FIRE 0641 - HAZARDOUS MATERIALS TECHNICIAN 1B, APPLIED CHEMISTRY

Catalog Description

Prerequisite: Completion of FIRE 640 with grade of "C" or better or approved Federal/State equivalent course(s)
Hours: 40 (24 lecture, 16 laboratory)
Description: Basic terminology and theory of chemistry as it relates to hazardous materials. Covers chemical aspects of the hazard classes, toxicology, including hazard and risk assessment, function and use of detection instruments, monitoring hazardous atmospheres and use of a field identification kit to identify unknown solids and liquids. Meets standards prescribed by the CA State Fire Marshal and Office of Emergency Services. (not transferable) (not degree applicable) (pass/no pass grading)

Course Student Learning Outcomes

- CSLO #1: Identify and explain the 9 hazard classifications and the hazards associated with each.
- CSLO #2: Explain why the incompatibility of chemicals is important to know for first responders.
- CSLO #3: Demonstrate the use of hazardous material detection equipment.

Effective Term

Fall 2019

Course Type

Credit - Nondegree-applicable

Contact Hours

40

Outside of Class Hours

48

Total Student Learning Hours

88

Course Objectives

Lecture Objectives:
1. Define the term "matter";
2. Analyze the three states of matter;
3. Explain physical and chemical change;
4. Organize information from the periodic table;
5. Differentiate between the four families: alkali metals, alkaline earths, halogens and noble gases;
6. Provide the chemical formula and list the hazards for six salts;
7. Compare and contrast salts vs. non-salts;
8. Describe the method for fighting explosives fires;
9. Differentiate explosive from non-explosives by their chemical formula, structure or characteristics;
10. List initiators of explosives;
11. Define and give examples of explosophores;
12. List three of the multiple hazards that the gases hazard class could have;
13. Compare the common characteristics of gases and how they are measured;
14. Predict the behavior of gases using the concepts of the gas laws and critical temperature and pressure;
15. Analyze the hazards associated with each of the three conditions of gas storage;
16. Evaluate the multiple hazards of flammable liquids and describe the following physical properties: vapor pressure, flash point, ignition temperature, flammable range, explosive limits, specific gravity, vapor density, boiling point, and the definitions of flammable and combustible liquids;
17. List several electronegative elements;
18. Compare spontaneous combustion, pyrolysis, surface burning and hyperbolic combustion;
19. Evaluate the three types of ignition;
20. List three elements that burn and their allotropes;
21. Compare the flammable solids cellulose nitrate and naphthalene;
22. List several flammable and combustible metals and their hazards;
23. Differentiate between the processes of oxidation and reduction;
24. List some common uses of organic peroxides, identifying them by name or formula;
25. Prepare a list of the hazards and classification of organic peroxides;
26. Compare and contrast the two types of radiation, identify those elements that are naturally radioactive;
27. Assess each of the three types of ionizing radiation and the three types of protective measures;
28. Evaluate the various sources of background radiation and a typical annual exposure;
29. Differentiate between internal and external contamination and contamination vs. exposure;
30. Analyze the difference between the strength and concentration of corrosives, including how these are measured and how they pertain to the risk posed by that corrosive;
31. Describe the reaction that occurs between acids and bases and other materials;
32. Compare the processes of absorption, dilution and neutralization, including the advantages and disadvantages of each of these methods when used for mitigating corrosives spills;
33. Describe the importance of chemical compatibility to responders;
34. Analyze the four types of chemical reactions;
35. Generate a list of the rules of solubility and use an incompatibility chart to determine the potential reaction(s) between two materials;
36. Examine the OSHA requirements for entry into a confined space;
37. List the four uses of monitoring and the types of instruments available, including the capabilities of each;
38. Design a monitoring strategy to analyze unknown atmospheres including an analysis of site-specific conditions;
39. Identify emergency exposure limits set by the EPA;
40. Calculate the inverse square law and the appropriate shielding based on the type of shielding present;
41. Evaluate the various types of radiation detection equipment, what they measure, and how to utilize them;
42. Define what CGIs are designed to detect and how they operate;
43. Describe how to interpret the results of a CGI and list some of their limitations;
44. Define what PIDs are designed to detect and how they operate;
45. Describe how to interpret the results of a PID and list some of their limitations;

