</td>
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<td>Natl. Questions for Discussion</td>
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<td><em>Earth in the Balance</em> Team Report</td>
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<td>Overview of Your Environ. Issue</td>
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<td>and Preliminary Bibliography for Term Paper</td>
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<td>Newspaper Analysis</td>
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<td>Oral Final Reports</td>
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<td>Written Term Paper</td>
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APPENDIX D: “AIDS AND SOCIETY” COURSE
UNIVERSITY OF CALIFORNIA, DAVIS

Required Texts:
- A student reader containing additional readings assignments, listed below following the associated lecture topic, will be available for purchase at Classical Notes, MU. We will announce in class when it is available.
- Before the midterm, watch the video “A Time of AIDS” (two tapes, 2 hr each: Part 1 - The Zero Factor and Hunting the Virus; Part 2 - Fighting for Life and The End of the Beginning). Two copies of each tape are on reserve in the Media Distribution Classroom, 1101 Hart Hall.

COURSE OUTLINE:

WEEK 1. Introduction and Biological and medical issues
Jan 7 Introduction to the course and to AIDS - show 30 min of A Time of AIDS - Kathryn Radke and others
   AIDS Text: Chapter 1
Jan 9 Infectious diseases and the body’s defenses - Kathryn Radke
   AIDS Text: Chapter 2
   Journal Assignment: None this week
   Discussion: Get acquainted; talk about why you’re taking the class. Go over ground rules; sign confidentiality statement; agree to respect diverse opinions; agree to disagree.

WEEK 2. Biological and medical issues (cont.)
Jan 14 Immune system - Kathryn Radke
   AIDS Text: Chapter 3
   Jan 16 Viruses, HIV - Kathryn Radke
   AIDS Text: Chapter 4
   Journal Assignment (due in this week’s discussion)
   Our experience with and expectations about infectious diseases have changed greatly over the past several generations. Compare the spectrum of common infectious diseases, routine drug treatments for infections, and vaccinations available to you with those available to your parents and your grandparents (interview them or other people of their generations). What do you envision will be available for your children?

WEEK 3. Biological and medical issues (cont.)
Jan 21 Modes of HIV transmission - Kathryn Radke
   AIDS Text: Chapter 7
   Jan 23 Treatment of HIV infection; prospects for vaccines - Kathryn Radke
   AIDS Text: Chapter 6

**Journal Assignment** (due in this week’s discussion)
Where did HIV come from? From reading and talking with your friends, what are three different ideas about the origin of the virus? Evaluate these ideas in light of the biology you have learned. Why do we have so many ideas?

**WEEK 4: Biological and medical issues (cont.)**

Jan 28 Drug therapies for HIV infection; clinical disease - Neil Flynn (Infectious Diseases)
* AIDS Text: Chapter 5

Jan 30 Medical care; HIV in intravenous drug users - Neil Flynn
* AIDS Text: Chapter 9

**Journal Assignment** (due in this week’s discussion)
Suppose that your roommate or a member of your household became HIV-positive. What concerns would you and others in the household have about virus transmission? What precautions would you take to prevent infection of yourself and others in the household? How would your concerns and precautions be modified, if you had an intimate relationship with the infected person?

**WEEK 5: Economic, social, and political issues**

Feb 4 Health care - Michelle Famula (Med. Director, Student Health Center), Don Palmer (Graduate School of Management), Russ Suey (hospital administrator), Tom Pucci (pharmacist)

Feb 6 MIDTERM EXAM (biological and medical issues)

**Journal Assignment** (due in this week’s discussion)
Suppose that you have just discovered that you are infected with HIV. Investigate and report what options for treatment and care are covered by your existing means of health care. Will your health care cover you throughout asymptomatic infection, during the many illnesses that occur as the immune system loses its ability to function, and during terminal disease? Would your health care coverage change if you had to leave school or stop working because of your illness? If you should choose to seek alternative treatments not covered by standard health plans, how would you pay for them?

**WEEK 6: Economic, social, and political issues (cont.)**

Feb 11 Risk perception, psychology - Peg Rucker (Textiles and Clothing), Carl Winter (Food Science and Technology)
* AIDS Text: Chapter 8

Feb 13 Social, political, economic and cultural themes - Gary Segura (Claremont Graduate School)

**Discussion:** Safer-sex demonstrations; negotiating safer sex.

**Journal Assignment** (due in this week’s discussion)
If you are sexually active and didn’t use barrier protection, what are the reasons you didn’t use it? If you are not sexually active, what are the reasons behind your most risky behavior, for example: smoking, biking without a helmet, drinking and driving?

**WEEK 7: Economic, social, and political issues (cont.)**

Feb 18 Cultural and historical understanding of AIDS - Susan Kaiser Feb 20 Legal and political issues - Gary Segura

**Journal Assignment** (due in this week’s discussion)
Think back to the most recent or memorable media portrayal you have seen of a person living with HIV/AIDS. If none comes to mind, find a story in the media or on the Internet to use. You can choose a fictional story or character, e.g., Tom
Hanks in the movie “Philadelphia,” or a real-life situation. What are some of the assumptions the media makes about people with HIV/AIDS? Can you detect a blurring of boundaries between traditional news, as an impartial information source, and entertainment, which is meant to move us emotionally, but not to be taken as truth? Describe how this blurring of boundaries occurs in your portrayal. How much of what you see is news, and how much is entertainment? How does the media use some of the taboos surrounding HIV (sex, homosexuality, drugs) to tell the story? How is the issue of morality dealt with? Is this something traditional news should steer clear of? If at all possible, please include your article with your journal.

WEEK 8. Economic, social, and political issues (cont.)
Feb 25 Media representations of AIDS - Susan Kaiser
44. Weise, E. “CIA-Drug Controversy Bringing Blacks to the Internet,” The Sacramento Bee (December 1996).

Journal Assignment (due in this week’s discussion)
Envision three people diagnosed with HIV/AIDS: the first is a woman, upper-income, married for 14 years and the mother of three; the second is a male, very wealthy, single, with no children; the third is a male, poor, divorced, and the father of one. What is the first thing you want to know about these people? What kinds of assumptions did you make about them based on this information? Describe your image of these people. What kinds of stereotypes did you find yourself making, and where did they come from - the media, friends, experience? How would your thinking change if the three people were described this way instead: The first is a former sex worker who has three children from three different partners; she lives off of her savings and investments while her husband finishes out his sentence for insider trading. The second is a plastic and reconstructive surgeon who donates 25% of his time to the organization Doctors without Borders. Although he always wanted a family, he never found the time to settle down with the right person. The third is a relief worker with the United Nations. His wife wasn’t ready for the rigors of living abroad and divorced him after three years of marriage, leaving him to care for their young child. Have the races or sexual orientations you envisioned for the people in the scenarios changed? How favorably or unfavorably do you look at them now? Is this a change from your first impression? Answer as honestly as you can.

WEEK 9. Personal to global context
Mar 4 Living with HIV - People contacted through Sacramento AIDS Foundation - Beth Coleman
AIDS Text: Chapter 10
Mar 6 Death and dying - Juliana Tachiban (hospice volunteer); Jennifer Gustavson (Avalon house); Kathryn Radke Death and Dying Text: Chapters 1-9
51. “Grief and Mourning,” Counseling Center UC Davis.

