Industrial Engineering and Operations Research
NATIONAL POLLUTION PREVENTION CENTER FOR HIGHER EDUCATION

Course Syllabi

- *Environmental Science and Public Policy: Reducing Industrial Waste*
  William Clark and Robert Frosch, Harvard University
- *Clean Fuels and Clean Technology: The Technical, Environmental, and Policy Issues.*
  Rex T. Ellington, University of Oklahoma
- *Pollution Prevention*
  Robert B. Pojasek, Tufts University
- *Hazardous Material/ Waste Management*
  Wayne C. Turner, Oklahoma State University

National Pollution Prevention Center for Higher Education • University of Michigan
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Industrial Engineering and Operations Research

NATIONAL POLLUTION PREVENTION CENTER FOR HIGHER EDUCATION

Environmental Science and Public Policy: Reducing Industrial Wastes

William Clark and Robert Frosch

ESPP 98/ENR 204, Spring 1994

John F. Kennedy School of Government, Harvard University

National Pollution Prevention Center for Higher Education • University of Michigan
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ESPP98 / ENR204 -- Spring 1994

Environmental Science and Public Policy: Reducing industrial wastes

T 1:00-3:00 -- Hoffman Lab Penthouse (Adjoins Peabody Museum)
[LIMITED ENROLLMENT: All interested attend first session]

Syllabus (January 25, 1994)

1 Introduction to the course

Outlines the objectives, approach and expectations of the course. Sketches a framework for analysis of public policy interface with technical dimensions of waste production and management. Substantive discussion focuses on a number of paradoxes of waste reduction efforts, summarized in a handout.

Part I: Science and engineering issues

2 Waste production: An overview

Provides an overview of the waste production problem, distinguishing flows associated with raw material acquisition, industrial production, and end use consumption. Introduces typology of recoverable vs dissipative material flows. Illustrates trends with time, and across countries.

3 Waste flows from a product life cycle perspective: The case of the modern automobile

Examines the material flow, waste and recovery streams inherent in production and use of the automobile. Case selected as an illustration of a relatively well-integrated product cycle in which a high fraction of wastes have either been eliminated through green design or are recovered for reuse.

4 Waste flows from a regional perspective: The case of cadmium in the Rhine Basin

Develops a systems perspectives on the multiple sources, pathways, and sinks for a single industrial chemical (cadmium) in a large river basin. Traces changes through time on the relative importance of production- and consumption-related sources of the waste stream.

Part II: Policy Perspectives

5 Economic dimensions of industial waste reduction

Examines the economic dimensions of the industrial waste problem. Includes discussion of relative costs of alternative waste reduction, disposal, and recycling technologies, pricing of externalities associated with

waste, and impact of on waste treatment of liability rulings.

6 Legal and regulatory dimensions of industrial waste reduction

Explores the impacts of alternative legal definitions of industrial wastes and hazards. Considers the unintended consequences of current regulations for industrial ecology.

7 Organizational intelligence for waste reduction

Considers the role of information and non-economic incentives in waste reduction. Special attention paid to the utility of regional electronic "clearing houses" for waste producers and users, such as proposed by the Chicago Board of Trade. Looks at role of accounting and reward structures within corporations for encouraging innovations in waste reduction.

Part III: A field study in industrial waste reduction

The class will study in depth the waste management problems and prospects of a major manufacturing company in the Boston area. The study will involve a visit to the company, as well as discussions with key staff.

8 Introduction to wastes in the XX Company

Senior official from XX provides an overview of waste problems and management efforts at the Company.

9 Site visit to XX Company

Class visits XX, observes general flow of materials, conducts small group interviews with relevant officials concerning efforts at, opportunities for, and obstacles to waste reduction.

10 Analysis of site visit experience

Student teams report on data gathered on Company XX. Class discussion of prospects for improvements, plus relative importance of economic, regulatory, information barriers to improvements in performance.

Part IV: A Massachusetts Commission on Industrial Waste Reduction

The major class exercise will be a simulation of a governor's advisory commission on public policies to enhance waste reduction in Massachusetts' industries. Class members will be broken into groups and given their charge as commission members early in the term. Subsequent meetings, in and out of class, will pave the way for presentation and discussion of the commission's findings.

