

BOS 3640, Interactions of Hazardous Materials Course Syllabus

Course Description

A systematic analysis of how hazardous materials escalate an incident or emergency event. Examination of the basic fundamental concepts common to hazardous chemicals with an emphasis on how some key elements, compounds, and mixtures are inherently dangerous.

Course Textbook

Meyer, E. (2014). Chemistry of hazardous materials (6th ed.). Upper Saddle River, NJ: Pearson.

Course Learning Outcomes

Upon completion of this course, students should be able to:

- 1. Recognize how to use basic chemistry fundamentals that are essential in the study of hazardous materials, such as the common elements by their atomic symbols on the periodic table; the difference between elements, compounds, and mixtures; how ionic and covalent bonding influence chemical properties; and properties of gases, liquids, and solids.
- 2. Identify the common units of measurement used in the practice environmental health and safety (EHS) and fire science (FS), such as concentration, temperature, and pressure.
- 3. Describe the chemistry of some common elements, including oxygen, ozone, hydrogen, fluorine, chlorine, phosphorus, sulfur, and carbon as applicable to their industrial uses and hazards.
- 4. Apply the principles of chemical interactions to emergency response incidents that occur at home, in the workplace, or in public sites.
- Identify the hazard classes as outlined by the Department of Transportation (DOT) and the basic DOT hazardous
 material regulations related to the identification, classification, labeling, marking, and transporting of hazardous
 materials and response to hazardous material incidents.
- Describe key chemical-specific factors or properties that should be considered when managing or responding to incidents involving corrosive materials (acids and bases), water reactive substances, pyrophoric materials, toxic substances, oxidizers, organic compounds, and polymeric materials.
- 7. Describe the hazards, regulations, and precautions that should be taken when handling, storing, using, or transporting DOT regulated explosive and radioactive materials.
- 8. Demonstrate the ability to use resources such as the DOT Emergency Response Guidebook (ERG) to determine emergency response actions and/or management techniques to mitigate hazardous material incidents or projects.
- 9. Demonstrate familiarity with the Global Harmonized System of Classification and Labeling of Chemical Substances (GHS) and the NFPA system of identifying potential hazards.

Credits

Upon completion of this course, the students will earn three (3) hours of college credit.

Course Structure

- 1. **Unit Learning Outcomes:** Each unit contains Learning Outcomes that specify the measurable skills and knowledge students should gain upon completion of the unit.
- 2. Unit Lessons: Each unit contains a Unit Lesson, which discusses unit material.
- Reading Assignments: Each unit contains Reading Assignments from one or more chapters from the textbook. Suggested Readings are listed in the unit study guides to aid students in their course of study. The readings themselves may or may not be provided in the course, but students are encouraged to read the resources listed if

the opportunity arises as they have valuable information that expands upon the lesson material. Students will not be tested on their knowledge of the Suggested Readings.

- 4. **Discussion Boards:** Discussion Boards are a part of all CSU term courses. Information and specifications regarding these assignments are provided in the Academic Policies listed in the Course Menu bar.
- Unit Assessments: This course contains eight Unit Assessments, one to be completed at the end of each unit. Assessments are composed of multiple-choice questions, matching questions, fill-in-the-blank questions, and/or written response questions.
- 6. **Unit Assignments:** Students are required to submit for grading Unit Assignments in Units IV, V, and VII. Specific information and instructions regarding these assignments are provided below. Grading rubrics are included with the Unit IV, V, and VII Assignments. Specific information about accessing these rubrics is provided below.
- 7. Ask the Professor: This communication forum provides you with an opportunity to ask your professor general or course content related questions.
- 8. Student Break Room: This communication forum allows for casual conversation with your classmates.

CSU Online Library

There is a virtual library with resources, including both journals and ebooks, to support your program and your course at Columbia Southern University. eResources are accessible 24 hours a day/7 days a week from the CSU Online Library gateway page. To access the library, log into myCSU, and then click on CSU Online Library. Resources are organized in the library by title, but if you click on Research Guides, you will find eResources arranged by subject.