Journal Assignment (due in this week’s discussion)
Imagine that you have just discovered that you were HIV-positive. Who would you tell? How would they react? How would being HIV-positive change your plans for the future?

**Discussion:** The Giving-Away Exercise

**WEEK 10. Personal to global context (cont.)**

Mar 11 Global perspective - Willi McFarland, UCSF.

AIDS Text: Chapter 11


5-page paper due

Mar 13 Treated as a Monday so no class; Thurs. discussion sections will have to meet anyway.

Journal Assignment (due in this week’s discussion).

What did you learn in this class? How has this changed you? How has this shaped your view of how our society should deal with HIV infection and AIDS? What are you going to do with the information you have learned in this class?

**SUMMARY AND FEEDBACK (out of class session) - Time and Location: TBA**

Mar 19 - Wed. - FINAL EXAM 1:30-3:30 pm

**Appendix**

Connections. Published by Alliance for a Global Community. 2, No. 3 (Winter 1995/1996), 1.


“Ways to Develop Intimate Relationships,” from *Health & Wellness*, Golanty and Edlin.

“Sharing Your Innermost Feelings,” from *Health & Wellness*, Golanty and Edlin.

“Acquaintance Rape,” adapted from *Acquaintance Rape*, Rape Crisis Network.

“Rape Trauma Syndrome,” UCD Rape Prevention Education Program.

“Rape Prevention Education Program: Who We Are and What We Do,” published by the UC Davis Rape Prevention Education Program.


“Peer Counselors in Sexuality,” publication of Cowell Student Health Center

“Campus & Community Resources,” published by the UC Davis Women’s Resources and Research Center

“Counseling and Psychological Services,” published by The Counseling Center, UC Davis (November 1991).

Counseling Center Locations and Hours

Pamphlet from the Women’s Resources and Research Center.

**GRADING**

25% Midterm - short answer and short essay (100 points)
25% Final - short answer and short essay (100 points)
25% 5-page paper due March 11 in class (100 points)
25% Weekly journals (100 points) (5 points each for 9 entries; 5 points for handing in the complete binder at the end of the quarter) and participation in discussion section (5 points each week for 10 weeks). You must attend discussion section.

Only one unexcused absence is allowed. You must attend the section in which you are enrolled.

**Weekly Journals**

Your journal will be a loose-leaf binder. Entries will be printed on loose sheets of paper and stapled to be handed in. When they are returned to you, put them into your binder. You’ll need the complete binder at the end of the course.

Topics for weekly journals are listed on a separate sheet. Each journal entry will be a minimum of two pages, typewritten and doublespaced. Each entry will be handed in to your TA in your discussion section meeting during the week indicated on the list. The discussion topic for the week is frequently based on the journal topic. Journal entries will be read, assigned points, and returned the next week during discussion section.

The journal assignment is intended both to provoke and reflect your thinking about the class and the specific issues brought to your attention. Journals prompt thinking in that the very act of writing in an open-ended fashion prompts discovery and articulation of ideas, feelings, and connections; and of course, writing in a journal provides the opportunity to capture and examine your thinking. Finally, your journal provides us with insights into how and what
students are thinking. To help you develop a journal for this class, your TA will rate your entries on a 1 to 5 scale. These ratings will be converted to points for your grade.

Each paper will be given from 1 - 5 points. Minimum points indicate that you are merely repeating material from lectures or from reading assignments. Medium points are awarded for entries showing that you are communicating some insight into the topic. Maximum points are awarded for entries showing that you are integrating ideas, connecting topics from the course and from other sources, and that you are thinking on your own.

You will be evaluated on the content and presentation of your entries. You must use correct spelling and grammar because they make your writing effective and understandable. TAs will point out obvious problems with presentation so that you can seek help and learn to avoid such problems.

**Participation in discussion section**

Your informed and thoughtful participation in a discussion section is an essential component of student learning and involvement in the class. Effective discussion sections benefit all participants by reviewing and extending course material, by providing opportunities to learn about and question multiple perspectives, and by helping you reflect on your own ideas and experiences in light of the rich variety of ideas and experiences of others. Discussion sections also promote integration of content from different perspectives and academic disciplines. We hope that you will be challenged by your discussion section experiences and will benefit from them.

Up to 5 points will be assigned each week: 1 point for attending, and 1 point for speaking at least once. Up to 3 more points will be based on the degree to which you participate. We ask you to offer something thoughtful to the discussion, to listen actively to others, to elicit and extend ideas of others, to further discussion through constructive questioning, to show that you’ve done assigned reading, and to integrate material from reading and lectures with other sources and with your own experience.

**SAS 15 Paper Assignment**

Paper due March 11 at the beginning of class. 

Design an outreach program for a group at risk of becoming infected with HIV. The goal of your program is to prevent HIV infection among this group.

Describe your target group by at least seven parameters. Some factors to consider are: age, behaviors, cultural identity, ethnic background, gender, level of education, place of residence, racial identity, religion, sexual orientation, socio-economic status, and the ease of finding and approaching your population.

- What are the unique risks associated with your identified group?
- How will you design a program that would actually result in a change in behavior in the areas at risk?
- Try to be unique in your approach. You will be evaluated on the efficacy of your outreach program to change behavior.
- What methods will you use to provide information?
- How will you evaluate the success of your program?
- What are the strengths and weaknesses of your program?
- What are the limitations to designing such a program?

Consider a group having one factor that differs from your target group. How does this change your approach?

You must provide a bibliography; it can include one interview.

**Format of paper:**

- At least 5 pages long and not more than 8 pages, plus a title page and bibliography. Typewritten in 12-point type and doublespaced.
- The exact format is up to you but must include an introduction, body, and summary. Organize for ease of reading by using headings and transitions. Correct spelling and grammar must be used.
- References must be correctly cited in the text and in a bibliography. In the text, you may use either an author-year format (Smith, 1995) or footnotes (1). For the bibliography, you may use any referencing system, but please be consistent and complete; examples can be found in your reader. Please cite all information that is derived from published sources. In citing a person you interview, you will need to ask whether the individual minds being quoted by name. If permitted, you can cite the person's name, position, and date of the interview. If not you can describe the interviewee generally without revealing the individual's identity; include the person's position and the date of the interview. When obtaining information from the Internet, be careful to distinguish between fact and opinion. Refer to an Internet source by citing the source of information and an address that would enable the reader of your paper to find it.

For assistance with writing, see the Campus Writing Center, 378 Voorhies Hall.
Grading:
- Organization and cohesion - 30%
- References - 10%
- How well the basic question is addressed - 30%
- Grammar and spelling - 10%
- Uniqueness of approach - 20%
APPENDIX E: “ETHICS IN ENGINEERING” COURSE
NORTH CAROLINA STATE UNIVERSITY

MDS 320 ETHICS IN ENGINEERING
Spring 2002

Instructor
Dr. Joseph R. Herkert Office: 2 Carter-Williams Bldg. (2806 Hillsborough St.)
Division of Multidisciplinary Studies Hours: 2:30-4:00 PM Tuesdays and Thursdays,
Campus Mail: Box 7107 or by appointment
E-mail: joe_herkert@ncsu.edu Phone: 515-7993

Course Description
Engineering in American culture and the emerging ethical issues confronting the profession:
corporate responsibility, personal rights, whistle blowing, conflicts of interest, professional autonomy, risk assessment, sustainable development, and the place and purpose of engineering codes of ethics. Three hours credit. (Prerequisite: Junior Standing)

Course Requirements
1. Preparation, class attendance and regular participation in class discussions (36% of course grade). One third of the grade for this portion of the course will be based on attendance (see below), one third on unannounced pop-quizzes on the assigned readings (no make-ups for unexcused absences), and one third on class participation.
2. Two take-home essay examinations, mid-term (20% of the course grade) and final (24% of the course grade).
3. Participation in a group project (20% of course grade).