11 Presentation of Commission findings in class
Teams will present their findings to the class and answer questions from a panel of critics.

12 Retrospective on Commission findings and the prospects for reducing industrial wastes.

John F. Kennedy School of Government
Harvard University

MEMORANDUM

March 8, 1994

To: ESPP98 / ENR204 Students

From: Bill Clark, Bob Frosch (L-360; 5-3981)

Subject: **The Commission on Managing the Industrial Ecosystem**

As an exercise to explore the intersection of environmental science and public policy, and as a vehicle for development of your term papers, you will serve for the remainder of this term on a (simulated) Commission on Managing the Industrial Ecosystem. The purpose of this note is to set forth the terms of reference for the Commission and its schedule of tasks. [In fact, three Commissions have been established, each with an identical charge. You will conduct your work and report out your results in parallel.]

Convenor: The Commission has been convened by the New England Governors' Council, a bi-partisan coalition of Governors from each of the region's states.

Motivation: Three factors have motivated the Governors to establish the Commission:

* First, business, state and local governments and environmental groups alike have been expressing increasing dissatisfaction with the current management system. Regulations have grown increasingly complex, costs of waste disposal are rising, and yet many citizens do not feel that they are being protected from risks associated with industrial wastes.

* Second, experience with some product lines (eg. automobiles) and some policy experiments abroad (eg. Germany's takeback requirements) have led the Governors to believe that radical improvements in the management of the region's industrial ecosystem might in fact be accomplished.

* Third, the upcoming review of Federal legislation pertaining to industrial wastes provides an opportunity for the states to help shape the national policy within which the management of New England's industrial ecosystem is embedded.

Charge: The Commission has been charged by the Governors with developing a vision of how the region's industrial ecosystem should evolve into the next century.

Consistent with their commitment to an economically vibrant and environmentally responsible future for New England, the Governors seek an inspiring but realistic set of goals

to guide the evolution of the industrial ecosystem, and a strategy laying out the most important actions needed to implement those goals. The Governors are unanimous in their conviction that government alone can not do the job. They therefore have instructed the Commission to consider actions needed from the private and non-governmental, as well as public sectors. They want a short, hard-hitting, but authoritative report on which they can base a region-wide campaign of education, research and development, monitoring, legislation, and corporate action. The Commission is invited to address any or all of these dimensions of industrial ecology problems and opportunities.

Composition: In keeping with the charge outlined above, the Governors have appointed Commission members (ie. you) representing the public, private, and non-governmental sectors. A distinguished and nonpartisan public servant has been asked to chair the Commission.

All members have been asked to serve in their individual rather than institutional capacities. The Governors are clearly hoping for a report that accommodates the views of, and can thus be endorsed by, the wide range of constituencies represented in the Commission's membership. A list of Commission members is appended to this note.

The work of the Commission: The Commission will produce 3 major products:

1) Final report (Summary only): The Commission will produce a 10 page Executive Summary of its findings. This will include, inter alia, a restatement of the charge, a diagnosis of the present situation and prognosis for the future, and a statement and defense of recommendations. Recommendations can entail actions on the part of all sectors of society. At the Commission's discretion, they may entail both direct interventions in the flow of industrial materials, and the building of capacity through research and monitoring programs, the design of institution, or the conduct of educational programs. Keep in mind, however, that the Summary report should highlight only the most important strategic initiatives that the Commissioners believe should receive priority attention from the Governors. Laudry lists will not be appreciated. The final report summary, as presented to the Governors, should be produced and approved jointly by the Commission members. It should not exceed 10 pages (4000 words) in length.

2) Staff papers -- the Commission's list: Like virtually all Commissions, this one will need to procure a number of technical staff papers to support its analysis and recommendations. The Commission as a whole will be required to develop a list and short (ie. less than 200 words) "abstract" of the 10 staff papers it judges most important to its work. Some of the abstracts will be produced by individual Commission members as part of their own work for the Commission (see below). Others will have to be prepared on an ad hoc basis by the Commission as a whole. Each abstract should convey why the paper has been selected for priority attention by the Commission.

3) Staff papers -- individual contributions: In addition, each Commission member will be responsible for preparing one staff (ie. term) paper in full. (Actually, Commission members may collaborate in groups of 2 or 3 in producing their staff papers,

upon approval of the Governors). These papers should provide background for and help to illuminate the work of the Commission. Final drafts should be about 12,000 words in length (and not more than 16,000).

