Version 09-07-2009

56:134 Process Engineering

Course Syllabus

Fall 2009

http://css.engineering.uiowa.edu/~coneng/

Objectives: The course introduces a process approach to innovation, product development, manufacturing, and service applications. Models, modeling tools, solution approaches, and methodologies for analysis and improvement of processes, including the product development and manufacturing process are discussed. The science of process modeling and analysis is illustrated with case studies.

Textbook: There is no required textbook however, the text *Product Development: A Structural Approach to Consumer Product Development, Design, and Manufacturing* by A. Mital, A. Desai, A. Subramanian, and A. Mital (Elsevier, 2008) can be purchased at Amazon.com.
All course material and Power Point slides will be available on the course website.

Software:

- Dependency Structure Matrix: http://www.icaen.uiowa.edu/%7Eankusiak/process-model.html
- Data Mining: Weka and Statistica, both available at the CSS platform
- Expert System: http://www.expertise2go.com/webesie/e2gdoc/

References:
M. Crawford and A. Di Benedetto, *New Product Management*, McGraw Hill, New York, 2005.
M.A. Annacchino, *New Product Development: From Initial Idea to Product Management*, Elsevier**,** New York, 2003.
D.W. Whitney, *Mechanical Assemblies*, Oxford University Press, New York, 2004.
Y. Haik, *Engineering Design Process*, Thompson Books/Cole, Pacific Grove, CA, 2003.
D.G. Ulman, *The Mechanical Design Process*, McGraw Hill, New York, 2000.
K.T. Ulrich and S.D. Eppinger, *Product Design and Development*, McGraw-Hill, New York, 2000.
A. Kusiak, *Engineering Design: Products, Processes, and Systems*, Academic Press, San Diego, CA, 1999.

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Class Time: 8:05 – 9:20 am, TTh 2217 Seamans Center

Course Contents:	Topic	Week
1:	Fundamentals of Process Modeling	Aug 24
2:	Product and Process Innovation	Sep 01
3:	Analysis of Process Models and Problems	Sep 07
4:	Process and System Decomposition	Sep 14
5:	Quality Function Deployment and Process Models	Oct 05
6:	Data Mining in Process Engineering	Oct 12
	Midterm Exam	Oct 15 (Th)
7:	Reliability of Process Models	Oct 19
8:	Design of Process and Facility Layout	Oct 26
9:	Mass Customization	Nov 09
10:	Analytical Process Methodology	Nov 16
11:	Renewable Energy and Process Engineering	Dec 01
12:	Project Presentations Begin	Dec 03

Final Exam (Monday, Dec 14, 9:45 AM; See http://www.registrar.uiowa.edu/exams/)

Course grading scheme

Homework assignments	20%
Midterm Exam	20%
Quizzes	10%
Semester Project	30%
Final Exam	20%
Participation	(up to 3%)

Check your grade at the ICON website http://icon.uiowa.edu/index.shtml

Homeworks: Regular homework assignments are due by 9:30 AM on the day indicated on the assignment. Some homeworks that may be due in more than one week. All homeworks need to be submitted to ICON.
Each student is to submit her/his own work.

Exams: Two in-class exams (midterm and final) will be given.
The exams and quizzes will be open book and open notes.

Quizzes: A number of quizzes will be given in preparation for exams. The quizzes will NOT be announced. The best n - 1 quizzes will be graded. If there is a valid reason for a student missing a quiz, the average grade of n - k quizzes (for $k > 1$) will be assigned for the missing quiz.

Participation: Classroom participation involves asking questions in the classroom, commenting on the material covered in class, or making a brief (not longer than 15 min an individual student or group of two students) presentation on a topic related to the class. The minimum requirement is asking two questions per student per Semester or making one classroom presentation. Semester project presentations do not count for the classroom participation.
To receive an extra credit, submit you comment to ICON the day of your participation.
Email the topic of your presentation for approval to andrew-kusiak@uiowa.edu two weeks in advance of the planned classroom presentation.