Group Project
Each group will consist of 6-7 students who will be responsible for planning and leading an entire class session on a case study in engineering ethics to be assigned by the instructor (see attached guidelines, case descriptions and assigned readings).

Attendance Policy
Attendance is expected at all times. It is the student’s responsibility to inform the instructor if there is a legitimate excuse for an absence (e.g., illness). Roll will be taken and the number of unexcused absences will determine the attendance grade as follows:

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<td>0-1 class missed</td>
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<td>3 classes missed</td>
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<td>more than 3 classes</td>
<td>F</td>
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Academic Integrity

With the exception of assigned group activities, all students are expected to do their own work in this course. Students are expected to be familiar with and adhere to the provisions of the statement on Academic Integrity contained in the Code of Student Conduct (http://www.fis.ncsu.edu/ncsulegal/41.03-codeof.htm).

Required Reading

2. Various book chapters and articles listed below, that have been placed on electronic reserve (http://www.lib.ncsu.edu/rbr/). For reserve readings, the authors' names are italicized on the course outline.
3. Hyperlinks to articles, cases and other resources found on the MDS 320 World Wide Web Page, document URL: http://www4.ncsu.edu/~jherkert/mds320.html.
4. Miscellaneous handouts to be distributed by the instructor at various times throughout the course.

Reserve Readings

Guidelines for Group Projects

Each group will consist of six to seven students who will be responsible for planning and leading an entire class period on a case study in engineering ethics. Groups will be formed and topics assigned in consultation with the instructor. However, it is the responsibility of the student groups to research the topics and obtain the information necessary for the class presentations. All students in the class are required to complete the assigned readings for each case presented.

In conjunction with the classroom presentation, each group is responsible for producing a technical media exhibit, such as an original videotape (which may be utilized during the classroom presentation) or a World Wide Web home page. Groups are responsible for obtaining the resources necessary for producing the media exhibit, which is due at the time of the classroom presentation (a video camera is available for loan from the instructor but must be reserved in advance). PowerPoint presentations are encouraged but will not normally qualify as technical media exhibits.

You are allowed considerable leeway in the organization of the class period, but two requirements should be kept in mind: all members of the group are expected to participate equally in the project, and provision must be made for meaningful and significant class participation. You are encouraged to be creative. For example, such formats as talk shows,
games, and role-playing are appropriate. Keep in mind, however, that the number one priority should be serious presentation and discussion of the topic. Up to one third of the class time may consist of guest speakers, videos, etc. If you invite a guest speaker, make sure they understand that their time and role in the class will be limited.

The groups are required to meet twice with the instructor to discuss progress on the projects. *All group members are required to attend.* The first meeting will be held three to six weeks prior to the presentation date. This meeting will consist of a discussion of the topic, progress to date on research, and a general outline of the class presentation, including division of responsibilities among the group members. The second meeting will be scheduled to occur during the week or two before the class presentation. By the time this meeting takes place, the bulk of your research should be completed and you should be finalizing the details of the presentation itself.

The group project constitutes twenty percent of the overall course grade. *Group members who do not fulfill their responsibilities to the group will be removed from the group and receive a grade of “F” for the project.* The grade for the project will be based upon three sources: an evaluation by each group member of the contribution to the project of the other members in the group, an evaluation of the class presentation by the rest of the class, and an evaluation of the project by the instructor. Each group is required to submit to the instructor a bibliography of sources consulted, copies of handouts, overheads, PowerPoint slides, etc. utilized in class, and a copy of the technical media exhibit (e.g., video tape or computer files). Other supporting material (outlines, notes, etc.) may also be turned in.

**Group Project Cases and Assigned Readings**

1. **The BART Engineers**
   Three engineers working for San Francisco’s Bay Area Rapid Transit (BART) System were fired for blowing the whistle on design flaws in the Automated Train Control (ATC) System. Following their dismissal, as a result of a failure in the ATC system less than three weeks after BART began commercial operation, a BART train overran a station, injuring several passengers.

   Unger 20-25, 251-262

2. **The DC-10 Case**
   The largest single-plane air crash in history occurred when a DC-10 went down near Paris in 1974, as a result of a failure in a cargo door, killing 346 people. Two years earlier an employee of Convair, a subcontractor of McDonnell-Douglas, the manufacturer of the DC-10, had notified his superiors of design flaws in the cargo door. Convair withheld this information from McDonnell-Douglas.

   Unger 16-20, 247-250; Schlager 52-58

3. **Hyatt Regency Walkway Collapse**
   The deadliest structural collapse in U.S. history took place in Kansas City, Missouri in 1981 when two suspended walkways fell during a dance in the lobby of the Hyatt Regency Hotel, killing 114 people and leaving 185 injured. Extensive lawsuits were filed against various parties to the collapse, and the engineers responsible for the design of the walkway supports were stripped of their professional engineering licenses.
4. The Pfizer Heart Valve Case
The Convexo/Concave heart valve, manufactured by a subsidiary of the health-care giant, Pfizer, Inc., is at the heart of one of the most interesting product liability cases in recent times. Of the 86,000 valves implanted in patients worldwide, about 600 are known to have failed, with two-thirds of those failures causing fatalities. Among other allegations, Pfizer has been accused of fraudulently concealing information about design and manufacturing flaws in the valves.

Fielder “Defects and Deceptions”; FDA News Release 3/12/92

5. The Dalkon Shield IUD
Between 1971 and 1975, the A. H. Robins Company distributed over four million Dalkon Shield intrauterine devices in eighty countries, with false claims of efficacy and safety. In the U.S. alone, more than two million women were fitted by doctors who believed the misleading claims. To date, thousands of women have suffered serious damage caused by the Shield, from pelvic infection to sterility, miscarriage, and even death. More than $340 million has been paid by Robins and its insurer to litigants.

Schlager 481-485; Intrauterine Devices

6. Silicone Breast Implants
Over a million women in the U.S. have received silicone breast implants for cosmetic reasons, including women who have had mastectomies or other medical problems. During the 1990s, serious concerns arose regarding health impacts resulting from deterioration and leakage of the implants. The largest manufacturer of breast implants, Dow-Corning, has been found to have withheld from the public information concerning these impacts as well as falsifying data regarding the manufacture of the implants. Though the health effects of breast implants remain controversial, Dow Corning, and its shareholder company, Dow Chemical, have been subject to extensive litigation.

Schlager 475-480; FDA News Release 1/6/92; Summary of Report of National Science Panel

7. Therac-25
Between 1985 and 1987 at least six patients were seriously injured or killed when they received massive overdoses of radiation from the Therac-25, a radiation therapy machine. The overdoses were attributed to operator error, poor software engineering, over-reliance on software for safety assurance, inadequate response by the manufacturer when accident reports began to surface, and unrealistic risk assessments.