In carrying out its work, the Commission should strongly consider addressing the following issues:

1) What should be the goals of the region's industrial ecosystem? What are we trying to accomplish?

2) What kinds of changes in technologies, institutions, behavior and knowledge are needed to meet these goals? In particular: What should government do? What should industry do? What should environmental groups do?

A possible approach to these questions would be to begin with the Commissioners representing the industrial sector proposing what industry should do, those from government proposing what government should do, etc. The Commission could then move on to examine, as a group, the "systems" consequences of each sector's proposed actions. Finally, it could move from this analysis to a specification of what additional actions are needed in order that overall goals are achieved.

Schedules and Procedures: Three formal meetings of the Commission have been scheduled, together with a number of briefings by outside experts and a site visit to an industry wrestling with industrial ecology challenges. Additional working sessions of the Commission will almost certainly be necessary, and should be arranged and scheduled as needed by the Commission members. Scheduled meetings are summarized immediately below, and discussed in more detail in the following paragraphs. Unless otherwise noted, all meetings and briefings take place in Hoffman Lab from 1-3pm:

Summary Schedule:

February 15 - March 1: Technical briefings
March 8: First formal meeting of the Commission
March 15: Briefings on regulatory and economic issues
March 22 **(10am-3pm)**: Site visits to affected industries
[Term paper prospectus due]
March 29: Spring break
April 5: Progress report of Commission to Governors
[Term paper outline due]
April 12: Expert witnesses: topics defined by Commission
April 19: Expert witnesses: topics defined by Commission
April 26: Final Report of Commission presented to Governors
May 3: Response of Governors to Commission
May 17 **(5pm)**: Supporting papers due

Formal Commission Meetings:

1) Final presentation: Presentation of final report to Governors (April 26): At that time, the Commission will deliver a 20 minute oral presentation, backed by a 10 page written Summary, abstracts (ca. 300 words each) of all 10 staff papers requested by the Commission, and copies of any presentational materials. Questions and comments from the Governors will begin then and continue a week later. Staff (ie. term) papers requested by the Commission should be drawn on in this presentation, and abstracts should be presented with the Executive Summary. Final drafts of the full papers are not due with the Governors until 5pm on May 17.

2) First meeting: The first formal meeting of the Commission is scheduled for March 8. The Governors will welcome the Commissioners and give them their formal charge. Commission members will be introduced to each other. A schedule of subsequent meetings and task assignments will be developed by the Commission;

3) Progress report (mid-term) meeting: A report on the Commission's progress is due to the Governors on April 5. This should include:

a) a written outline of the planned report (less than 3 pages);

b) a written list of the 10 most important staff papers chartered by the Commission, with a paragraph justifying each and reporting on its status (ie. being developed by a Commission member, or sought from the existing literature);

c) an oral presentation (less than 15 minutes) of the above.

Briefings: The Commission will receive a number of informal briefings from relevant experts in the course of its work:

1) In anticipation of their appointment to the Governors' Commission, most members have been attending over the past month a series of informal technical briefings on industrial ecology run by Dr. Robert Frosch of the National Academy of Engineering (February 15 and 21, and March 1).

2) Economic and regulatory dimensions of industrial waste management will be addressed by expert witnesses to the Commission on March 15.

3) Briefings on other topics, or more detailed discussions of topics already touched on, may be requested by the Commission in the course of its work.

Written submissions: Several written submissions are expected from the Commission as a whole and from its individual members:

1) By the Commission as a group:

a) April 5: Accompanying the oral presentation of its progress report, the Commission will submit i) a written outline of the planned report, stating what topics will be covered with what approach (less than 3 pages); ii) a written list of the 10 most important staff papers chartered by the Commission, with a paragraph justifying each and reporting on its status (ie. being developed by a Commission member, or sought from the existing literature).

b) April 26: Accompanying the oral presentation of the final report, the

Commission will submit i) a 10 page Summary of its findings and recommendations; ii) abstracts (ca. 300 words each) of all 10 staff papers requested by the Commission, whether these are written by Commission members or drawn from the existing literature; and iii) copies of any presentational materials. [Note that the full report of the Commission is indeed a fiction and need not be written].

