Course Description

A study of solid and hazardous wastes and how such wastes are managed in modern society. Topics covered are the generation, treatment, and disposal of wastes generated by the non-commercial and industrial segments of society.

Course Textbook


Course Learning Outcomes

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

1. Assess the fundamental science and engineering principles applicable to the management and treatment of solid and hazardous wastes.
2. Examine the key attributes of solid and hazardous wastes.
3. Evaluate laws, standards, and best practices related to hazardous wastes.
4. Examine leadership and management principles related to industrial and hazardous waste issues.
5. Evaluate operations and technologies related to industrial and hazardous wastes.
6. Assess the impact of industrial and hazardous waste on human populations.
7. Solve hazardous waste related problems through collaborative methods of problem solving.

Credits

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

Course Structure

1. **Study Guide**: Each unit contains a Study Guide that provides students with the learning outcomes, unit lesson, required reading assignments, and supplemental resources.
2. **Learning Outcomes**: Each unit contains Learning Outcomes that specify the measurable skills and knowledge students should gain upon completion of the unit.
3. **Unit Lesson**: Each unit contains a Unit Lesson, which discusses lesson material.
4. **Reading Assignments**: Units I-VII contain Reading Assignments from one or more chapters from the textbook.
5. **Suggested Reading**: Suggested Readings are listed in the Unit I-V and VIII study guides. Students are encouraged to read the resources listed if the opportunity arises, but they will not be tested on their knowledge of the Suggested Readings.
6. **Unit Assessments**: This course contains eight Unit Assessments, one to be completed at the end of each unit. Assessments are composed of written-response questions.
7. **Unit Assignments**: Students are required to submit for grading Unit Assignments in Units I-III, V, VI, and VIII. Specific information and instructions regarding these assignments are provided below. Grading rubrics are included with each assignment. Specific information about accessing these rubrics is provided below.
8. **Ask the Professor:** This communication forum provides you with an opportunity to ask your professor general or course content related questions.
9. **Student Break Room:** This communication forum allows for casual conversation with your classmates.

### CSU Online Library

The CSU Online Library is available to support your courses and programs. The online library includes databases, journals, e-books, and research guides. These resources are always accessible and can be reached through the library webpage. To access the library, log into the myCSU Student Portal, and click on “CSU Online Library.” You can also access the CSU Online Library from the "My Library" button on the course menu for each course in Blackboard.

The CSU Online Library offers several reference services. E-mail (library@columbiasouthern.edu) and telephone (1.877.268.8046) assistance is available Monday – Thursday from 8 am to 5 pm and Friday from 8 am to 3 pm. The library’s chat reference service, *Ask a Librarian*, is available 24/7; look for the chat box on the online library page.

Librarians can help you develop your research plan or assist you in finding relevant, appropriate, and timely information. Reference requests can include customized keyword search strategies, links to articles, database help, and other services.

### Unit Assignments

#### Unit I Project

Over the course of these eight units, we will be developing a course project. We will do a single section of the course project in every unit by completing one section of the course project, and then adding to it with the subsequent work in the following unit. This unit work will be in the form of unit projects.

In following units (Units II, III, V, VI, and VIII), the Unit Lesson will contain an interactive model that will enable you to effectively select the most appropriate equipment and technology to engineer into your waste management system design for the facility. It is imperative that you read the Unit Lessons within the study guide in each unit, use the interactive model, and consider the current (as well as previous) material from Bahadori’s (2014) textbook in every unit. This project will serve as a comprehensive demonstration of your applied learning of engineering industrial and hazardous waste treatment systems.

Your course project will be to develop a document titled “A Proposal for an Industrial Waste Treatment Facility” and will serve as a simulation of your work as a contract environmental engineer for a small, rural town in the United States.