The Library Reference service is available 7 days a week; you can reach CSU's virtual librarians by emailing <u>thevirtuallibrarian@columbiasouthern.edu</u>. These professional librarians will be glad to help you develop your research plan or to assist you in any way in finding relevant, appropriate, and timely information.

Librarian responses may occur within minutes or hours, but it will never take more than 24 hours for a librarian to send a response to the email address you have provided. Replies to reference requests may include customized keyword search strategies, links to videos, research guides, screen captures, attachments, a phone call, live screen sharing, and meeting room appointments, as well as other forms of instruction.

Unit Assignments

Unit IV Article Review

For this assignment, you are required to read the article entitled "HazMat Emergencies: Decontamination and Victim Chain of Survival," by Gunderson, Helikson, and Heffner (2014), and write a review. The article may be found in the Academic Search Complete database in the CSU Online Library. Your review must include the following:

- Summarize the key points presented in the article.
- Describe the key elements of a solid emergency response program.
- Discuss why proper decontamination of victims is important.
- Discuss your opinion or what you can conclude from the article.

Your response must be at least 800 words in length. All sources used, including this article, must be referenced. Paraphrased and/or quoted materials must have accompanying in-text and reference citations in APA format.

Information about accessing the Blackboard Grading Rubric for this assignment is provided below.

Unit V Research Paper

For this assignment, write about a hazardous materials incident or an environmental health and safety (EHS) project that involves a material(s) with a hazard(s) that falls under the hazard classification that we have studied so far (water/air reactive, corrosive, or toxic). The incident or project could be one that you have researched or been involved with. Your essay must include the following:

- summary of the project or incident,
- identification of the hazardous material(s) involved and hazardous classification,
- discussion of chemical properties and interactions relevant to the incident/project,

- any short or long-term mitigation implemented, and
- conclusion (your professional opinion on the project/incident).

Your response must be at least 400 words in length. You are required to use at least two references, including your textbook for your response. All sources used, including the textbook, must be referenced. Paraphrased and/or quoted materials must have accompanying citations in APA format

Information about accessing the Blackboard Grading Rubric for this assignment is provided below.

Unit VII Case Study

Read the incident scenario, and write a response that is at least three pages in length. Your response must include answers to the questions being asked. All sources used, including the textbook, must be referenced. Paraphrased and/or quoted materials must have accompanying in-text and reference citations in APA format.

Scenario:

You are the Refinery Emergency Response Coordinator for an incident at the SJV Refinery which has been in operation since 1966. The refinery processes 120,000 bbls of crude oil per day, which has a sulfur content of 2.5 percent. The refinery converts crude oil to naptha, light oil, and heavy oils using the Atmospheric/Vacuum Distillation Unit with key equipment such as the following:

- naptha, kerosene, gasoline, and diesel hydrotreaters;
- isomerization unit;
- naptha reformer;
- fluid catalytic cracker;
- coker;
- hydrocracker;
- polymerization unit (petrochemical section of the refinery polymerizing olefin gases to produce polyethylene);
- sulfur recovery Claus plant (catalytic reactors); and
- distillate/gasoline blending tanks.

The refinery was initiating work on a major plant turnaround at the time of the incident to complete required maintenance repairs, mechanical integrity inspections, and modifications to existing equipment. Twenty contractor companies (approximately 150 employees) have been contracted to perform this work under the direction of refinery staff. All of the contractor workers completed the refinery orientation training.

Work for the contractor crews is assigned/scheduled each morning. On the day of the incident, the day-shift (6 am to 6 pm) crew had been tasked with isolating the acid gas feed stream for the Claus unit. Due to other work priorities, the crew did not isolate the line as planned. A shift turnover for the night contractor crew did not happen due to mandatory safety training that delayed their arrival at the worksite. Upon their arrival at the work site, the night crew held a job safety analysis (JSA) review of the scheduled task (line breaking of the acid gas feed line to replace a segment) to be performed and the hazards present. No pressure gauges or monitoring was present to indicate that the acid gas feed line was operational. The crew initiated the line breaking activity (open the line to the atmosphere) at approximately 7:45 pm under self-contained breathing apparatus (SCBA), which almost immediately resulted in the uncontrolled release of acid gas. A nearby ignition source from a welding operation ignited the flammable gas. The following actions were initially taken:

- The evacuation alarm was sounded and the refinery emergency response team (ERT) was activated.
- The plant manager and the local fire department were notified of the incident.
- The incident command was established at the refinery office near the main refinery access gate to the south (this is the furthest distance within the refinery boundary from the incident location).
- The refinery ERT incident commander implemented actions required under the approved refinery emergency response plan.
- The ERT was not able to immediately isolate the acid gas feed pipeline.
- The fire department arrived on location and assumed the incident command of the event.