Leveson and Turner “An Investigation”; A medical risk of computers

8. Firestone/Ford Explorer
In August 2000 Bridgestone/Firestone announced a recall of 6.5 million tires, after receiving reports that some tires suddenly failed. Since then, federal investigators have documented 271 deaths from thousands of accidents involving the tires. Many of the accidents involved rollovers
of the Ford Explorer, the world's best-selling sport utility vehicle. Legal investigations and settlements have ensued; key legal and ethical questions concern the extent to which Firestone and Ford were aware of problems with the tires, and how long they had this knowledge before the recall was initiated.

Why are Firestone tires failing? Is Explorer part of the problem?

**Daily Assignments**

See next page
# MDS 320   Ethics in Engineering   Spring 2001

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<td>What Is Engineering?</td>
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<td>“Some Definitions of Engineering” (handout); Davis “Defining ‘Engineer’”; Florman “The Engineering View” pp. 65-68</td>
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<td>Group Project Organizing Session</td>
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<td>Ferkiss “Seeking a New Identity”; Alpert “How to Manage Engineers”</td>
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## II. MORAL DILEMMAS IN ENGINEERING

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<td>William LeMessurier; Unger 1-13</td>
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<td>Boisjoly “The Challenger Disaster”; McConnell “Recommendation to Launch”; Roger Boisjoly</td>
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<td>Challenger, II</td>
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<td>Harris “Explaining Disasters”; Gladwell, “Blowup”; Unger 91-102</td>
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## III. FRAMEWORKS FOR ENGINEERING ETHICS

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<td>Moral Thinking And Moral Theories, I</td>
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<td>Schinzinger and Martin “Moral Reasoning”; Anonymous “I Gave Up Ethics—To Eat!”</td>
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<tr>
<td>T 19</td>
<td>Moral Thinking And Moral Theories, II</td>
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<td>WMU Case: Price is Right?; WMU Case: Health in the Workplace</td>
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<td>H 21</td>
<td>Codes of Engineering Ethics, I</td>
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<td>Unger 106-133, 281-314; Ladd “The Quest for a Code of Professional Ethics”</td>
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<td>T 26</td>
<td>Codes of Engineering Ethics, II</td>
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<td>NSPE Case 78-10: Related Services for Private Party Following Public Employment; NSPE Case 88-7: Public Criticism of Bridge Safety</td>
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<td>H 28</td>
<td>Support for Ethical Engineers, I</td>
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<td>Unger 27-30, 136-174</td>
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## IV. ENGINEERING ETHICS AND PUBLIC POLICY

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<tr>
<th>Date</th>
<th>Topic and Details</th>
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<tbody>
<tr>
<td>T 5 Mar</td>
<td>Support for Ethical Engineers, II</td>
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<td></td>
<td>Unger 177-187, 194-204; Government Accountability Project</td>
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<td>H 7</td>
<td>Risk Assessment and Communication, I</td>
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<td>Winner “Engineering Ethics and Political Imagination”; Herkert “Ethical Risk Assessment”; USDOE “Risk Principles”</td>
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<td>T 12</td>
<td>No Class—Spring Break</td>
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<td><strong>T 26</strong> Product Liability, II</td>
<td>De George “The Pinto Case”; Schlager 156-162</td>
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<td><strong>T 2 Apr</strong> Engineering &amp; Sustainable Development, I</td>
<td>Hatch “Accepting the Challenge”; Roberts “Sustainable Development”; International Institute for Sustainable Development</td>
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<td><strong>T 23</strong> Group #5</td>
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<td><strong>T 30</strong> Group #6</td>
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**V. CASES IN ENGINEERING ETHICS**

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<tr>
<th>T 9 Group #1</th>
<th>H 11 Group #2</th>
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<td>T 16 Group #3</td>
<td>H 18 Group #4</td>
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<td>T 23 Group #5</td>
<td>H 25 No Class (tentative)</td>
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Final Exam Due Tuesday, May 7 11:00 AM
APPENDIX F: “SUSTAINABILITY PERSPECTIVES IN RESOURCES & BUSINESS” COURSE
MIAMI UNIVERSITY OF OHIO

Syllabus

Finance/Zoology 494                     Ray Gorman
Spring 1998                            Orie L. Loucks

Description: This capstone course addresses the development of interdisciplinary answers to the
prospect of declining quantities of critical resources and growing public awareness of environmental and
related health risks. Another goal is to bridge the disparities between business and scientific views of
resource use, waste disposal, risk, and the consumer society. The course requires participants to think
critically about (1) how the best scientific knowledge can be used in evaluating resource use options; (2)
the parameters of business planning, ethics, and profitability; and (3) the role and impact of citizens,
human values, and government or corporate institutions in policymaking.

The course will be team-taught in a mixed lecture/discussion format. Students will prepare
reaction papers or small projects, and one larger team project report, working in interdisciplinary pairs or
groups that link business majors with non-business majors to solve crosscutting problems. Learning
appreciation for, and communication among, the diversity of worldviews from different fields of study is
a secondary goal of the course.

Lecture: The course will meet twice a week, for 75-minute periods. Some lectures will be divided
between two faculty representing different disciplines within the one class period, and many periods will
be divided between lecture and discussion of specific case studies.

Reaction Paper/Assignments: Each student will be asked to write three reaction papers. These are
short papers (about 2 double-spaced typewritten pages each) in which the student “reacts” to a
provocative chapter, article, or question posed by the instructors. In your reaction paper you should state
whether you agree or disagree with points made by the author(s) and why you agree or disagree. You may
want to compare the article or chapter with others that have been read.

Audience: Seniors in science, business, and other fields.

Evaluation: Overall evaluation will be based on five components:

Three Reaction Reports  20%
Final Exam              25%
Mid-term Exam           15%
Team Project            20%
Class Participation     20%

(Since 20% of the grade depends on your oral contributions to the class, we will assign the following
grades after each class, based on your contribution: 4 - Exceptional contribution and good preparation; 3
- Demonstrated command of materials and well prepared; 2 - Able to respond modestly to issues raised in
class; 1 - Attended class; or 0 - Absent. Being prepared for class each day can only enhance your learning,
classroom performance, and final grade.)

Textbooks:
(1) Anthology of Readings in Sustainability, 1997
(2) Monograph on Perspectives in Sustainability: Principles and Case Studies,
    August 1997.

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Course Outline

The Concept of Sustainability
Week I (Jan. 13 & 15)
(23) Introduction to the idea of Sustainability
· Monograph: Chapter I
(24) Ecological Systems: Stock Balances and Sustainability
· Monograph: Chapter 2

Week II (Jan. 20 & 22)
(25) Defining Sustainability: Intergenerational and Geographic Equity and Public vs. Private Responsibility
· Monograph: Chapters 3 and part of 5
Assignment: Reaction Paper #1, Due Jan. 27
(2) Ecological and Economic Systems Theory; Stocks and Flows
· Monograph: Chapters 2 and 3

The Systems View of Resources, Economics, Business, and Integrity
Week III (Jan. 27 & 29)
(1) Business Accounting and Environmental Accounting/ Ashland Chem. disc.
· Monograph: Chapter 6
· Case Study: Internal Environmental Health and Safety Auditing: The Ashland Chemical Company Example
Assignment: Reaction Paper #2, Due Feb. 5
(2) Estimating Present Values through Discounting Methods
· Monograph: Chapter 6

Valuing Assets: Measurement, Ethics and the Problem of Discounting
Week IV (Feb. 3 & 5)
(1) The Problem of Measuring Sustainability
· Monograph: Chapter 4
(2) Values and Ethics and Intergenerational Equity in Valuation
· Monograph, Chapter 5
Application to Resources Industries: Forestry, Fisheries, Biodiversity; Case Studies

Week V (Feb. 10 & 12)
(1) Measurement of Stocks and Flows in West Coast Forestry
   · Reaction paper #2 Due.