The Scenario:
*You have contracted with the city named Small Town, USA, to design and engineer a municipal industrial waste pretreatment facility. The city currently accepts liquid wastes from three significant industrial users (SIU): (a) a petroleum refinery, (b) an animal rendering plant, and (c) a tanker truck washout. In an effort to capture revenue, the city is currently accepting the liquid waste physically hauled by tanker truck from all three SIU members and is subsequently collecting the liquid wastes into a 300,000 gallon storage tank, pending your facility design.*

*The city wants to be able to effectively treat and neutralize the liquid waste, landfill or reuse the sludge in an agriculture application, and discharge the neutralized treatment plant effluent water to the existing municipal (residential) wastewater plant for final treatment after successfully meeting the local limits for each analyte.*

*The current waste profile has been analyzed at a local environmental chemical testing laboratory. This is the lab report at 30°C:*

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Concentration (mg/L or ppm)</th>
<th>Local Limits (mg/L or ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD</td>
<td>4200</td>
<td>1300</td>
</tr>
<tr>
<td>COD</td>
<td>6000</td>
<td>2400</td>
</tr>
<tr>
<td>TSS</td>
<td>800</td>
<td>160</td>
</tr>
<tr>
<td>pH</td>
<td>5.5</td>
<td>6.0-9.0</td>
</tr>
<tr>
<td>TDS</td>
<td>5000</td>
<td>200</td>
</tr>
<tr>
<td>TOC</td>
<td>1300</td>
<td>150</td>
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</table>
### Cyanides

<table>
<thead>
<tr>
<th>Compound</th>
<th>Standard</th>
<th>Allowance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenols</td>
<td>15</td>
<td>12</td>
</tr>
<tr>
<td>Cadmium</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>Chromium (trivalent)</td>
<td>5</td>
<td>0.25</td>
</tr>
<tr>
<td>Iron</td>
<td>800</td>
<td>50</td>
</tr>
<tr>
<td>H₂S (hydrogen sulfide)</td>
<td>6</td>
<td>0.5</td>
</tr>
<tr>
<td>TPH (total petroleum hydrocarbons)</td>
<td>1600</td>
<td>640</td>
</tr>
</tbody>
</table>

Instructions:

1. Closely read the Required Reading assignment from Bahadori (2014) and the Unit Lesson within the Study Guide.
2. Use APA style (title page, body with level one headings, and a reference page) for a research paper, and begin drafting a proposal document. You will add to this document in every unit with another level one heading.
3. Since this is a project that you add to throughout the course, make your Unit I work your first level one heading, titled “Municipal Situation,” and describe the scenario that is presented above. You are required to describe the scenario in at least one page.

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

**Unit II Project**

As a continuation of our course project due in Unit VIII (a proposal for an industrial and hazardous waste treatment facility), complete the next two sections (management considerations and physical treatment) of your proposal by following the instructions carefully, and then submit your continued draft of your proposal into Blackboard for grading.

Instructions:

1. Closely read the Required Reading assignment from Bahadori (2014) and the Unit Lesson within the Study Guide.
2. Open your proposal draft from Unit I and make any improvements to your draft using your professor’s feedback from the Unit I project assignment.
3. Open the Unit II Study Guide, read the Unit II Lesson, and then work with the embedded interactive model to decide what physical treatment equipment to include in your treatment process design.
4. Continue from your Unit I Project and make your second level one heading titled “Management Considerations.” Discuss the following variables as part of the scenario. Be sure to mention your intentions to provide physical treatment, chemical treatment, biological treatment, general sewage treatment techniques, and solid waste treatment using the financial resources identified below. Also, consider how you would organize, manage, and lead staff. Discuss what staff certifications and facility licenses will be required in order to operate the facility. Finally, discuss when you anticipate that the facility will demonstrate a return on the investment (ROI):

   - Capital costs of construction budget: $1,000,000 (5-year note)
   - Capital cost of equipment budget: $1,000,000 (5-year)
   - O&M budget: $500,000/year
   - Forecasted revenue generation: $1,000,000/year
   - Useful life of plant: 15 years minimum
   - Loan interest rate: 5% (5 year note)
   - Operating hours: Monday through Friday: 0800hrs – 1700hrs
   - Available personnel: 4 staff members

   You are required to describe the scenario in at least one page.

5. Continue from your Unit I Project and make your third level one heading titled “Physical Treatment.” Discuss what physical treatment equipment you are proposing for your treatment process. Be sure and describe why you selected the equipment and what final effluent concentrations you anticipate will be lowered with the equipment. You are required to describe the equipment selection in at least one page.
Information about accessing the Blackboard Grading Rubric for this assignment is provided below.