Additional Relevant Information:

• The refinery encompasses an area measuring 2000 feet by 1400 feet. The Claus unit is located in the most northern part of the refinery, approximately 1350 feet from the main refinery access gate to the south. The polymerization unit is operating directly adjacent to the Claus unit.

- The nearest residential community is located approximately 1000 feet to the northeast of the refinery.
- A plastic recycling plant is located along the south fence boundary of the refinery.
- A major interstate highway runs directly parallel to the plant, approximately 1/4 of a mile directly north of the refinery.
- The ambient temperature on the day of the incident was 85° F and the wind was blowing at 7 mph from the southwest to the northeast.
- Work crews were scheduled to work 12-hour shifts, 24-hours a day, to complete the refinery turnaround.
- Due to the age of the refinery, SJV has implemented a robust mechanical integrity program.
- The refinery has a trained ERT that can respond to incidents.
- Fixed water monitors are present throughout the refinery to extinguish refinery equipment fires. The refinery ERT does not fight fires past the incipient stage.
- The refinery has received notices of violation (NOVs) from the local air district in the past several years due to gas and liquid leaks from piping components, such as valves, compressor/pump seals, and for excess sodium dioxide (SO₂) emissions related with their sulfur plant.
- Due to historical discharges of organic compounds, groundwater monitoring wells are present down gradient of the facility. Groundwater underlying the plant has historically been encountered at 30 feet below ground surface.
- Hydrogen sulfide is present in the acid gas feed to the Claus plant. The H₂S concentration of the acid gas feed is approximately 70 percent by volume. H₂S and sulfur dioxide (SO₂) have the following physical properties:

| Physical Property | H ₂ S | SO ₂ | |
|---------------------------------|------------------|-----------------|--|
| Specific Gravity at 68°F (20°C) | 1.54 | 1.4 | |
| Vapor Density (Air=1) | 1.18 | 2.22 | |
| Flashpoint | -116°F (-82.4°C) | Not Applicable | |
| Autoignition Point | 500°F (260°C) | Not Applicable | |
| Lower Explosive Limit | 4.3% | Not Applicable | |
| Upper Explosive Limit | 46% | Not Applicable | |
| IDLH | 100 ppm | 100 ppm | |

Questions:

- 1. Discuss the hazards posed by the interaction of the hazardous materials present at the refinery and adjacent facilities, including the resulting by-products of the incident fire and acid gas release.
- 2. As the lead refinery representative on the unified incident command (UIC), what actions should be taken by the UIC to respond to this incident (please consider all receptors).
- 3. If the polymerization unit is engulfed in the fire, how will this affect your response?
- 4. All emergency responders participated in the post-incident critique. What corrective actions should be implemented by the refinery to prevent the reoccurrence of this incident?

Information about accessing the Blackboard Grading Rubric for this assignment is provided below.

APA Guidelines

CSU requires that students use APA style for papers and projects. Therefore, the APA rules for formatting, quoting, paraphrasing, citing, and listing of sources are to be followed. Students can find CSU's Citation Guide in the myCSU Student Portal by clicking on the "Citation Resources" link in the "Learning Resources" area of the myCSU Student Portal. This document includes examples and sample papers and provides information on how to contact the CSU Success Center.

Blackboard Grading Rubrics

Assignment Rubrics

One or more assignments in this course utilizes a Blackboard Grading Rubric. A rubric is a tool that lists evaluation criteria and can help you organize your efforts to meet the requirements of an assignment. Your professor will use the Blackboard Grading Rubric to assign points and provide feedback for the assignment.

