CM4310
Chemical Process Safety/Environment
Fall Semester, 2016

Curricular Designation: Required

Catalog Description: A study of the technical fundamentals of chemical process safety and designing for the environment. Includes toxicology, industrial hygiene, source models, fires and explosions, relief systems, hazard identification, risk assessment, environmental fate and transport, hazardous waste generation, pollution prevention, and regulatory requirements.

Credit: 3.0 credits (2 safety; 1 green engineering) (Lec 3-0-0) Semesters Offered: Fall

Prerequisites: CM3120 Transport/Unit Operations II, CM3230 Thermodynamics for Chemical Engineers, plus Senior Standing


Course Objectives: 1. Learn the technical fundamentals of chemical process safety
2. Learn the technical fundamentals of green engineering:
3. Develop an understanding of regulations related to the process safety and the environment

Topics Covered: 1. Chemical process safety
2. Industrial hygiene
3. Fires and explosions
4. Hazard identification and risk assessment
5. Pollution prevention
6. Regulatory requirements (safety and environment focused)
7. Introduction to Environmental Issues
8. Environmental Properties of Chemicals
9. Environmental Fate of Chemicals
10. Life Cycle Assessment of Chemical Processes and Products

Course times: MWF, 3:05 - 3:55 PM, 103 EERC (Lecture 3 hours/week for 14 weeks)

Contribution of Course to Curriculum: Engineering

Instructors: Dr. John F. Sandell, Associate Professor; Dr. David Shonnard, Robbins Chair
Class Schedule:

<table>
<thead>
<tr>
<th>Week</th>
<th>Content</th>
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</table>
| **Process Safety** | **1** Course Introduction  
Read Chapter 1: Introduction  
Watch CSB video: Runaway: Explosion at T@ Laboratories (9:28)  
Watch CSB video: Inherently Safer: The Future of Risk Reduction (11:05) |
| | **2** Read Chapter 2: Toxicology  
Read Chapter 3: Industrial Hygiene  
Watch CSB video Anatomy of a Disaster—Explosion and Fire at BP (6:14)  
Watch AICHE videos: Introduction to Video Series (4:22), and  
Introduction to Corporate Safety (10:40) |
| | **3** Read Chapter 4: Source Models  
BASF Emergency Response Video shown in class  
Watch AICHE video: Laboratory Safety and Inspections (23:50)  
Watch CSB video: Experimenting with Danger (24:05) |
| | **4** Read Chapter 5: Toxic Release and Dispersion Models  
Watch CSB video: Hazards of Nitrogen Asphyxiation (12:06)  
Begin reading Chapter 6: Fires and Explosions |
| | **5** Watch AICHE video: Personal Protective Equipment (19:18) |
| | **6** Complete Chapter 6: Fires and Explosions  
Watch CSB video: Public Worker Safety (7:50)  
Watch AICHE video: Process Area Safety Features (17:00), and  
Process Area Safety Procedures (14:10) |
| | **7** Read Chapter 7: Designs to Prevent Fires and Explosions  
Watch CSB video: Ethylene Oxide Explosion at Sterigenics (9:26)  
Watch AICHE video: Process Area Inspections (15:00) |
| | **8** Read Chapter 8: Chemical Reactivity  
Watch CSB video: Reactive Hazards (20:00)  
Watch AICHE video: Dust and Vapor Explosion Apparatus (22:49) |
| | **9** Read Chapter 9: Introduction to Reliefs  
Watch CSB Video: Combustible Dust: An Insidious Hazard  
Watch AICHE video: DIERS and VSP (16:30) |
| | **10** Monday and Wednesday only  
Read Chapter 11: Hazards Identification  
Watch CSB video: Explosion and Fire at Formosa Plastics (Illinois) (10:52)  
Watch AICHE videos: Informal Safety Reviews (18:38), and  
Introduction to Formal Safety Reviews (10:00), and  
Formal Safety Reviews (27:30)  
Piper Alpha Video shown in class  
Completion of Safety part of course |
| **Environment** | **11** Chapter 1: Introduction to Environmental Issues  
Chapter 5: Environmental Properties of Chemicals Based on Structure  
Chapter 5: completion  
Sustainability Concepts for the Chemical Process Industries  
Chapter 11: Environmentally Conscious Design of Processes  
Chapter 13: Life-Cycle Concepts, Product Stewardship and Green Engineering |
<p>| | <strong>13</strong> Chapter 13: Completion of Life Cycle Assessment |</p>
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<thead>
<tr>
<th>Outcome</th>
<th>Contribution</th>
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<tbody>
<tr>
<td>a) An ability to apply knowledge of mathematics, basic science and engineering science</td>
<td>Substantial</td>
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<tr>
<td>b) An ability to design and conduct experiments as well as to analyze and interpret data</td>
<td>Minimal</td>
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<td>c) An ability to design a system, component or process to meet needs within realistic constraints</td>
<td>Moderate</td>
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<td>d) An ability to function on multidisciplinary teams</td>
<td>Minimal</td>
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<td>e) An ability to identify, formulate, and solve engineering problems</td>
<td>Substantial</td>
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<td>f) An understanding of professional and ethical responsibility</td>
<td>Substantial</td>
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<td>g) An ability to communicate effectively</td>
<td>Minimal</td>
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<td>h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social context.</td>
<td>Substantial</td>
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<tr>
<td>i) A recognition of the need for, and the ability to engage in lifelong learning</td>
<td>Moderate</td>
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<td>j) A knowledge of contemporary issues</td>
<td>Substantial</td>
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<td>k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice</td>
<td>Substantial</td>
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**Prepared by:**
John F. Sandell/David R. Shonnard

**October 14, 2016**