**Unit III Project**

As a continuation of our course project due in Unit VIII (a proposal for an industrial and hazardous waste treatment facility), complete the next (fourth) section (chemical treatment) of your proposal by following the instructions carefully, and then submit your continued draft of your proposal into Blackboard for grading.

Instructions:

1. Closely read the Required Reading assignment from Bahadori (2014) and the Unit Lesson within the Study Guide.
2. Open your proposal draft from Unit II and make any improvements to your draft using your professor’s feedback from the Unit II project assignment.
3. Open the Unit III Study Guide, read the unit lesson, and then work with the embedded interactive model to decide what chemical treatment equipment to include in your treatment process design.
4. Continue from your Unit II Project and make your fourth level one heading titled “Chemical Treatment.” Describe the chemical treatment equipment that you engineered into your treatment process. Be sure and describe the relevance and anticipated reduction of related analytical concentrations within your industrial and hazardous waste treatment system as they correspond with each technology that you selected.

You are required to describe the equipment selection in at least 200 words (minimum).

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

**Unit V Project**

As a continuation of our course project due in Unit VIII (a proposal for an industrial and hazardous waste treatment facility), complete the next (fifth) section (biological and secondary treatment) of your proposal by following the instructions carefully, and then submit your continued draft of your proposal into Blackboard for grading.

Instructions:

1. Closely read the Required Reading assignment from Bahadori (2014) and the Unit Lesson within the Study Guide.
2. Open your proposal draft from Unit III and make any improvements to your draft using your professor’s feedback from the Unit III project assignment.
3. Open the Unit V Study Guide, read the unit lesson, and then work with the embedded interactive model to decide what biological and secondary treatment equipment to include in your treatment process design.
4. Continue from your Unit III Project and make your fifth level one heading titled “Biological and Secondary Treatment.” Describe the secondary treatment equipment that you engineered into your treatment process. Be sure and describe the relevance and anticipated reduction of related analytical concentrations within your industrial and hazardous waste treatment system as they correspond with each technology that you selected.

You are required to describe the equipment selection in at least one page.

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

**Unit VI Project**

As a continuation of our course project due in Unit VIII (A Proposal for an Industrial and Hazardous Waste Treatment Facility), complete the next (sixth) section (solid waste treatment) of your proposal by following the instructions carefully, and then submit your continued draft of your proposal into Blackboard for grading.

Instructions:

1. Closely read the Required Reading assignment from Bahadori (2014) and the Unit Lesson within the Study Guide.
2. Open your proposal draft from Unit V and make any improvements to your draft using your professor’s feedback from the Unit V project assignment.
3. Open the Unit VI Study Guide, read the unit lesson, and then work with the embedded interactive model to decide what solid waste treatment equipment to include in your treatment process design.
4. Continue from your Unit V Project and make your sixth level one heading titled “Solid Waste Treatment.” Describe the solid waste treatment equipment that you engineered into your treatment process (sludge dewatering equipment). Be sure and describe the relevance and anticipated reduction of related analytical concentrations within your industrial and hazardous waste treatment system as they correspond with each technology that you selected.

You are required to describe the equipment selection in at least one page.

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

Unit VIII Course Project

As the final and complete step of our course project (a proposal for an industrial and hazardous waste treatment facility), complete the last (seventh) section (cake solids disposal) of your proposal by following the instructions carefully. Draft a one paragraph abstract (insert the abstract immediately following the title page), and then submit your final copy of your completed proposal into Blackboard for grading.

Instructions:

1. Closely read the Required Reading assignment from Bahadori (2014) and the Unit Lesson within the Study Guide.
2. Open your proposal draft from Unit VI and make any improvements to your draft using your professor’s feedback from the Unit VI project assignment.
3. Open the Unit VIII Study Guide, read the unit lesson, strongly consider reading the article referenced in the suggested reading section, and then consider your filter cake disposal strategies available to you and your client.
4. Continue with your Unit VI Project and make your seventh level one heading titled “Cake Solids Disposal.” Describe the waste profiling process, the process of locating an appropriate site of final disposition for the filter cake, contracting with a landfill, and the paperwork associated with final disposal. You are required to describe the entire filter cake disposal process in at least one page.
5. Throughout the course you have continued to add pieces to the course project. After you have added the “Cake Solids Disposal” component to the project, review your project to be sure you have included all components from the course and incorporated feedback from the instructor. Along with the title page and reference list, create a one paragraph abstract following the title page that summarizes the entire project.