46. Evaluate and defend safe and unsafe behaviors as they pertain to chemical handling;
47. Identify the principles and tests used in the field identification kits to determine the hazards of identity of unknown chemicals;
48. Define toxicology;
49. List two subdivisions of toxicology;
50. Compare the seven types of toxins and describe the characteristics and behavior of each;
51. Describe the two major determinants that affect toxicity; and
52. Examine the concept of dose-response relationships and define the reading levels.
Laboratory Objectives:
1. Diagram atomic structure;
2. Distinguish between hydrocarbon radicals and derivatives and draw their structural formulas;
3. Categorize the five DOT divisions of explosives;
4. Conclude the probable location of flammable atmospheres from low an high vapor pressure liquids;
5. List the three special conditions associated with burning flammable liquids;
6. Diagram the process of oxidation;
7. Diagram the peroxide functional group in organic oxidizers and identify the NFPA classification system for oxidizers;
8. Describe the process of looking for contaminants in air;
9. Investigate the major components of a normal atmosphere and the types of contaminants which make an atmosphere hazardous;
10. Defend the process of finding unknown gases based on vapor density and interpreting results;
11. Prepare a CGI for use and properly use it to monitor an unknown atmosphere;
12. Describe how to interpret the results of a CGI and list some of their limitations;
13. Prepare a PID for use and properly use it to monitor an unknown atmosphere; and
14. Evaluate colorimetric tubes, electrochemical sensors, flame ionization detectors and infrared spectroscopy and describe what they are designed to detect, how they work, and some of the use considerations and limitations.

General Education Information

- Approved College Associate Degree GE Applicability
- CSU GE Applicability (Recommended-requires CSU approval)
- Cal-GETC Applicability (Recommended - Requires External Approval)
- IGETC Applicability (Recommended-requires CSU/UC approval)

Articulation Information

- Not Transferable

Methods of Evaluation

- Objective Examinations
  - Example: Students will take a written examination on gases and liquids. Standard Grading. Sample question: What distinguishes a gas from a liquid and why is this definition limited in usefulness for emergency responses?
- Reports
  - Example: In a report, students are to explain the difference between maximum safe storage temperature and self accelerating decomposition temperature. Rubric Grading.
- Skill Demonstrations
  - Example: Students will prepare a PID for use and properly use it to monitor an unknown atmosphere. Grade based on industry standard Pass/Fail.

Repeatable

No

Methods of Instruction

- Laboratory
- Lecture/Discussion

Lab:

1. The instructor will review how elements on the periodic table of elements are placed into families and groups. Using a provided list of elements, the students will place the elements into the correct family or group.

Lecture:

1. The instructor will lecture on reactivity between flammable solids and air, water or halogens. Students will then work in small groups to determine the reactivity of various flammable solids to air, water or halogens.

Typical Out of Class Assignments
Reading Assignments

1. The student will read the material in the textbook on OSHA requirements for entry into a confined space, then fill out the proper forms to obtain a permit to enter an above ground storage tank. 2. The student will read the material in the textbook on DOT divisions of explosives. Using the provided list of explosives, assign the explosives to the correct division and be prepared to discuss your decision in class.

Writing, Problem Solving or Performance

1. The student will complete activity sheets which require students to analyze situations, apply rules, evaluate objects or situations. 2. The student will prepare a list comparing and contrasting the three ways which gases are stored. Discuss some of the hazards associated with each.

Other (Term projects, research papers, portfolios, etc.)
Required Materials

- Hazardous Materials Technician 1B Applied Chemistry Student Manual
  - Author: California Specialized Training Institute
  - Publisher: State of California
  - Publication Date: 2003
  - Text Edition:
  - Classic Textbook?:
  - OER Link:
  - OER:
- Chemistry of Hazardous Materials
  - Author: Eugene Meyer
  - Publisher: Brady

- Publication Date: 2010
- Text Edition: 5th
- Classic Textbook?:
- OER Link:
- OER:

- Hazardous Materials, Managing the Incident
  - Author: Gregory G. Noll and Michael S. Hildebrand
  - Publisher: Jones and Bartlett Learning
  - Publication Date: 2014
  - Text Edition: 4th
  - Classic Textbook?:
  - OER Link:
  - OER:

Other materials and-or supplies required of students that contribute to the cost of the course.