Spring 2009

Ch. E. 454 CHEMICAL PROCESS ANALYSIS AND DESIGN - II
M.S.E. 414 PROCESS DESIGN

in MCCL 214a *time scheduled*

Ch. E. 452 ENVIRONMENTAL MANAGEMENT DESIGN *in* MCCL 315 *time scheduled*

INSTRUCTOR: Dr. DAVID C. DROWN - OFFICE: BEL 303 ddrown@uidaho.edu

OBJECTIVE:

Application of economic, optimization, and design principles to industrial chemical operations and processes.

TEXT & REFERENCES Þ Every Engineering book you own or that's in the Library:

Peters, Timmerhaus & West ***Plant Design and Economics for Chemical Engineers***, Fifth Edition, McGraw-Hill, 2003.

Perry & Green ***Perry's Chemical Engineers' Handbook***, Sixth Edition, McGraw-Hill, 1984. { or other editions }

Drown ***Written & Oral Engineering Reports***, Fifth Edition, UI Ch.E. Dept., 2003. { available from AIChE Student Chapter }

CREDITS: **3** PREREQUISITES: Ch.E. 453 *or* *MSE 415*

CLASSES: 1 One hour period per week per design group

MCCL 315 11:00 AM - 12:15 PM Tuesday-Thursday **** NOTE **** design group status sessions will be utilized instead of normal class sessions.

To be scheduled = one hour per group per week meetings = in BEL 307 Conf. Rm.

COURSE GRADE: The semester's work will consist of -

Design Progress Memos & Discussions	20 %
Mid-Term Status Report	10 %
Design Project Report	40 %
Design Project Notebook	15 %
Design Oral Presentation	10 %
Final Exam { oral review discussion }	5 %

All Design Projects will be presented at the Engineering Design **EXPO:** May 1, 2009

Design reports will be judged on:

1. Technical Accuracy and Thoroughness.
2. Design Innovation and Creativity.
3. Judgment and Decision Making.
4. Presentation Readability, English, and Neatness.

{ Clear & Concise Communication }

DEADLINES:

Due to the sequential nature of the assignments,

NO CREDIT will be given for late assignments.

Formal design report due date is ultimate deadline **!**

WERC Tasks delivered to Las Cruces before Wed. March 11, 2009

454 & 414 Projects delivered to instructor before 5 PM April 24, 2009

I. Desired State Objectives ® *what the student should learn !*

A. Synthesis, Design Experience, and Problem Solving Practice

0. **ECONOMIC OPPORTUNITIES EXIST Þ Find the Best Ones.**
1. Innovative process design synthesis.
2. Optimization improvement of process designs.
3. Safety, Environmental, & Technical feasibility analysis.
4. Market Research & Economic feasibility analysis.
5. Detailed equipment design for construction.
6. Communicating results.

B. ***REVIEW & PRACTICE of all Chemical Engineering CONCEPTS.***

1. Synthesis and Screening of Alternatives:
   Use of techniques for innovation, creativity,
   and generation of ideas. ***FUNCTIONAL ANALYSIS***
   Logical screening of concepts & decision making.
2. Predicting Behavior and Sizing Process Equipment:
   Material and Energy Balances, Thermophysical Properties,
   Thermodynamics, Reaction Stoichiometry and Kinetics,
   Stagewise Processes, Process Control & Instrumentation,
   Momentum, Heat, and Mass Transport & Rate Processes.
3. Economic Evaluation Criteria:
   How criteria differ and selection of when to use what.
   Present Worth, Discounted Cash Flow ROI, & Payout Time.
   Depreciation and tax effects.
   Cost estimating methods.
   Forecasting techniques.
4. Hazardous Operations:
   Fail safe design, Regulatory compliance, Waste minimization.
5. Chemical Process Troubleshooting: How to diagnose operating problems.

II. Relevancy ® *how I will know if you learned anything ?*

Active participation in class discussions.
Creative new ideas presented for problems and project.
Incorporation of classroom concepts into design project.
Thorough well organized project notebook.
Good project reports & presentations.