2) By individual Commission members:

a) March 22 (10am): A one page prospectus for each member's "staff" (ie. term) paper must be turned in for discussion with and approval by faculty.

a) April 5: An extended (ca. 5 pages) outline of each member's "staff" (ie. term) paper must be submitted in class. This should include a 1-pg. draft Executive Summary of the paper, and the identification of major sources of information (ie. principal articles, data sets, or interviews) on which the final report will be based.

b) May 17: A final draft of each member's "staff" (ie. term) paper must be submitted by 5pm. [Target ca. 12,000 words; must be less than 16,000].

--- Finally, back in the world... ---

Grading: Grading for the course will be based on individual and group participation [40%], the extended outline of the term paper [10%], and the final draft of the term paper [50%].

In fairness to others in the class, late submissions of the written material will be penalized at a rate of 20% of the submission's value per day (eg.. a final paper presented one day late will receive at most a weight of 40 out of 100 points to the final grade).

Participation grades will be informed by anonymous rankings of individual contributions to the Commission's work provided by each Commissioner's peers in his/her group. Rankings will be performed in class after the Progress Report presentation and again after the Final Report presentation.

SAMPLE TOPICS FOR STAFF PAPERS

* The current industrial structure of the region.

* A vision for the future industrial structure of the region.

* The current uses and flows of materials in the region. (Possibly for some particular material or materials.)

* Desirable/proposed changes in the uses and flows of materials in the region. (Possibly for some particular material or materials.)

* Waste disposal and pollution problems of the region.

* The current regulatory system for industrial waste in the region.

* Alternative possibilities for pollution prevention and the regulation of industrial waste in the region.

* An economic incentives system for waste minimization. (Waste prevention, waste reuse.)

* Are scrap and waste materials an asset or a liability for industrial competitiveness?

Industrial Engineering and Operations Research

NATIONAL POLLUTION PREVENTION CENTER FOR HIGHER EDUCATION

Clean Fuels and Clean Technology: The Technical, Environmental, and Policy Issues

Rex T. Ellington

HON 3993, May 1994

University of Oklahoma

National Pollution Prevention Center for Higher Education • University of Michigan
Dana Building, 430 East University, Ann Arbor MI 48109-1115
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Ellington
February 1995

HON 3993 002

Clean Fuels and Clean Technology: The Technical, Environmental, and Policy Issues

Dr. Mark Meo and Dr. Rex Ellington

Course Description:

Clean fuels and clean technologies are widely perceived to be essential to world economic development. This colloquium is designed to provide undergraduate students in any major with an appreciation of how technology and policy have evolved in response to rising national and international demands for environmental quality, and the roles that technical and policy criteria play in guiding planning, management, and decision making. The discussion will focus on: (1) The challenges placed on industry to develop fuels and technologies with which economic development can proceed in a more environmentally-benign and sustainable manner, and (2) The evolution in public policy that has sought to place a value on natural resources that is commensurate with their services to society. A probing type of study will be employed to teach students how to analyze complex issues and expand their horizons. Discussion topics will include examination of energy systems and applications, technological innovations for minimizing material and energy use, the evolution of business and public policy issues, institutional frameworks and management strategies, assessment criteria, and the research and development agenda. The course is an interdisciplinary one that is led by a professor with a background in ecology, environmental science, and public policy analysis and a professor emeritus of chemical engineering who has substantial experience in corporate leadership and management.

Requirements:

Students will be asked to prepare two brief papers, midterm and final, based on assigned readings, handouts, and class discussion. Access to reference and special library materials will be facilitated by the instructors.

Reading List:

"Energy for Planet Earth," Scientific American, Vol. 263, No. 3, September 1990.

U.S. Congress, Office of Technology Assessment, Green Products by Design: Choices for a Cleaner Environment, OTA-E-541 (Washington, DC: U.S. Government Printing Office, October 1992).

Additionally, selected readings from books and journals will be assigned.