SEMESTER PROJECT

There are three components to the semester project:

1. Project Proposal (ICON) DUE: Th, Oct 15
   Post the proposal electronically at ICON.

2. Project Report (ICON) DUE: Dec 8 (Tues)
   Post the project report and power point presentation at ICON.
   (Look under "Project report" for submission details)
3. Project Presentations In class: Dec 8 and Dec10
   ⇒ *The project content used in this class can not be used for credit in other courses.*
   ⇒ *Before engaging in a project check this website*
   http://www.icaen.uiowa.edu/%7Eie166/avoiding_plagiarism.doc

Project grading scheme

- 30% project presentation
- 60% project content
- 10% attendance of discussion meetings and project presentations

YOU MAY CHOOSE ONE OF THE FOLLOWING SIX TYPES OF PROJECTS:

A. **Application Project** (Teaming of 2 - 3 students is encouraged)
You need to describe the problem considered for your project and propose a model and/or solution approach for solving the problem. Ideally, the project should be based on an industrial application. For industrial projects the emphasis should be given on the problem statement and a model developed, as those might be relatively difficult to accomplish. The solution procedure for an industrial project is likely to be extension of one of the algorithms discussed in class or a combination of more than one algorithm. If you do not have an industrial project, you may want to select a problem from a journal (e.g., *IIE Transactions*, *Journal of Manufacturing Systems*, *International Journal of Production Research*, and *Journal of Intelligent Manufacturing*), a magazine (e.g., *IE Solutions*, *Interfaces*) or a book (e.g., one of the reference books) for your project. For the journal selected project you are expected to present a model (e.g., integer programming, neural network) of the problem and a solution procedure (e.g., heuristic algorithm, expert system). Writing computer codes (e.g., JAVA, C++) and using standard computer software (e.g., Expert System Shells, Neural Network software, Data Mining software – for DM software go under All Programs|Engineering Software|WEKA) to support the algorithm (methodology) developed in the project will be an asset. Make attempt to consider alternatives (e.g., three business process models) while proposing design solutions, show the benefits and pitfalls of each alternative, and use visualization tools to demonstrate the results (e.g., bar charts, virtual reality)
Examples of projects conducted by students in previous years include: *Modeling and Analysis of Dock-to-Stock Operations at AAA Corporation, Analysis of Systems Engineering Activities at BBB Corporation, Reengineering Image Data Storage and Retrieval Process at CCC Hospital, and Modeling Innovation Process.*

B. **Technical Proposal** (Teams of 2 - 3 students are encouraged)
The technical proposal option involves preparing a proposal to a funding agency, e.g., Department of Commerce, Company X. Each of you is likely to write numerous proposals in your professional career. In fact, most of non-routine tasks performed at any corporation result from a proposal written by someone and funded from an internal or an external source. Technical proposal usually involves a technical description of an intended entity (e.g., product, software) and a business proposal. Calls for SBIRs and STTRs are good models for such proposals. This link is useful http://www.grants.gov in searching current Call for Proposals.

C. **Research Paper** (Teaming is not encouraged)
You may choose a specific topic in the area of engineering design, manufacturing, or business and explore it in greater detail. This type of project should survey the existing literature, identify a problem (or a gap) to be researched, present existing methods for solving the problem, and in some cases develop an improved solution approach (e.g., an algorithm). Go to http://www.icaen.uiowa.edu/~coneng/ and search the digital libraries listed under "For literature search use" towards the bottom of the page.
for sample journal papers.

D. **Research Proposal** (Teaming is not encouraged)
The research proposal option involves preparing a proposal for a funding agency, e.g., National Science Foundation, Department of Defense. Those of you planning research careers are likely to write many proposals in your career.
Website of interest: http://www.grants.gov/

E. **Software Development** Project (Teams of 1 - 2 students)
The student(s) will be responsible for the development of software of an algorithm discussed in the class, e.g., the triangularization algorithm, decomposition algorithm, and reliability and risk assessment algorithms. The code should be written in a widely accepted language, e.g., C, C++, JAVA and a user-friendly interface should be developed (Visual Basic, etc.). Web implementation of the software is encouraged.