Week VI (Feb. 17 & 19)
(1) Sustaining Fisheries and the Seafood Industry
   · Monograph: Chapter 4
   · Reaction Paper #3 Due.

Week VII (Feb 24 & 26)
(1) Business and Biodiversity Issues
   · McCoy, C. Timber Town in Bitter Fight Over Efforts to Save the Rare Spotted Owl. *Wall Street Journal*. (On reserve)
   · Sustainability Principles in Corporate Management; Cases
      (2) Stakeholders Interests: Information/Dialog vs. Conflict Resolution
         · Monograph: Chapter 7
         · Case discussion: Rainforest Negotiation Exercise: Oil Development in Ecuadorean Amazon.

Week VIII (Mar. 3 & 5)
(1) MIDTERM EXAMINATION.
(2) Risk Assessment and Regulation in Corporate Decision Making

Week IX (Mar. 17 & 19)
Week X (Mar. 24 & 26)

(1) Conclude discussion of Procter & Gamble Case.
     Environmental Change of Heart. Corporate Environmentalism, July/August, pp. 52-58. (On
     reserve)

Applications to Resources: Water, Agriculture and Case Studies

(2) Western Water and Eastern Air: Asset Appropriation, Public Subsidy and Business Decisions.
   · Monograph: Chapter 4
     Farming on Rural Areas of Origin in Arizona. American Journal of Agricultural Economics,

Week XI (Mar. 31 - Apr. 2)

(1) Agricultural Costs and Agricultural Policies; Values and Ethics in Food and Health.
   · Begin Case discussion of Fetzer Wines (Monograph).
   · Kleiner, A. What Does it Mean to be Green? Harvard Business Rev., Vol. 69, No. 4, 38-47.
     (On Reserve)

(2) Trends in U.S. Agricultural Systems
   · Conclude Fetzer Case discussion.

Week XII (Apr. 7 & 9)

(26) Case discussion: The Chemical Manufacturing Association and Responsible Care:
     The Role of Community-Industry Dialogue in Risk Management
     (Monograph).

Application to The Global Commons: Energy, Air and Greenhouse Gases

(2) Energy, its Externalities and the Context for Global Chancre.
   · Anthology: Flavin, C. 1994. Storm Warnings: Climate Change Hits the Insurance
     Journal of World Business, Fall and Winter, pp. 164-173.

Week XIII (Apr. 14 & 16)

(1) Electricity Production Options and Regulatory Framework for Public Policy or Energy.
     reserve)
     Northeast Utilities Scope. Northeast Utilities, August, pp. 4-11. (On reserve)
   · Case study: Cincinnati Gas & Electric (Monograph)
Environmental Security and U.S. Foreign Policy.

Week XIV (Apr. 21 & 23)
   - See also the Homer-Dixon article. (On reserve)
(2) International Security and Sustainability.
   - Monograph: Chapter 8.
   - Semester Projects Due, April 23

Week XV (Apr. 28 & 30):
(1) Team Project Presentations I
(2) Team Project Presentations II

Final Exam
APPENDIX G: THE UNIVERSITY OF VIRGINIA'S
TECHNOLOGY, CULTURE, AND COMMUNICATION PROGRAM
(Submitted by Kathryn Neeley)

Program of Integrated HSS Course Work

The Division of Technology, Culture, and Communication is an interdisciplinary group of humanities and social sciences faculty that is located in the School of Engineering and Applied Science. They have been given the responsibility for providing engineering students an educational experience that integrates HSS and engineering content and perspectives, and they have been given part of engineering students’ required humanities and social sciences course work for this purpose.

As noted in the indicators of integration listed in Section II of this report, integration need not occur in every course in the engineering curriculum but must occur in more than one course. The approach used at the University of Virginia structures a part of engineering students’ required humanities and social sciences courses so that students receive an integrative framework, take a mixture of HSS courses of both interdisciplinary and disciplinary character, and have a capstone experience that draws on these other elements. Students take 40% of their humanities and social science requirements (4 courses) in interdisciplinary HSS courses designed for engineering students, with the remaining 60% (6 courses) being selected from those offered by humanities and social science departments in the College of Arts and Sciences and designed for a general student population. The interdisciplinary HSS courses are distributed as follows:

Freshman Year: Language Communication in a Technological Society

This first-year course provides students with an introduction to engineering as a profession and a social enterprise combined with instruction and practice in all four modes of language communication: reading, writing, speaking, and listening. Students are introduced to the basics of professional/technical communication, which is then compared and contrasted with studies of analytical/persuasive communication and expressive/affective uses of language. This course is designed to provide them with an integrative framework that helps them understand how the curriculum as a whole is designed and how their HSS courses (in TCC and outside) contribute toward the development of the overall goals of the curriculum.

Sophomore Year: In-depth Study of a Particular Intersection of Technology and Culture

These thematic courses focus on a particular intersection between technology and culture and offer students the opportunity to pursue particular interests in depth. Representative topics include: Utopias and the Technological Society; Technology, Aggression, and Peace; Man and Machine; History of Space Flight; Technology and the Civil War; Religion and Technology; Computer Ethics; History of American Technology in the 20th Century; Science, Technology, and Imagination; and History of Technology and the Environment. Students complete a major research project, participate in and lead seminar-style discussions, and present both written and oral reports.
Senior Year: HSS Two-Course Capstone Experience – TCC 401: Western Technology and Culture & TCC 402: The Engineer, Ethics, and Society (Complemented by the Undergraduate Thesis Project as described below)

The TCC 401-402 sequence is designed to draw together students’ earlier course work and knowledge and develop the abilities and perspectives that will allow them to succeed in their chosen profession and realize their leadership potential. Companies are looking for engineers who possess not only technical expertise and the ability to express themselves well, but also the broader vision and commitment to professional ethics that underlie excellence in engineering. The best engineering designs reflect a deep engagement with the world around us—they create new connections and outcomes and do so while engaging knowledgeably and creatively with ideas, people, organizations, and the environment. The better students understand the context and ethical dimensions of engineering, the better the chance that they will achieve excellence in their field. TCC 401 and 402 help them achieve these goals.

In TCC 401: Western Technology and Culture, students step back and consider the broader context of technology and science in Western civilization. More specifically, they consider what constitutes scientific and technological progress, focusing especially on ethical and cultural dimensions. In TCC 402: The Engineer, Ethics, and Society, students develop an understanding of the engineer's role in society and the role of ethical issues and ideals in engineering. Another way to put this is to say that TCC 401 helps to analyze and clarify the big ideas that have dominated Western culture's understanding of technology, and that TCC 402 focuses on the engineer's professional role and special obligations.