Industrial Engineering and Operations Research
NATIONAL POLLUTION PREVENTION CENTER FOR HIGHER EDUCATION

Pollution Prevention

Robert B. Pojasek
CE-194J, Spring 1994
Tufts University

Department of Civil/Environmental Engineering
TUFTS UNIVERSITY

CE-194J Pollution Prevention
Instructor: Dr. Robert B. Pojasek

Spring 1994

COURSE DESCRIPTION

Rather than designing water, air, and waste treatment facilities, engineers are often asked to help prevent the generation of these wastes. Tools for understanding, communicating, and managing industrial manufacturing processes are presented using actual cases. Practical problem-solving methodologies are incorporated using a rigorous engineering framework of problem assessment data management, feasibility study, and implementation.

This is a "hands-on" course where the student will learn by actually working on a pollution prevention project. In lieu of a final examination, the student will work in a small group to evaluate a designated manufacturing facility. Together they will prepare process flow diagrams, materials accounting summaries, a description of all of the opportunities for pollution prevention, and a rank ordering of these opportunities. Each student in the group will then research one of the primary opportunities, conduct a feasibility study, and make recommendations for implementation. Using a pollution prevention project in an actual facility allows students to exploit the knowledge they have learned about pollution prevention methods. Creative problem-solving and quality improvement procedures are introduced in the context of pollution prevention. The course includes examples of changing operating practices, materials substitution, process/product changes and recycling/reuse. Proper use of the engineering method for planning and implementing pollution prevention is stressed.

COURSE SCHEDULE

1. January 24, 1993 INTRODUCTION TO POLLUTION PREVENTION

Without dwelling extensively on the terminology and definitional problems that currently exist in this emerging field, some generic pollution prevention theories and concepts will be presented. These concepts will include chemical use cycles, the waste management hierarchy, shifting media, materials use and loss control, efficiency concepts, and broader concepts of sustainable development. Incentives and impediments to the use of pollution prevention practices in industry will be examined along with pressures that have been brought to bear to induce facilities to utilize these practices. No attempt will be made to examine specific pollution prevention legislation or regulations.

2. January 31, 1994 UNDERSTANDING MANUFACTURING AND MANAGEMENT

Emphasis in this course is placed on pollution prevention in manufacturing. All manufacturing categories have commonalities which, when recognized, allow the pollution prevention practitioner to apply the concepts described in the previous class without regard to the type of industry. Consideration must be given to the product life cycles and the supplier/customer connections. The manner in which manufacturing is managed is a key to the successful implementation of pollution prevention. Understanding the culture of the organization is very important. Analogous management programs (such as quality improvement, just-in-time and computer integrated manufacturing) will be discussed along with a model for manufacturing for competitive advantage in a global marketplace.

3. February 7, 1994 PREPARING FOR AN ASSESSMENT

Process mapping is utilized to help develop a picture of the process or operation being examined for pollution prevention. Resolving the differences between the way different people see the process and what is actually happening is a valuable activity. A variety of mapping and other visualization techniques will be evaluated along with analogies to road maps and electrical schematic diagrams. Using process flow diagrams to help understand process functionality is at the heart of the descriptive approach to pollution prevention assessments. Conducting materials accounting and activity-based costing activities and looking at ancillary/intermittent operations using the process flow diagram as a template are skills that are required for a proper assessment.

4. February 14, 1994 CONDUCTING THE FACILITY ASSESSMENT

To conduct a successful pollution prevention assessment, one must learn to become a good EXPLORER. Utilizing prescriptive tools (i.e., checklists, worksheets and questionnaires) for conducting assessments have many problems associated with them. Process flow diagrams and materials accounting are the keystone of a descriptive approach to pollution prevention. It is important that the facility assessment identify all the losses from the process or operation. Documentation of the assessment will be discussed.

5. February 23, 1994 (Wednesday) DEVELOPING POLLUTION PREVENTION OPPORTUNITIES

An ARTIST takes information gathered from the assessment and uses graphical techniques to present the data and find trends. Every loss identified in the assessment is an opportunity not to have that loss. A variety of quality improvement tools can be used to describe the opportunity and to qualify which opportunities are most important. Criteria for screening and various techniques for prioritizing the opportunities will be explored.

6. February 28, 1994 PREPARING FOR THE FEASIBILITY STUDY

Avoiding the search for "right answers" is the key to proper preparation for a feasibility study. Use of brainstorming, storyboarding, mindmapping, and computer simulation

are important to derive as many alternatives for each pollution prevention opportunity selected to study. Categories of alternatives that will be discussed include the following: operating practices, materials substitution, process/product change and recycle/reuse. The importance of creative thought in this activity will be emphasized.

