MFG 5312/SE 5347
Strategic Design of Manufacturing Processes/System Engineering Processes
Course Syllabus

Instructor: Bill Tseng, Ph.D., CMfgE/ Honglun Xu, Ph. D.
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Office Hours: M&W 4 pm – 5 pm online via Blackboard or to make an appointment

Text: Andrew Kusiak, *Computational Intelligence in Design and Manufacturing*, Wiley 2000.

TA: Mr. Md Fazle Rabbi,
Office: Room E-113 Engineering Building
Email: mrabbi1@miners.utep.edu
Office Hours: M&W 4 pm – 5 pm

Reference books:

1. Andrew Kusiak, Computational Intelligence in Design and Manufacturing, Wiley 2000
2. Microsoft HoloLens By Example by Joshua Newnham (2017), eBook (https://learning.oreilly.com/library/view/microsoft-hololens-by/9781787126268/), and
3. Develop Microsoft HoloLens Apps Now by Allen G. Taylor (2016), eBook (https://learning.oreilly.com/library/view/develop-microsoft-hololens/9781484222027/#toc)

Prerequisite: Permission of instructor

Course Description:
The course is to introduce concepts of integrated design and manufacturing. The emphasis is placed on the study and analysis of models, algorithms, and systems applicable to the system-life-cycle from the design of components, through manufacturing, to distribution. The design and management of manufacturing and service systems is paramount to this course. In addition, to develop the skillset of future engineers, this course also includes the concept of and virtual reality (VR) and augmented reality (AR) where the students will learn the basic development VR/AR applications for modern manufacturing systems. Upon completion of this course students will:

- Have a clear understanding of the design of a manufacturing system.
- Gain expertise in process and production planning, scheduling, and optimizing the facility layout.
- Develop skill-set in data analytics using different algorithms and software.
- Be able to design a 3D model using "Maya" software
- Be familiar with VR/AR toolkit used by the features of the Microsoft HoloLens device.
- Develop an application for target devices using the "Unity" game engine

Course Contents:

- Introduction to Virtual and Augmented Reality
- 3D design
- VR/AR application development
- Modern manufacturing
- Production planning and scheduling
- Group technology
- Layout of machines and facilities
- Process planning
- Neural networks

Method of Instruction: This module involves PowerPoint presentation, classroom instruction and discussion, quizzes, homework, exams, and hands-on activities like working with different AR/VR hardware and software, 3D designing.

Exams/Homework/Quizzes policy: The student will be required to sit for **two in-class exams**: (a) mid-term exam and (2) final exam. The exams will be comprehensive, open book and open notes. Students will also submit weekly homework or assignments. The homework and assignments will be given based on the contents covered each week. Regular **homework are due by 6:00 pm** on the day indicated on the assignment. Some homework that may be due in more than one week. Students are also required to complete several in-class or online quizzes. The length of the quiz will be determined based on the module and material covered. The nature of these **quizzes can be unannounced**.

Attendance and Class Participation: A class roaster will be taken at the beginning of each class. The evaluation is based on the student's active engagement & participation in the class.

Course Grading Scheme:

- Homework 20%
- Midterm 20%
- Quizzes 10%
- Semester Project 25%
- Final Exam 20%
- Classroom participation 5%

Project Timelines:

- Proposal Sept. 19th
- Proposal Presentation Sept. 26th
- Final Presentation Begin Nov. 28th
- Final Exam Dec. 5th
- Final Report Dec. 11st

Project Grading Scheme:

- 5% project proposal
- 20% project presentation
- 70% project content
- 5% attendance of the final project presentations

Semester Project Guidelines

YOU MAY CHOOSE ONE OF THE FOLLOWING FIVE 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 is normally given on the problem formulation and a model to be developed, as those might be relatively difficult to accomplish. The solution procedure for an industrial application project is likely to be an extension of one of the algorithms discussed in class or a combination of more than one algorithm. If you do not have industrial contacts, you may select for your project a problem from a journal (e.g., *Journal of Manufacturing Systems, IIE Transactions on Design and Manufacturing, International Journal of Production Research, Journal of Intelligent Manufacturing*), a magazine (e.g., *IE Solutions, Interfaces*) or a book (serf the web). In such case you will be expected to present a model (e.g., integer programming, neural network) of the problem and a solution procedure (e.g., heuristic, expert system).