In association with both courses, students define and complete their undergraduate thesis, which (1) serves as a case study in the full range of cultural and ethical issues raised in both courses; (2) provides a focus for integrating and personalizing what they learn; and (3) gives them first-hand experience of the range of resources and skills that are necessary for successfully managing a major project. The thesis project (described fully below) requires them to consider and integrate economic, environmental, sustainability, ethical, political, health and safety, and sociopolitical issues into the design, implementation, and management of technological systems, and their work with the thesis also plays a major role in achieving the specific outcomes described below.

Specific Outcomes of the TCC 401-402 Sequence

The specific outcomes for TCC 401 and 402 are based on the Accreditation Board for Engineering and Technology (ABET) criteria and also reflect the particular philosophy, goals, and mission of the School of Engineering and Applied Science at the University of Virginia. As a result of engineering students’ engagement with the readings, the discussions, and other experiences in the capstone HSS course sequence, in conjunction with their completion of the thesis project, students should be able to:

1) communicate effectively with both expert and non-expert audiences

2) identify, formulate, articulate, and solve engineering problems
3) think critically about and reflect on the processes of problem definition, engineering design, and project management

4) understand the impact of engineering solutions in a global and social context and use that understanding in the formulation of engineering problems, solutions, and designs

5) understand professional and ethical responsibilities as they apply to both particular engineering projects and to the engineering profession as a whole

6) recognize and analyze the role that technology and engineering play in important contemporary issues

7) appreciate perspectives that differ from their own and integrate their individual expertise and views with those of other people of both technical and non-technical backgrounds.

The Undergraduate Thesis Project

An undergraduate thesis project is required of every student who receives an undergraduate degree in engineering at the University of Virginia. The project, which is completed during the senior year, is jointly advised by a technical advisor (usually a member of the engineering faculty) and a faculty member from the Division of Technology, Culture, and Communication. The project may involve either engineering research or design and should give the student who undertakes it the opportunity to synthesize the various elements of his or her undergraduate education. The project is undertaken simultaneously with the capstone HSS course sequence described above, and the expectation is that there will cross-fertilization between them. The project begins with a proposal and culminates in a final report (the thesis itself). Both the proposal and the thesis are presented orally as well as in writing.

From the point of view of EC 2000 and the integration of the HSS into engineering education, the project has several significant features:

1) the students’ communication task is to satisfy expert audiences will at the same time making the thesis meaningful and accessible to non-experts. This feature requires not only that students make an effort to minimize jargon but also—and more importantly—that they frame the project in a context that makes it meaningful to a non-expert. This task often requires articulating assumptions and premises that go unarticulated in expert considerations of the subject of the thesis.

2) each student uses his or her project as a case study in a whole range of issues related to engineering and technology, including: the ideas and values that shape technology; the role of individuals and organizations in innovation; the role of technology in solving problems and generating unintended consequences; the impact of technology on society; ethical issues in engineering, the way personal values are expressed in professional choices and values; and the management over time of a major project involving a variety of resources. The project emphasizes problem definition as a process that involves reflection and critical thinking.
3) the project has been a graduation requirement for nearly 100 years and a major part of the engineering curriculum since the early 1930s. When graduates have been surveyed about their educational experience, they have reported that the undergraduate thesis was the single most valuable educational experience in the curriculum.

4) the project is managed and contextualized through a set of fourth-year courses offered in the Division of Technology, Culture, and Communication (the titles are “Western Technology and Culture” and “The Engineer, Ethics, and Society”).

5) the project is organized so that students can have the benefits of doing an individual thesis while also participating as part of a group research or design project. In other words, many students work in groups (including multidisciplinary groups) and base their individual theses on some aspect of their particular contribution to the group effort. Thus, they get the value of both individual reflection and performance and participation in a group effort.
When the Accreditation Board for Engineering and Technology (ABET) first published its Engineering Criteria 2000 for discussion, Rose-Hulman Institute of Technology decided to use the occasion to reexamine its humanities and social sciences requirements, since some of those requirements were the result of ABET limitations on skills courses, for example. After two years of discussion a new set of requirements was established, which represented the important elements of the non-engineering and science qualities sought as outcomes of engineering education in Criterion 3 of EC 2000. Retained was the requirement of a total of nine HSS courses, including a course in Rhetoric and Composition (RH 131). The remaining eight courses were divided into four categories, with students required to take two courses in each category. The categories are: Rhetoric and Expression (RH), Global Studies (GS), Self and Society (SL), and Values and Contemporary Issues (VA). RH courses fit with EC3g—“an ability to communicate effectively.” GL and SL courses fit with EC3h—“the broad education necessary to understand the impact of engineering solutions in a global and societal context.” VA courses fit with EC3f—“an understanding of professional and ethical responsibility” and EC3j—“a knowledge of contemporary issues.” Students are able to make their selections from a large variety of electives offered within each category. A modified set of requirements was also established for students wishing to study a foreign language.

We believe this to be a “best practice” activity because the requirement structure accomplishes several goals. It focuses students on the types of outcomes they are to attain as a result of their education. It encourages HSS faculty members to develop courses which accomplish ABET’s goals. It makes it visible for visiting accreditors that all engineering students are at least being exposed to the types of experiences which ABET has deemed necessary parts of an engineering education.

For over thirty years Rose-Hulman Institute of Technology has offered a four-year program in German technical translation to complement our students’ engineering education. The program consists of twelve courses, yet is designed to enable students to graduate within the normal four year time frame. The first six courses are typical introductory language courses, but with a heavy cultural component. Students who have studied German in high school are able to test into any of these courses. From the seventh course on students are introduced to techniques of technical translation, culminating in a final translation project, alongside more advanced language and cultural studies. Students completing the four-year program receive a certificate in technical translation at graduation. Many students take some of their required courses at summer programs in Germany or through a junior year abroad program. About a dozen students complete the program each year.

The University of Rhode Island offers a combined five year program for dual majors in German and Engineering. While this is also an exceptional program, we consider our program a “best practice” because it meets the desire of our engineering students to enter the job market after four years, while simultaneously providing the benefits of a program which is close to being the equivalent of a major. The program has many benefits. It exposes the students in depth to another culture. It aids them in the job market when they can show dual skills. It provides most
of them with an overseas experience. It increases the likelihood of obtaining an overseas
assignment during their careers. It means they are required to take a total of 15 HSS courses
rather than the normal nine. Although very few of our technical translation students become
translators rather than engineers, they almost all have found their language study career
enhancing. A further benefit is that the program encourages many more students to begin the
study of foreign language, even if they don’t complete the program.

Most engineering students do not have the opportunity to study abroad, either because of
financial or time constraints, because of lack of interest or opportunity, or because they lack the
required language skills. Studies have shown that even a short overseas experience can enhance
engineers’ global awareness throughout their careers. In recognition of that, Rose-Hulman
Institute of Technology last year instituted a new program of courses which combine on-campus
study with a short overseas trip. Students spend 16 class hours on academic course work on a
particular country and then take a ten-day trip to the foreign country with their instructor, either
during Spring break or at the beginning of summer. Academic reading about the country is done
before the trip. During the trip the instructor then lectures extensively on site and students keep
a journal. After the trip students then meet again as a class for several hours and complete a term
paper project. Last year classes about Mexico and Japan were successfully conducted, with
additional classes to Spain, England, and Germany being in the planning stages.

