

Prepared by the Department of Social Sciences and Human Services

Date of Departmental Approval: September 15, 2006

Date approved by Curriculum and Programs: September 27, 2006

Effective: Fall 2007

**1. Course Number: FSC105**

**Course Title: Hazardous Materials**

**2. Description:** This course reviews the fundamental physical and chemical principles which govern the behavior of Hazardous Materials. Specifically, the course deals with identifying Hazardous Materials and the hazards of solids, dusts, water reactive materials, liquids, gases, toxic materials, plastics, corrosives, oxidizing agents, explosives, radioactivity, LP gases, cryogenics, general hazards and electricity. Handling, transporting, storage and recommended fire fighting practices within extreme fire hazard areas are discussed. Laboratory demonstrations illustrate and supplement the class work.

**3. Student Learning Outcomes (instructional objectives; intellectual skills):** Upon successful completion of this course, students are able to do the following:

- Discuss the hazards involved in dealing with identified and unidentified Hazardous Materials.
- Make more informed judgments for implementing proper actions in dealing with Hazardous Materials
- Recognize existing knowledge gaps before incidents occur, rather than during the performance of emergency procedures.
- Engage in ongoing professional development and training for dealing with Hazardous Materials emergencies.
- Know governmental regulations for the storage, transportation and handling of Hazardous Materials.

**4. Credits:** 3 credits

**5. Satisfies General Education Requirement:** No

**6. Prerequisites:** CHM106 Survey of Chemistry or CHM101 General Chemistry I or CHM109 Chemistry for the Health Sciences I

**7. Semester(s) Offered:** Varies

**8. Suggested General Guidelines for Evaluation:** The student is evaluated by performance on quizzes, a Final Exam, weekly problems and a Term Report. The student must demonstrate competence in using reference materials, reading comprehension and writing skills.

**9. General Topical Outline (Optional):**

I. Fundamentals

A. Metric System

1. Volume
2. Mass
3. Length
4. Density

B. Temperature

1. Fahrenheit
2. Celsius
3. Kelvin
4. Temperature and Heat
  - a. Specific Heat
  - b. Heat of Fusion
  - c. Heat of Vaporization

C. Matter

1. Phases or States
  - a. Solids
  - b. Liquids

- c. Gases
    - d. Plasma
  - 2. Compounds
    - a. Molecules
    - b. Atoms
  - 3. Elements
    - a. Atoms
      - i. Protons
      - ii. Electrons
      - iii. Neutrons
  - 4. Energy Considerations
    - a. Conservation of Mass
    - b. Conservation of Energy
  - 5. Rate of Reactions
    - a. Reaction Coordinate vs. Energy
    - b. Collision Frequency
    - c. Energy Factor
    - d. Probability Factor
    - e. Exothermic and Endothermic Reactions
    - f. Energy of Activation
    - g. Catalysts
- D. Combustion and Explosion
  - 1. Rapid Oxidation
  - 2. Deflagration
  - 3. Detonation
  - 4. Rate Constants
  - 5. Subsonic and Supersonic
- E. The Chemistry of Fire
  - 1. Oxygen
  - 2. Fuel
  - 3. Heat
  - 4. Molecular Chain Reactions
- F. Kinetic Molecular Theory
  - 1. Ideal Gas Law
  - 2. Solids and Liquids
  
- G. Important Definitions
  - 1. Flash Point
  - 2. Flammable Limits
  - 3. Fire Point
  - 4. Ignition Temperature
  - 5. Boiling Point
  - 6. Vapor Pressure
  - 7. Vapor Density
- H. Heat Transfer
  - 1. Conduction
  - 2. Convection
  - 3. Radiation
- I. The Fire Gases
  
- II. Combustible Solids, Dusts, Metals and Water Reactive Materials
  - A. Solids
    - 1. Wood
    - 2. Paper
    - 3. Cotton
    - 4. Carbon
    - 5. Phosphorous
    - 6. Sulfur
  - B. Dusts
    - 1. Graineries
    - 2. Warehouses
  - C. Metals
    - 1. Sodium
    - 2. Potassium
    - 3. Magnesium

- 4. Class D Fire Extinguishers
- 5. Other Metals

### III. Flammable Liquids

- A. Hydrocarbons
  - 1. Aliphatic
  - 2. Aromatic
  - 3. Fuel Oils
- B. Alcohols
- C. Ethers
- D. Amines
- E. Aldehydes & Ketones
- F. Esters
- G. Animal and Vegetable Oils
- H. Boiling Liquid Expanding Vapor Explosions
  - 1. Storage Tanks
  - 2. Boilovers

### IV. Compressed Gases

- A. Classification
  - 1. Flammable
  - 2. Unstable
  - 3. Explosive
  - 4. Corrosive
  - 5. Toxic
- B. Cylinders
  - 1. Pressure Restrictions
  - 2. Safety Features
- C. Anesthetics
- D. Acetylene
- E. Hydrogen
- F. Oxygen
- G. Air
- H. Nitrogen

### V. Toxicity

- A. Toxins
  - 1. Cytotoxin
  - 2. Neurotoxin
  - 3. Hemotoxin
- B. Measurement of Toxicity
  - 1. LD50
  - 2. LC50
  - 3. TLV
- C. Irritants
- D. Asphyxiants
- E. Nerve Poisons
- F. Systemic Poisons

### VI. Plastics

- A. History
- B. Composition
- C. Tradenames
- D. Classification
  - 1. Thermoplastics
  - 2. Thermosets
- E. Evolution of Toxic Fire Gases

### VII. Corrosive Materials and Oxidizing Agents

- A. Corrosive Materials
  - 1. Definition
  - 2. Acids
  - 3. Bases
- B. Oxidizing Agents
  - 1. Peroxides
  - 2. Nitrates

3. Dichromates
4. Permanganates
5. Halogens

#### VIII. Explosives

- A. Combustion vs. Explosion
- B. Shock Waves
- C. Sensitivity
- D. High Explosives
- E. Primary Explosives
- F. Secondary Explosives
- G. Homemade Bombs
- H. Incendiary Devices

#### IX. Radioactive Materials

- A. Types of Radiation
  1. Alpha Particles
  2. Beta Particles
  3. Gamma Particles
- B. Half-Lives
- C. Measuring Radioactivity
- D. Biological Effects
- E. Identification
- F. Protection

#### X. Liquefied Gases and Cryogenics

- A. Cryogenics
- B. Critical Temperature and Pressure
- C. Dangers of Cryogenic Gases
  1. Hazard of Individual Gas
  2. Liquid to Gas Ratio
  3. Extreme Cold
- D. Storage
- E. Relief Systems

#### XI. Electricity

- A. Amperes
- B. Volts
- C. Resistance
- D. DC vs AC

#### XII. Other General Hazards

#### XIII. Labeling Systems

- A. DOT System
- B. NFPA System
- C. UN System
- D. Common Systems

#### XIV. Storage

- A. Compatible Materials
- B. Construction of Shelves
- C. Identification
- D. Quantity

#### XV. Fire Fighting Problems

- A. Identification
- B. Information
- C. Plan of Attack
- D. Cleaning Up
- E. Disposal
- F. Preplanning