You are encouraged to view the assignment rubric before submitting your work. This will allow you to review the evaluation criteria as you prepare your assignments. You may access the rubric in "My Grades" through the "Tools" button

in your course menu. Click the "View Rubric" link to see the evaluation criteria for the assignment. Upon receiving your assignment grade, you may view your grade breakdown and feedback in the rubric.

CSU Grading Rubrics for Papers/Projects, Discussion Boards, and Assessments

The Learning Resource area of the myCSU Student Portal provides the rubrics, and information on how to use them, for Discussion Boards, written response questions in Unit Assessments, and Research Papers/Projects.

The course writing assignments will be graded based on the CSU Grading Rubric for all types of writing assignments, *unless otherwise specified within assignment instructions*. In addition, all papers will be submitted for electronic evaluation to rule out plagiarism. Course projects will contain project-specific grading criteria defined in the project directions.

To view the rubrics, click the Academic Policies link on the Course Menu, or access them through the CSU Grading Rubric link found in the Learning Resources area of the myCSU Student Portal.

Communication Forums

These are non-graded discussion forums that allow you to communicate with your professor and other students. Participation in these discussion forums is encouraged, but not required. You can access these forums with the buttons in the Course Menu. Instructions for subscribing/unsubscribing to these forums are provided below.

Click here for instructions on how to subscribe/unsubscribe and post to the Communication Forums.

Ask the Professor

This communication forum provides you with an opportunity to ask your professor general or course content questions. Questions may focus on Blackboard locations of online course components, textbook or course content elaboration, additional guidance on assessment requirements, or general advice from other students.

Questions that are specific in nature, such as inquiries regarding assessment/assignment grades or personal accommodation requests, are NOT to be posted on this forum. If you have questions, comments, or concerns of a non-public nature, please feel free to email your professor. Responses to your post will be addressed or emailed by the professor within 48 hours.

Before posting, please ensure that you have read all relevant course documentation, including the syllabus, assessment/assignment instructions, faculty feedback, and other important information.

Student Break Room

This communication forum allows for casual conversation with your classmates. Communication on this forum should always maintain a standard of appropriateness and respect for your fellow classmates. This forum should NOT be used to share assessment answers.

Grading

| Total | = | 100% |
|---|---|------|
| Unit VII Case Study | = | 25% |
| Unit V Research Paper | = | 10% |
| Unit IV Article Review | = | 20% |
| Unit Assessments IV, VII (2 @ 2.5%) | = | 5% |
| Unit Assessments I, II, III, V, VI, VIII (6 @ 5%) | = | 30% |
| Discussion Boards (8 @ 1.25%) | = | 10% |

Course Schedule/Checklist (PLEASE PRINT)

The following pages contain a printable Course Schedule to assist you through this course. By following this schedule, you will be assured that you will complete the course within the time allotted.

BOS 3640, Interactions of Hazardous Materials

By following this schedule, you will be assured that you will complete the course within the time allotted. Please keep this schedule for reference as you progress through your course.

| Unit I | Introduction to Chemistry |
|--------------|---|
| Review: | Unit Study Guide |
| Read: | Chapter 1: Introduction Chapter 2: Some Features of Matter and Energy Chapter 4: Chemical Forms of Matter Suggested Reading: See Study Guide |
| Discuss: | Discussion Board Response: Submit your response to the Discussion Board question by Saturday, Midnight (Central Time) Discussion Board Comment: Comment on another student's Discussion Board response by Tuesday, Midnight (Central Time) |
| Submit: | Assessment by Tuesday, Midnight (Central Time) |
| Notes/Goals: | |

| Unit II | Chemistry of Some Common Elements |
|--------------|---|
| Review: | Unit Study Guide |
| Read: | Chapter 6: Use of the DOT Hazardous Materials Regulations by Emergency Responders Chapter 7: Chemistry of Some Common Elements Suggested Reading: See Study Guide |
| Discuss: | Discussion Board Response: Submit your response to the Discussion Board question by Saturday, Midnight (Central Time) Discussion Board Comment: Comment on another student's Discussion Board response by Tuesday, Midnight (Central Time) |
| Submit: | Assessment by Tuesday, Midnight (Central Time) |
| Notes/Goals: | |