7. March 7, 1994 CHARACTERIZING THE ALTERNATIVES

Operating practices are often referred to as the "low hanging fruit" of pollution prevention. These are the easiest alternatives to implement and may often lead to the largest increments of reduction. Materials substitution is most frequently utilized by industry to move from listed regulated materials to unlisted materials. There are many cases where the substitute causes unanticipated problems or simply shifts the media of the lost material. Process change can range from equipment modification and process automation to quantum leaps in the manner in which an item is manufactured. Industrial ecology is a term used to examine the concept of recycling. There is often an overlap between recycling and treatment. Information resources will be explored.

8. March 14, 1994 MID-TERM EXAMINATION

9. March 21, 1994 NO CLASS-----SPRING BREAK------

10. March 28, 1994 CONDUCTING THE FEASIBILITY STUDY

Conducting the feasibility study is like being a JUDGE. Considering the specifics in each case is important. Criteria for screening alternatives will include effectiveness, implementability, and cost. Pollution prevention evaluations must avoid the use of "killer phrases." A more detailed analysis of the primary alternatives will consider engineering economics and institutional considerations. The need for bench and pilot testing must be determined at this time. All this activity will help establish a successful implementation program.

11. April 4, 1994 PLANNING FOR IMPLEMENTATION

Using continuous improvement and strategic planning concepts are important to get everybody moving in the same direction. A good plan will have measurements built into the implementation process. Benchmarking is often utilized in this planning effort. It is very important that the plan fit the culture of the firm. Regulations may have different planning requirements. Perhaps there is a way to have one plan and meet varied externally applied requirements.

12. April 11, 1994 IMPLEMENTATION

Implementing the alternatives selected in the feasibility study is often like being a WARRIOR. Instead of having to fight to get something implemented, teamwork, program integration, and proper preparation should help facilitate project and program implementation. Means for sustaining pollution prevention programs and leveraging them with other

management initiatives is quite important to maximizing the benefits associated with pollution prevention.

13. April 18, 1994 NO CLASS

14. April 25, 1994 DESIGN FOR X

It is always preferable to design pollution prevention into new processes and products. The "X" can stand for the following terms: environment, recyclability, disassembly, remanufacturability, reliability, durability, etc. These terms have been in use for a long time and are all related to one another. Problems with retrofitting and justifying the costs of capital improvements will be explored. Life cycle impacts of these changes will be discussed. **Note: The term papers will be due on this date.**

15. May 2, 1994 PLANTS OF THE FUTURE

Each of the important lessons learned in this course will be utilized to conjecture on the design of future facilities. The concept of breakthrough technologies will be explored. Roles of government, academia, industry and the investment community in moving in this direction will presented. Programs which currently exist to look at this issue will be evaluated. **Note: Course evaluation forms will be completed during this class.**

COURSE INFORMATION

Textbooks. There are four texts: "A Kick in the Seat of the Pants" by Roger von Oeck (ISBN 0-06-096024-8 pbk.); "21st Century Manufacturing" by Thomas G. Gunn (ISBN 0-88730-546-6); "Facility Pollution Prevention Guide," EPA/600/R-92/088, 1992; and "Guides to Pollution Prevention-The Paint Manufacturing Industry," EPA/625/7-90/005, 1990.

Additional reading materials will be handed out each week in class or be placed in reserve reading in the departmental library.

Class Schedule. Each class will begin promptly at 6:30 p.m. on the dates indicated above and will end at 9 p.m.

Grading. Each student will receive a letter grade based on the following components:

1. Mid-term examination = 40%
2. Term project = 50%
   - Group Report = 33%
   - Individual Report = 67%
3. Classroom Participation = 10%

Office Hours. Dr. Pojasek will be available one hour before every class, i.e., 5:30 to 6:30 p.m. He is also available by appointment and by telephone during the normal business day at the following location:

GEI Consultants, Inc.
1021 Main Street
Winchester, MA 01890
(617) 721-4097 (Voice Mail)
(617) 721-4073 (Fax)

CE-176 POLLUTION PREVENTION MANAGEMENT

Catalog Description

Rather than designing water, air and waste treatment facilities, engineers are often asked to help prevent the generation of these wastes. Tools for understanding, communicating and managing industrial manufacturing processes are presented using actual cases. Practical problem-solving methodologies are incorporated using a rigorous engineering framework of problem assessment, data management, feasibility and implementation. Senior standing and engineering or physical science background. Pojasek. Spring.