Doing the Right Thing and **Þ Doing the Thing Right.**

I. MID-PROJECT DESIGN REVIEWS ® *~monthly!*

1. How useful & understandable is your PROBLEM STATEMENT?
2. Have you identified & understood the KEY ISSUES?
   Have you ANALYZED the AUDIENCE? (i.e., your customer)
3. Have you developed one or more PROBLEM SOLUTIONS
   which satisfy the needs of your CUSTOMER?
4. What DELIVERABLES can your team show at this time?
   a. What will you be able to show at the next review?
   b. What will you be able to show on April 24, 2009?
      - alternative flowsheet concepts
      - literature research proof-of-principal
      - economic potential
      - material & energy balances (computer simulations)
      - equipment selection & sizing
      - design analysis
      - flowsheet drawings
      - plant layout scale drawings
      - economic analysis
      - P&ID drawings
      - profitability analysis
5. Have you developed a realistic MANAGEMENT PLAN for completing your project on time and within budget, while preserving TEAM DYNAMICS?
6. What investments have you made to improve TEAM PRODUCTIVITY and member well-being?

If you were the customer Þ would you give the team the go ahead to purchase materials and labor for the next phase of the project with a high confidence that they will be successful?

II. WEEKLY TEAM MEETINGS ®

1. What have you ACCOMPLISHED? *since last meeting!*
2. What do you PROPOSE to accomplish next? *by next meeting!*
3. What are the PROBLEMS you face? *what do you need guidance on?*
   a. How do you propose to overcome them?
   b. What resources do you need?

DESIGN is the ART of combining

THEORY, EXPERIENCE, ASSUMPTIONS, ORIGINALITY, and COMMON SENSE

Pareto Principle ® *~80-20 rule!* -- . stated by Italian Scholar a century ago

or the "Concept of the Vital Few and the Trivial Many"

1. 80% of cost comes from 20% of parts
2. 20% of sales people write 80% of business

* For most design problems, a large fraction of the objective function (e.g., 80% of total cost) is due to a small fraction (e.g., 20% of components) of the contributing factors.

ATTEMPT TO UNDERSTAND CONTROLLING (-or- limiting) FACTORS

⇒ Chemical, Physical, Economic, or People and Process Phenomena

Helps to suggest new or improved techniques, eliminate bottlenecks

* Key to a successful design is identifying the significant factors that dominate the technical feasibility and economic profitability of the project. The earlier in the project that the important controlling features are identified, the more the work effort can focus on improving them.

Typically the **MOST SIGNIFICANT** Design Variables**:**

1. Involve product distribution or recycle trade-offs
2. Affect process flow rates

Process Design Objectives are to:

1. Determine **DOMINANT economic trade-offs** for each design variable.
2. Prioritize the **order of IMPORTANCE** of the design variables.

Design Project: ® *team members* Þ *weekly meeting !*

1. MSE 414 Autoliv: Cleanweld — Bean, Howell Hewitt, Jerred, Shallman — Þ **Mon. & Wed. 3:30 & Fri.**
2. WOW Energies: WOWclean — L. Prizer — Þ **Tue. 10:30**
3. WERC contest entire team — Þ **Tue. 1:00**
4. Restoration Technologies: Wood Composite — Bassler, Mansour — Þ **Tue. 2:00**
5. Hybrid Battery Charger — Elgan, Muntifering, Smith, Weakley — Þ **Tue. 3:30**
6. WERC Task 1: Sulfate Water — Kane, Nonthabenjawan, Sobcyzk, Canady (Chem 452 WERC) — Þ **Thur. 10:30**
7. WERC Task 5: Wind-2-Water — Kooda, Penberthy, Sorge Price (Jr. 452 WERC) — Þ **Thur. 2:00**
8. 393 Chem-E-Car: Biopower — Penberthy, Hidalgo Hanson (ECE), Piekarski — Þ **Mon. & Fri. 2:30** *ends at spring break*