| Unit III | Chemistry of Acids/Bases and Water/Air-Reactive Materials |
|--------------|---|
| Review: | Unit Study Guide |
| Read: | Chapter 8: Chemistry of Some Corrosive Materials Chapter 9: Chemistry of Some Water- and Air-Reactive Substances Suggested Reading: See Study Guide |
| Discuss: | Discussion Board Response: Submit your response to the Discussion Board question by Saturday, Midnight (Central Time) Discussion Board Comment: Comment on another student's Discussion Board response by Tuesday, Midnight (Central Time) |
| Submit: | Assessment by Tuesday, Midnight (Central Time) |
| Nistes/Ossie | |

Notes/Goals:

BOS 3640, Interactions of Hazardous Materials

| Unit IV | Chemistry of Toxic Substances |
|--------------|---|
| Review: | Unit Study Guide |
| Read: | Reading Assignment: See Study Guide Suggested Reading: See Study Guide |
| Discuss: | Discussion Board Response: Submit your response to the Discussion Board question by Saturday, Midnight (Central Time) Discussion Board Comment: Comment on another student's Discussion Board response by Tuesday, Midnight (Central Time) |
| Submit: | Assessment by Tuesday, Midnight (Central Time) Article Review by Tuesday, Midnight (Central Time) |
| Notoo/Coole: | |

Notes/Goals:

| Unit V | Chemistry of Some Oxidizers |
|--------------|---|
| Review: | Unit Study Guide |
| Read: | Chapter 5: Principles of Chemical Reactions Chapter 11: Chemistry of Some Oxidizers Suggested Reading: See Study Guide |
| Discuss: | Discussion Board Response: Submit your response to the Discussion Board question by Saturday, Midnight (Central Time) Discussion Board Comment: Comment on another student's Discussion Board response by Tuesday, Midnight (Central Time) |
| Submit: | Assessment by Tuesday, Midnight (Central Time) Research Paper by Tuesday, Midnight (Central Time) |
| Notes/Goals: | |

| Unit VI | Chemistry of Some Hazardous Organic Compounds |
|--------------|---|
| Review: | Unit Study Guide |
| Read: | Chapter 12: Chemistry of Some Hazardous Organic Compounds: Part I Chapter 13: Chemistry of Some Hazardous Organic Compounds: Part II Suggested Reading: See Study Guide |
| Discuss: | Discussion Board Response: Submit your response to the Discussion Board question by Saturday, Midnight (Central Time) Discussion Board Comment: Comment on another student's Discussion Board response by Tuesday, Midnight (Central Time) |
| Submit: | Assessment by Tuesday, Midnight (Central Time) |
| Notes/Goals: | |

Course Schedule

BOS 3640, Interactions of Hazardous Materials

| Unit VII | Chemistry of Toxic Substances |
|--------------|---|
| Review: | Unit Study Guide |
| Read: | Chapter 14: Chemistry of Some Polymeric Materials Suggested Reading: See Study Guide |
| Discuss: | Discussion Board Response: Submit your response to the Discussion Board question by Saturday, Midnight (Central Time) Discussion Board Comment: Comment on another student's Discussion Board response by Tuesday, Midnight (Central Time) |
| Submit: | Assessment by Tuesday, Midnight (Central Time) Case Study by Tuesday, Midnight (Central Time) |
| Notes/Goals: | |

| Unit VIII | Chemistry of Toxic Substances |
|--------------|---|
| Review: | Unit Study Guide |
| Read: | Chapter 15: Chemistry of Some Explosives Chapter 16: Radioactive Materials Suggested Reading: See Study Guide |
| Discuss: | Discussion Board Response: Submit your response to the Discussion Board question by Saturday, Midnight (Central Time) Discussion Board Comment: Comment on another student's Discussion Board response by Tuesday, Midnight (Central Time) |
| Submit: | Assessment by Tuesday, Midnight (Central Time) |
| Notes/Goals: | |