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

APA Guidelines

The application of the APA writing style shall be practical, functional, and appropriate to each academic level, with the primary purpose being the documentation (citation) of sources. CSU requires that students use APA style for certain papers and projects. Students should always carefully read and follow assignment directions and review the associated grading rubric when available. Students can find CSU’s Citation Guide by clicking here. This document includes examples and sample papers and provides information on how to contact the CSU Success Center.

Grading Rubrics

This course utilizes analytic grading rubrics as tools for your professor in assigning grades for all learning activities. Each rubric serves as a guide that communicates the expectations of the learning activity and describes the criteria for each level of achievement. In addition, a rubric is a reference tool that lists evaluation criteria and can help you organize your efforts to meet the requirements of that learning activity. It is imperative for you to familiarize yourself with these rubrics because these are the primary tools your professor uses for assessing learning activities.

Rubric categories include: (1) Assessment (Written Response) and (2) Assignment. However, it is possible that not all of the listed rubric types will be used in a single course (e.g., some courses may not have Assessments).

The Assessment (Written Response) rubric can be found embedded in a link within the directions for each Unit Assessment. However, these rubrics will only be used when written-response questions appear within the Assessment.
Each Assignment type (e.g., article critique, case study, research paper) will have its own rubric. The Assignment rubrics are built into Blackboard, allowing students to review them prior to beginning the Assignment and again once the Assignment has been scored. This rubric can be accessed via the Assignment link located within the unit where it is to be submitted. Students may also access the rubric through the course menu by selecting “Tools” and then “My Grades.”

Again, it is vitally important for you to become familiar with these rubrics because their application to your Assessments and Assignments is the method by which your instructor assigns all grades.

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.

Once you have completed Unit VIII, you MUST unsubscribe from the forum; otherwise, you will continue to receive e-mail updates from the forum. You will not be able to unsubscribe after your course end date.

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

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<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tr>
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<td>40%</td>
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<tr>
<td>Projects (5 @ 9%)</td>
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<td>Unit VIII Course Project</td>
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<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
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</tbody>
</table>

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.
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
**Industrial Hazardous Waste Attributes, Impacts, and Regulations**

- **Review:**
  - Unit Study Guide

- **Read:**
  - Chapter 1: Wastewater Treatment
  - Suggested Reading: See Study Guide

- **Submit:**
  - Assessment
  - Project

### Unit II
**Leadership and Management Aspects of Industrial and Hazardous Waste Management**

- **Review:**
  - Unit Study Guide

- **Read:**
  - Chapter 2: Physical Unit Operations

- **Submit:**
  - Assessment
  - Project

### Unit III
**Chemical Treatment of Industrial and Hazardous Waste**

- **Review:**
  - Unit Study Guide

- **Read:**
  - Chapter 3: Chemical Treatment
  - Suggested Reading: See Study Guide

- **Submit:**
  - Assessment
  - Project

### Unit IV
**Biological Treatment of Industrial and Hazardous Waste**

- **Review:**
  - Unit Study Guide

- **Read:**
  - Chapter 4: Biological Treatment
  - Suggested Reading: See Study Guide

- **Submit:**
  - Assessment

Notes/Goals:
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<th>Unit</th>
<th>Designing Liquid Waste Management Systems for Industrial and Hazardous Waste</th>
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<tbody>
<tr>
<td>Review</td>
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<tr>
<td>Read</td>
<td>Chapter 7: Sewage Treatment, Suggested Reading: See Study Guide</td>
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<td>Chapter 8: Solid Waste Treatment and Disposal</td>
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<table>
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<th>Unit VII</th>
<th>Integrated Approaches to Liquid and Solid Industrial &amp; Waste Management Systems Design</th>
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<tbody>
<tr>
<td>Review</td>
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<tr>
<td>Read</td>
<td>Chapter 5: Wastewater Treatment in Unconventional Oil and Gas Industries, pp. 129-143</td>
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<td></td>
<td>Chapter 6: Wastewater Sewer Systems, pp. 161-180</td>
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<td>Submit</td>
<td>Assessment</td>
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