CENG4130 Plant Design and Economics syllabus (tentative)

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PG TA:

Blended learning

- More personalized learning (watch lecture video outside of class)
- More interaction (discussion and Homework in class)

Intended Learning Outcomes (ILOs)

By the end of the course, learners will be able to:

- demonstrate mastery of economic analysis in chemical process and/or product development;
- make meaningful estimates on various economic aspects such as the capital investment, product cost, depreciation and profitability of an existing or new chemical process or project;
- be aware of the importance of environment/health issues in chemical industry;
- apply process safety management program, industrial hygiene, fire and explosion, toxic release and dispersion, and pressure relief system,
- conduct Hazards Identification, Risk Analysis, and HAZOP;

Course AI Policy

AI can be used in homework, quizzes, and exams

Weekly schedule

	ILOs	Module title and Topics	Tasks/Submissions/in-class
1	• Describe the purpose of the blended learning approach • Recall the course content and learning outcomes • Explain the importance of plant design and economics	**Course overview and BL Overview** • Students will be introduced to the blended learning approach • Course introduction • Introduce the importance of plant design.	• Discuss the economics for a typical chemical plant, converting coal to methanol • After 1st F2F class meeting, start online materials Module 1
2	• Estimate capital investment and equipment cost	**Capital and Cost Estimation** • Lecture video/notes on process economics, capital investment, equipment cost estimation, etc.	• In-class: Scenario-based quiz questions to check understanding of online materials • In-class: Tutorials on estimating investment and equipment cost
3	• List the components in TPC • Calculate the depreciation • Incorporate time value for financial analysis	**Total Product Cost (Time Value and Depreciation)** • Lecture notes and video on TPC components, time value of money, and depreciation	• Online: Scenario-based quiz questions to check understanding of online materials • In-class: Activity to calculate product cost, incorporate time value for financial analysis and determine depreciation
4	• Plot cash flow diagram • Determine criteria for profitability analysis	**Cash position diagram and Profitability criteria** • Lecture notes and video on cash flow, cash position, minimum attractive rate	• Online: Scenario-based quiz questions to check understanding of online materials • In class: Activities to plot cash flow diagram, and determine m_{ar}
5	• Use various methods for profitability analysis • Incorporate time value of money into profitability analysis	**Profitability Analysis** • Lecture video/notes on profitability analysis with/without time value	• Online: Scenario-based quiz questions to check understanding of online materials • In-class: Tutorials on profitability analysis calculation
6	• Compare alternative investment. • Evaluate replacement for equipment	**Alternative Investments & Replacement** • Lecture video/notes on Alternative investment and replacement • Debrief Financial Project	• Online: Scenario-based quiz questions to check understanding of online materials • In-class: Tutorial and debate to weigh out pros and cons for replacement of equipment and alternative investment

7	• Describe the major methods on process safety management • Identify the possible reason for accidents • Evaluate the chemical exposure	**Process Safety Management** • Videos investigating past accidents from Chemical Safety Board • Video on occupational safety	• Online: Scenario-based quiz questions to check understanding of online materials • In-class: Activity to analyze case studies on accident prevention and process safety management to real life cases, and tutorial on chemical exposure calculation
8	• Implement fire and explosion prevention measures in process design	**Fire and Explosion Prevention** • Lecture video/notes on fire and explosion	• Online: Scenario-based quiz questions to check understanding of online materials • In-class: Activity to design a floated roof tank for flammable liquid with fire and explosion prevention measures in mind
9	• Calculate the release and dispersion of toxics	**Toxic Release and Dispersion** • Lecture video/notes on the toxic release and dispersion	• Online: Scenario-based quiz questions to check understanding of online materials • In-class: Activity to calculate toxic release and dispersion of Fukushima or other real life situations and implications on public.
10	• Select the scenario and type of pressure relief	**Pressure Relief** • Lecture video/notes on pressure relief	• Online: Scenario-based quiz questions to check understanding of online materials • In-class: Activity to analyze cases on selection of pressure relief device and scenarios to real life case
11	• Conduct HAZOP	**HAZOP (Hazard and Operability Study)** • Lecture notes and other learning resources on HAZOP • Debrief HAZOP Project	• Online: Scenario-based quiz questions to check understanding of online materials • In-class: Activity to analyze and apply HAZOP to real life case
12	• Calculate the reliability for various safety components • Construct Fault Tree and Event Tree	**Reliability, Fault tree and Event Tree** • Lecture video/notes on reliability, Fault tree and Event tree	• Online: Scenario-based quiz questions to check understanding of online materials • In-class: Activity to apply Safety and reliability to real life case, construct a Fault Tree, Event Tree and risk calculation
13/ 14	• Q&A for HAZOP project • Course wrap-up	**Reviewing HAZOP Videos and prepare Q&A**	• In-class: Q&A on HAZOP project • Course summary

Assessments

	Components	Weighting	Details
1	Out-of-class Quizzes (self-assessment)	14%	On canvas
2	Class discussion and participation Online forum participation, 4 questions with 4 points	8%	Either post a valid question in online forum or give an answer to questions posted by others. At least 2 questions for Economics and 2 for Safety part.
3	Homework *4	10%	Consolidate/practice calculations (help prep for final)
3	Group Project 1: Financial Report (Economics)	10%	Written Report
4	Group Project 2: HAZOP (Safety)	10%	Video presentation + Q&A
5	Peer Evaluation	8%	Contribution to group discussion, homework and project
6	Final Exam	40%	Open book, computer and internet

Textbook

- Peter, M.S. Timmerhaus, K.D. & West, R.E. Plant Design and Economics for Chemical Engineers, 5th ed. McGraw-Hill 2003
- Crowl, D.A. and Louvar, J.F. Chemical Process Safety: Fundamentals with Applications. Prentice Hall International Series, 3rd, 2011. http://my.safaribooksonline.com/book/chemistry/9780132762489

References

- Towler and Sinnott. Chemical Engineering Design. Elsevier, 2008. E-book
- Turton, Bailie, Whiting & Shaeivitz. Analysis, Synthesis, and Design of Chemical Processes, 3rd edition, Prentice Hall PTR 2009