We consider this program, even though it is still in its initial phases and some non-HSS faculty
still need to recognize its value, to be a “best practice” activity for the following reasons. It
allows students to have a meaningful overseas academic experience while still permitting them to
seek summer employment. It enables students not studying a foreign language to have an
experience of a foreign country which is not simply that of a tourist. It encourages students to
participate since they will get academic course credit for their experience. It attracts students
who would otherwise not contemplate visiting a foreign country. It encourages the necessary
financial support from parents, since it is a recognized college activity. It accomplishes, in a
meaningful way, one of ABET’s accreditation goals.
While Clarkson University is a technological university, 40% of its students major in non-engineering areas, including business and the humanities and social sciences in addition to mathematics and science. Nevertheless, the committee working on the revision of the general education program for all students has found EC 2000 Criterion 3 to be a compelling framework for the learning outcomes – particularly those in the humanities and social sciences – that should be achieved by all students. The final product will be a revised humanities and social sciences program for all students that particularly serves those in engineering because its origins in and links to EC 2000.

Revised Humanities and Social Sciences Requirement for All Students

Over the past two years Clarkson has been revising its general education program in response to two imperatives – our “Vision of a Clarkson Education” and the new ABET Criteria. The “Vision of a Clarkson Education” states that in addition to developing students’ mastery of the core knowledge of their fields, Clarkson’s educational process will provide students with opportunities to:

· develop and refine exceptional communication skills, including written, spoken, interpersonal, and graphic
· develop an awareness of cultural differences
· work within teams, both as leaders and team members
· participate in experiential learning, particularly interdisciplinary projects
· attain mastery of computing and information technologies

This “Vision” emerged from a major strategic planning exercise in the mid-1990s that was heavily influenced by a series of studies, reports, and initiatives during this period that called for a fresh understanding of engineering practice and a consequent reconceptualizing of engineering education. ABET Criterion 3 (a-k), itself a product of these same influences, articulates a set of learning outcomes that span technical and non-technical fields. This combination of process goals and learning outcomes constitutes a framework within which an old-style general education program – take one of these, two of those, etc. – can be reformulated into a different type of general education experience.

Clarkson’s current general education program, called the Foundation Curriculum, is old-style, listing distribution requirements with no explanation and consequently no sense of coherence or integration, and the revision that is underway is intended to produce a better explained and more coherent and integrated program of activities and courses. During 2001-2002, a university committee began work on the revision, and it developed a set of global learning goals for all Clarkson students which was approved by the Faculty Senate at the end of the year. These global goals are as follows:
I. ACADEMIC ABILITIES
Students will:
- Communicate effectively, producing and comprehending written, oral and technological forms of communication within a variety of contexts
- Think critically and imaginatively
- Comprehend, analyze and solve complex problems
- Carry out rational, logical analysis that is contextual
- Employ appropriate quantitative skills

II. SELF AND SOCIAL AWARENESS
Students will develop:
- Insights into personal behavior
- An understanding of the nature of conflict and its resolution
Students will increase:
- Awareness of the need for self-motivated life-long learning
- Social awareness and interpersonal competence
- Awareness of influences that shape personal identity

III. KNOWLEDGE
Students will:
- Have a knowledge of contemporary issues
- Understand the nature of cultures and societies, others and their own
- Gain an awareness of the past
- Understand the nature of imaginative arts and their role in society
- Develop an understanding of personal, societal, and professional ethics
- Understand the nature of science and technology, including their relationship to society and their impact on the environment
- Understand economic and organizational concepts and decision-making

During 2002-2003, the committee has been engaged in the task of translating these global learning goals into specific learning outcomes and identifying methods(s) for achieving these. So, while the replacement for the Foundation Curriculum, which has the working title of the “Clarkson Common Experience,” has not yet been completed nor implemented, its general shape is clear. Equally clear are its ties to both the Clarkson “Vision” and ABET Criterion 3 (a-k).

During 2001-2002, faculty in the humanities and social sciences also engaged in a revision of our contribution to the general education program. The fact that a humanities and social sciences faculty member served on the university committee meant that we were aware of the committee’s work as well as able to influence it, as will be evident in the results of our work. We asked ourselves, “Of the vast range of contributions that the humanities and social sciences can make to Clarkson students’ education, which are so central they should be included in the general education program?” The answer consists of a set of process objectives, which identify abilities and habits of mind that can be fostered in H&SS courses, and a set of content objectives, which identify broad categories of learning that can be addressed in H&SS courses.
The process objectives are:
- Effective communication, both written and oral
- Critical thinking
- Ethical reflection and understanding
- Cross-cultural competence, by which is meant an ability to effectively respond to cultural differences

The content objectives are:
- Knowledge about past civilizations and societies
- Understanding of modernity and its origins
- Appreciation of the imaginative arts
- Knowledge about other cultures, race, ethnicity, and gender
- Understanding of science and technology in their cultural context

The department has traditionally espoused many of these learning outcomes within its courses, but the “ethical reflection & understanding” and “cross-cultural competence” process objectives and the “knowledge about other cultures, race, ethnicity, and gender” and “understanding of science and technology in their cultural context” content objectives are additions that ultimately stem from EC 2000 Criterion 3. The department’s commitment is that over time all of its courses will reflect the process objectives and that its curricular structures will maximize students’ experience re the content objectives. These goals for the humanities and social sciences component of Clarkson students’ education not only are manifestly congruent with the emerging “Clarkson Common Experience,” but also with ABET Criterion 3.

**The Interdisciplinary Thematic “Turn”**

In order to facilitate achievement of the process and content objectives for HSS within the new “Clarkson common experience,” we have organized our HSS courses into interdisciplinary thematic groups. These are entitled: “International & Cross-Cultural Perspectives,” “Science, Technology & Society Studies,” and “American Studies.” New course development and decisions about course offerings now take into account the number and composition of internationally-themed courses, or STS courses, for example, rather than focusing on disciplinary distribution. Although students will still freely choose among humanities and social science electives, their courses will necessarily be focused on issues and topics that are related to engineering design and practice.

Building on this thematizing effort, we have introduced a set of elective minors in our thematic focus areas: “International & Cross-Cultural Perspectives,” “Science, Technology & Society Studies,” and “American Studies.” These themes are particularly apt for students in Clarkson’s professionally oriented programs, and the scope of a minor will provide students with an extended experience with the integration of HSS concepts and perspectives with professional issues and concerns.
The Guy T. McBride, Jr., Honors Program in Public Affairs for Engineering Students, instituted in 1978 through a grant from the National Endowment for the Humanities, is a 24 semester-hour program of seminars and off-campus activities that has this primary goal: To provide a select number of engineering students the opportunity to cross the boundaries of their technical expertise and to gain the sensitivity to prove, project, and test the moral and social implications of their future professional judgments and activities not only for the particular organizations with which they will be involved, but also for the nation and, indeed, the world.

To achieve this goal, the program seeks to bring themes from the humanities and the social sciences into the engineering curriculum that will encourage in students the habits of thought necessary for effective management and enlightened leadership.