F. **Software Tutorial** Project (Teams of 1 - 2 students)
The project team will develop a tutorial and a demonstration of widely accepted software or a computational environment, for example, http://css.engineering.uiowa.edu/~coneng/NETWeb

SEMESTER PROJECT PROPOSAL REQUIREMENTS
The purpose of your project proposal is to outline the topic proposed and to receive feedback from the instructor. The proposal should be brief (less than 3 pages). You may attempt to prepare your project proposal in the format a project report (e.g., application project, software development project).
Each semester project proposal should contain a Gant chart of project activities prepared with MS Project available on the CSS platform.

SEMESTER PROJECT REQUIREMENTS
Each semester project (irrespectively of the type) must demonstrate some usage of software or programming skills, e.g., Weka data mining, PS8 project planning, Scitor (Sciforma) process modeling, C programming, etc. ARENA can not account for more than 10% of the project content.

SEMESTER PROJECT REPORT FORMAT

The project report should be prepared on a word processor and should contain figures and tables that well explain all design concepts. Be concise in your writing and consult technical writing references as needed (see below). The document should be double-spaced throughout and should use a standard font (Times 10 or 12). A title page should include the title of the project, project type (A, B, C, D, E, or F), student name(s), course title, and date. The title page should be followed by an abstract (executive summary). Include also a table of contents, a list of figures, and a list of tables. All references must be included at the end of the paper, followed by appendices, if any. All pages (with the exception of the title page) should be numbered.

Required Project Report Sections:

1. Project Plan: A Gant chart of project activities prepared with MS Project or PS8 Project Planning Software that is available on the CSS platform (Go under All Programs|Engineering Software|PS8).
2. Innovation: A subsection on innovation of the proposed model, idea, or a solution. You may incorporate the Innovation subsection in any of the main sections of the project, e.g., the Conclusion section.
3. Broader Impacts: Broader impacts of the idea pursued in the project.

The body of the term project report should include:

A. **Application Project**

1. Introduction
2. Problem definition

3. Project goals
4. Model formulation
5. Solution approach
6. Computational results
7. Conclusion

B. **Technical Proposal Project**

Requirements determined by the funding agency selected.

C. **Research Paper**

1. Abstract (about 100 words)
2. Statement of the problem
3. Literature review
4. Existing models and solution approaches
5. Proposed model and/or solution approach
6. Examples
7. Conclusion

D. **Research Proposal**

Requirements determined by the funding agency selected.

E. **Software Development Project**

1. Introduction
2. Algorithm description
3. User's manual
4. Example problems (2)
5. Disk with the code

F. **Software Tutorial**

The software tutorial should be implanted on the web in the form of a slide show. Use your creativity! All tutorials will be linked to the class home page.

REFERENCES ON TECHNICAL WRITING

[1] Olsen, L.A. and Huckin, T.N. (1983). *Principles of Communication for Science and Technology*, McGraw-Hill Book Company, New York.

[2] Sherlock, J. (1985). *A Guide to Technical Communication*, Allyn and Bacon, Inc., Newton, MA.

Semester Project Guidelines

Time estimate

It is expected that each student should spend not less than 50 hours on a project. Industrial or service application projects may take longer.

Project presentation

Each project has to be presented in class. A project team will be given about 15 - 20 minutes to present the results. In your presentation summarize the problem studied, proposed solution, and address innovation and broader impacts.

Project report

Each project team should hand in the following items (one per project):

- Post the project report file, the Power Point presentation slides, and software developed (when applicable) at ICON. Label all files with your name and course number, e.g., Doe_134_Sem_Project.

Hint

Usage of standard software, e.g., Scitor (Sciforma) PS Suite, MS Project, QFD, Statistica (data mining) in the semester projects is strongly encouraged.

Sample projects

Sample projects available on the class website.

University Information

This course is given by the College of Engineering. This means that class policies on matters such as requirements, grading, and sanctions for academic dishonesty are governed by the College of Engineering. Students wishing to add or drop this course after the official deadline must receive the approval of the Dean of the College of Engineering. Details of the University policy of cross enrollments may be found at http://www.uiowa.edu/~provost/deos/crossenroll.doc