Writing computer codes (e.g., JAVA, C++, ASP) and using standard computer software (e.g., expert system shells, neural network software, and data mining software) to support the developments included in the project will be an asset. Make attempt to consider numerous alternatives (e.g., three layouts of a manufacturing facility) while proposing solutions, show the benefits and pitfalls of each alternative, and use visual tools to demonstrate the results (e.g., bar charts, virtual reality).

B. Research Paper (Teams of 2 - 3 students is encouraged, **highly recommended**)
You may choose a specific topic in the area of production, manufacturing, energy, systems engineering and explore it in greater detail. This type of a project should survey the existing literature, identify and summarize a research problem, present existing methods for solving the problem, and formulate a new solution approach.

C. Technical Proposal (Teams of 2 - 3 students is encouraged)
This project option involves preparing a proposal for a funding agency, e.g., Department of Commerce, Department of Defense, Company X. Each of you is likely to write numerous proposals in your professional career. In fact, most of non-routine tasked performed in any require proposal preparation. The project is then funded from an internal or external source.
Examples of websites of interest: nsf.gov, darpa.mil, nasa.gov, atp.nist.gov.

D. Research Proposal (Teams of 2 - 3 students is encouraged)
The research proposal option involves preparing a proposal to a funding agency, e.g., National Science Foundation, Defense Advance Project Agency. If you plan a research career, you are likely to write many proposal proposals. Examples of websites of interest: nsf.gov, darpa.mil, nasa.gov.

E. Software Development Project (Teams of 1 - 2 students)
The student(s) are responsible for the development of software for one of the algorithms discussed in class, e.g., grouping algorithm, machine layout algorithm, scheduling algorithm. The code should be written in a widely used programming language (e.g., JAVA, C, C++, Visual Basic, ASP.NET) with a user-friendly interface.

SEMESTER PROJECT REQUIREMENTS
The project prepared for this class can NOT be used to meet requirements of any other class. Each semester project (irrespectively of the type) must demonstrate some usage of software or computer programming skills, e.g., layout software, neural network software, C programming, etc.

SEMESTER PROJECT REPORT FORMAT
The project report should be prepared on a word processor and should contain figures and tables that are necessary to make the report easy to read. Be concise in your writing and consult technical writing references as needed (see below). The document should be double-space throughout and should use a standard font (Times 12). The first page should include the title of the project, project type (A, B, C, D, or E), student name(s), course title, and the 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.

The body of each semester project report should include the sections outlined next.
A. **Application Project**
1. Introduction
2. Problem definition
3. Project goals
4. Model formulation

5. Solution approach
6. Computational study
7. Conclusions

B. **Research Paper**

1. Abstract (about one hundred word long)
2. Statement of the problem
3. Literature review
4. Existing models and solution approaches
5. Proposed model and/or solution approach
6. Examples
7. Conclusions

C. **Technical Proposal**

Requirements are determined by the selected funding agency.

D. **Research Proposal**

Requirements are determined by the selected funding agency.

E. **Software Development Project**

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

SEMESTER PROJECT PROPOSAL

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 page long). 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 the proposed project activities prepared with MS Project.

PROJECT STATUS REPORT

Each project team (student) is to make a five-minute presentation in class to report on the project status.

REFERENCES ON TECHNICAL WRITING

[1] Olsen, L.A. and Huckin, T.N., *Principles of Communication for Science and Technology*, McGraw-Hill Book Company, New York, 1983.
[2] Sherlock, J., *A Guide to Technical Communication*, Allyn and Bacon, Inc., Newton, MA, 1985.

Project effort (time) estimate

It is expected that each student will spend about 45 hours on a project. Industrial or service application projects may take longer.

Project presentation time estimate

Each project has to be presented in class. A project team will be given about 15 minutes to present the results.

Project report submission requirements

Each team (student) should submit the following items (one per project):

- Hard copy of the project report should be dropped off at TA's office (E-113).
- Project report folder containing the project report file, the Power Point presentation slides, and software developed (when applicable) needs to be uploaded via Blackboard. Compress the folder

with all files with Winzip before uploading. Label the compressed folder with your last name and the file content, e.g., Smith_5312_Sem_Project. Reference your email accordingly, e.g., RE: Smith_5312_Sem_Project.