Unique Curriculum

Designed by teams of faculty members from the humanities, social sciences, sciences, and engineering, the curriculum of the McBride Honors Program features the educational experiences listed here.

Seminars

Students take a series of honors seminars that explore HSS concepts and methods in depth, as well as bring them to bear on the issues of a technological society.

Freshman Year - Spring Semester
   Paradoxes of the Human Condition: Reflections in the Humanities, or
   Paradoxes of the Human Condition: Expressions in Fine and Performing Arts, or
   Paradoxes of the Human Condition: Reflections in American Culture

Sophomore Year - Fall Semester
   Cultural Anthropology: A Study of Diverse Cultures

Sophomore Year - Spring Semester
   Comparative Political and Economic Systems

Junior Year - Fall Semester
   International Political Economy, or
   Technology and Socio-Economic Change

Junior Year - Spring Semester
   U.S. Public Policy: Domestic and Foreign, or
   Foreign Area Study

Junior Year - Summer
McBride Practicum
Senior Year - Fall Semester
Study of Leadership and Power

McBride Summer Practicum
A central experience in the program is the Practicum, which comes during the summer following the junior year. Leadership and management demand an understanding of the accelerating pace of change that marks the social, political, and economic currents of society. While all the seminars in the program are designed to nourish such an understanding, the goal of the Practicum is to put students into situations where they can observe firsthand management and decision-making processes of the kind that will challenge them in their professional lives. Practicum options include an internship with a corporation, government entity or non-profit or travel abroad to an area of the world that the students have studied the previous semester. Currently, the areas on the study abroad rotation include China, Chile, Turkey, Southeast Asia, Brazil, and South Africa. Travel is subsidized by the program.

Admission: Leadership, Versatility, Communication
The McBride Honors Program seeks to enroll students who can profit most from, and contribute most to, the learning experiences upon which the program is based -- the idea being to bring bright young minds into situations where they will be challenged not only by the faculty, but also by their colleagues. Whereas many more conventional honors programs admit students almost exclusively on the basis of academic record, in the McBride Honors Program test scores, grade point, and class rank form only part of the criteria used in the admission process. Students must demonstrate their leadership potential, versatility of mind, and writing and speaking abilities through an essay and through an interview with two faculty members.

Although the educational experiences in the McBride Honors Program are rigorous and demand a high degree of persistence from the students, CSM graduates who have completed the program have gained positions of their choice in industry more easily than others and have been quite successful in winning admission to high-quality graduate and professional schools.

Mission and Goals

In preparing to become leaders, students completing the McBride Honors Program should possess the following skills, knowledge, and values:

Skills
- They should be able to communicate effectively, orally and in writing, to a variety of audiences.
- They should be competent in the art of civil discourse.
- They should be able to work effectively both alone and in teams.
- They should have the ability to analyze and critically evaluate both their own ideas and those of others.
Knowledge

- They should possess the knowledge necessary to explore the relationships among economic, political, social and cultural systems, an ability central to the mission of the Program.
- Whenever possible, they should have first-hand experience of the concepts discussed in their seminars through internships, overseas experiences, in-depth research, and community service.

Values

- They should be persons of high principle and character.
- They should develop reflective minds.
- They should accept personal responsibility for their actions as leaders, as professionals, and as citizens.
- They should be aware of and sensitive to diverse languages, cultures, and beliefs, both in this country and abroad, through direct experience wherever possible.
- They should exhibit a love of learning and the promise of continuing it throughout their lives.
- They should appreciate interconnectedness in the changing world.
APPENDIX K: THE PICKER ENGINEERING PROGRAM  
AT SMITH COLLEGE  
(Submitted by Borjana Mikic)

Smith College is the only all-women’s college in the U.S. to offer an engineering degree, and one of only a handful of liberal arts colleges to do so. Students interested in majoring in engineering can pursue a B.S. degree in engineering science: no other specialized degrees are offered. The average course load at Smith is four courses per semester for a total of 32 courses for graduation. The engineering curriculum consists of 5 courses in mathematics, 4 courses in the sciences (including chemistry, physics, and computer science), 10 core engineering courses, and 3 upper level technical electives to serve as a concentration in Civil, Environmental, Electrical, Mechanical, or Biomedical Engineering. Students can also propose their own concentration for consideration and approval by the faculty. In addition, students majoring in engineering are required to fulfill a breadth requirement, either by satisfying a Latin Honors Distribution (one course in each of seven general areas of knowledge, including a year long course in a foreign language) or by submitting a proposal describing an alternative approach to acquiring curricular breadth. In total, over one third of the undergraduate curriculum for engineering science majors is reserved for courses in the humanities and social sciences.

The stated ABET Program Objectives for the Picker Engineering Program are deeply contextualized by the liberal arts: graduates will incorporate their knowledge and understanding of the natural sciences, humanities, and social sciences in the application of their engineering education; apply their engineering education in service to humanity; consider the impact of their professional actions on society; demonstrate leadership in their personal and professional endeavors; and engage in continuous learning and self-discovery. At the same time, the program is technically rigorous so that students can successfully enter the engineering profession or graduate school should they choose to do so. No undergraduate engineering curriculum can provide a student with all of the technical knowledge that she will require as a practicing engineer. Consequently, the curriculum should aim to educate students in fundamental principles, provide them with the ability to understand assumptions and limitations, an understanding that learning is a continual process, and impart to them the importance of carefully defining and considering the constraints within which engineering problems are formulated, be they technically, socially, or culturally defined.

In addition to providing a greater number of opportunities for courses in the humanities and social sciences, the approach at Smith aims to further integrate engineering and the liberal arts in a number of other ways. Of the seven faculty in the program, two have advanced degrees which cross over into HSS (technology and public policy), while a third individual has a joint appointment in the department of education and child study. Most core and elective courses integrate elements of HSS into the technical content of the course. For example, in Introduction to Engineering, students not only engage in a semester-long design project, but they write about and discuss a variety of readings related to the impact of engineering on society and present in teams on contemporary issues of their own choosing related to the impact of technology on society. In Thermodynamics, students learn the historical context for the development of the first and second laws, and are required to write reflections on how thermodynamics relates to their everyday lives. In addition, all Smith engineering students are required to take a class entitled
Engineering, the Environment, and Sustainability, where they learn the global and temporal implications of engineering endeavors.

Smith College has a very strong junior year abroad program, with approximately 50% of students at the college taking advantage of this opportunity. In most engineering programs, study abroad is difficult to achieve because of the intense course requirements for engineering majors. At Smith, engineering students are encouraged to study abroad in order to gain a greater appreciation for the impact of different cultural factors on the formulation of engineering problems.

In summary, the B.S. degree in Engineering Science offered by the Picker Engineering Program at Smith College represents a “best practice” for the integration of engineering and the liberal arts for the following reasons: (1) over one third of the curriculum is reserved for courses in the humanities and social sciences; (2) majors are required to demonstrate breadth in their undergraduate course work by satisfying the Latin Honors Distribution; (3) most engineering courses integrate components of the humanities and social sciences into the technical course content; and (4) students are encouraged and able to study abroad. Perhaps most importantly, however, is the commitment on the part of the engineering faculty to viewing the critical thinking skills that come from the humanities and social sciences as being equally valuable as technical knowledge in the education of engineers who are dedicated to applying their education in service to humanity.