Rationale

Using a pollution prevention project in a designated manufacturing facility, allows students to exploit the knowledge they have learned about pollution prevention methods. Creative problem-solving and total quality management procedures are introduced in the context of pollution prevention. The course includes examples of changing operating practices, materials substitution, process/product changes and recycling. The proper use of the engineering method for planning and implementing pollution prevention is stressed.

This is an elective course in both the Hazardous Materials Management program and the Environmental Engineering M.S. programs in the Department of Civil and Environmental Engineering. As of December 1993, this course has been offered five times as CE-194J Pollution Prevention.

Industrial Engineering and Operations Research

NATIONAL POLLUTION PREVENTION CENTER FOR HIGHER EDUCATION

Hazardous Material/Waste Management

Wayne C. Turner
INDEN 5943, Spring 1994
Oklahoma State University

National Pollution Prevention Center for Higher Education • University of Michigan
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Turner
February 1995

INDEN 5943
HAZARDOUS MATERIAL/WASTE MANAGEMENT
SPRING 1994

CATALOG DESCRIPTION

Management of hazardous materials and waste by the generator to reduce operating costs and protect employees. Emphasis on hazardous communication program, reducing volume and toxicity, and management activities.

PREREQUISITES

INDEN 3503, CHEM 1515 or equivalent

TEXT

Several sources of reference will be used but the primary text is:

Handbook on Hazardous Materials Management, Edited by Tom Carson and Doye Cox, Institute of Hazardous Materials Management, Fourth Edition, 1992, Rockville, MD.

REFERENCES

- Code of Federal Regulations, Volumes 29, 40, 49 and others as needed, U.S. Government Printing Office.
- Turner, W. C., Text material developed for extension courses over the last 10 years at OSU.
- Serious Reduction of Hazardous Waste For Pollution Prevention and Industrial Efficiency, Congress of the United States, U.S. Government Printing Office.
- Huisingh, Donald, Vicki Bailey, Making Pollution Prevention Pay, Pergamon, New York, NY 1982.
- Overcash, Michael R., Techniques for Industrial Pollution Prevention, Lewis Publishers Inc, Chelsae, Michigan, 1986.
- Blakeslee, H. William, et.al., A Practical Guide to Plant Environmental Audits, Van Nostrand Reinhold, New York, NY 1985.

- Noll, Kenneth E., et.al. Recovery, Recycle and Reuse of Industrial Waste, Lewis Publishers Inc., Chelsae, Michigan, 1985.

- Tavlarides, Lawrence L., Process Modifications for Industrial Pollution Source Reduction, Lewis Publishers Inc., Chelsae, Michigan, 1985.

COURSE OBJECTIVES

Upon completion of the course, the student should be able to

- design, implement, and manage a hazard communication program including employee and community "right to know"

- design, implement, and manage a hazardous material/waste Volume and toxicity reduction program.

- prepare contingency plans, training programs, record keeping systems, and management structure for a comprehensive hazardous material/waste management program.

- deal effectively (from a generator viewpoint) with all state, federal, and local regulation agencies.

COURSE OUTLINE	PERCENT TIME
Hazardous Material/Waste Perspective significance of the problem, impact on industry and commerce, cost reduction potential	5%
Hazard Communication Program Employee and Community Right to Know, training, record keeping, management review, labeling	20%

INDEN 5943
HAZARDOUS MATERIAL/WASTE GENERATION MANAGEMENT

INSTRUCTOR::
W. C. Turner, PhD, PE
318 Engineering North
Industrial Engineering
Oklahoma State University
(405) 744-6055

GRADUATE ASSISTANT:

OFFICE HOURS: _____ _____

CLASS HOURS: Stillwater (TO BE DETERMINED)

Tulsa Monday 4:30-7:15 P.M.
(with 1-15 minute break)

SYLLABUS: See attached

			TOTAL
GRADING:	Two Tests @	25%	50%
	1 Term Paper	20%	20%
	Homework-Presentation	10%	10%
	Exam	20%	20%

Tests will be one hour in length and in class; but I retain the right to give a take home test if I feel it's best.

Term Paper: Topic must be agreed upon in advance. Paper should be of graduate level and written accordingly, (spelling, grammar, etc. will be graded). e.g. "Waste Management Plan for ACDZ Co."

Presentation-Homework: In addition, you will research into one topic (normally same topic as term paper) of general interest to the class and make a 10 minute presentation. You will be graded on the use of visuals, etc. (I want a copy of your visuals.)

Text: **Handbook on Hazardous Materials Management:** Edited by Tom Carson and Doye Cox, Institute of Hazardous Materials Management, Fourth Edition, 1992, Rockville, MD.

In addition, I will have 1 or 2 sets of my transparencies and actual regulations at UCT (OSU office) and in Industrial Engineering 322 Engineering North (Stillwater). You may xerox these or simply use as necessary by dropping by the office. **You may not take them home.**

For Spring 1994, I will have an abbreviated set available to you for $10.00 each. Please make checks out to "Industrial Engineering". I will bring them each week. First week is "on the house".

- Hazardous Waste Management — 35%
  Definition of hazardous waste, volume in industry, Federal and State regulations, coordination, record keeping, transportation, route selection, choosing transporters and disposal facilities, trends

- Reducing Volume and Toxicity — 15%
  Objectives, product redesign, process redesign, management systems, decision model, "True Cost" model, industrial process resource recovery

- Management Systems Review — 10%
  Review of program, coordination, dealing with regulations agencies, avoiding duplication

- Plant Tours, Outside Speakers, Test — 10%
  Industrial Engineering consultants talk about opportunities in industry, tours of successful operations

WEEK OF	SUBJECT	ASSIGNMENTS Dr. Turner's Transparencies and Reading From Text Shown Below
January 10	Introduction & Basics	P59-82,179-186,187-194,195-204 213-228,229-249,249-265,265-272,285-296, (1st & 3rd week)
January 17	Introduction & Basics UCT will have a short meeting September 8 to make up Labor Day	
January 24	Practices & Procedures	P83-122
*January 31	Chemistry - Radiation **BRING SCIENTIFIC CALCULATOR TO CLASS**	P1-55
**February 7	Practices and Procedures	P83-122, P273-284
February 14	**(TEST 1)** Employee Right to Know	P175-178
February 21	Community Right to Know	P205-212
February 28	Transportation	P145-174
March 7	**Spring Break**	
March 14	Transportation Choosing	P145-174
March 21	Choosing Transporters, Disposal Options, Disposal Sites	P113-122, P389-406
March 28	Spill Prevention & Control	P305-370 (Misc. Reading)

April 4	**(TEST 2)** Environmental Audits (Operations)	P371-378
April 11	Environmental Audits (Operations) (Real Estate)	P407-454
***April 18	Hazardous Material/Waste Tank Management	
April 25	Reducing Volume & Toxicity	P297-304, P379
May 2	**EXAM - Tulsa**	

* Talks Begin
** Topics Chosen
*** Papers Due (FIRM) - 5 points off each day late

GRADING OF TERM PAPERS

1) Choice of Subject — Maximum 10 points

2) Grammar, Spelling — Maximum 25 points

3) Report Structure — Maximum 25 points

   Abstract, Table of Contents,
   List of Tables & Figures, Bibliography - format, overall appearance of report, conclusions

4) Report Content — Maximum 40 points
   Development of Subject, flow, closure, amount of research, content of Bibliography

TERM PAPER SUPPLEMENT

* Please note the grading on format (#3 25 pts)

I believe it's important to have a properly structured paper. Thus,

Abstract	5 pts.
Table of Contents	5 pts.
Format of Bibliography	5 pts.
Conclusions - Summary	5 pts.
Overall Appearance	5 pts.

* On grammar and spelling I will deduct 4 points each mistake up to the maximum of 25 points.

* On choice of subject, you must tell me <u>why it's appropriate for you in this course</u>. You must do this in a separate memo to me that is turned in with the report.

Remember we are studying how to be better managers of hazardous materials/waste in operating entities (hospitals, manufacturing plants, schools, etc.) You then must address this in your argument.