

COURSE OUTLINE

**Fire Technology 102**  
**Fire Behavior and Combustion**

**I. Catalog Statement**

Fire Technology 102 offers instruction in fire behavior and control, matter and energy, units of measurement, flammable liquids, toxic gases, chemicals, radioactive hazards, and firefighting techniques. Fire Technology 102 meets or exceeds the Calif. State Fire Marshal core requirement for Fire 5.

Total Lecture Units: 3.0

**Total Course Units: 3.0**

Total Lecture Hours: 48.0

**Total Faculty Contact Hours: 48.0**

Recommended preparation: Eligibility for English 120 or ESL 151.

**II. Course Entry Expectations**

Skills Level Ranges: Reading 5; Writing 5; Listening/Speaking 5; Math 3.

**III. Course Exit Standards**

Upon successful completion of the required coursework, the student will be able to:

1. describe the basic laws differentiating matter and energy;
2. explain basic terminology, definitions, and phenomena of chemistry;
3. identify basic chemical symbols used when writing chemical formulas;
4. explain the three physical states of matter and how each is affected by fire;
5. analyze and evaluate manner in which fire changes the physical states of matter;
6. identify various methods and techniques of extinguishing fires based on development of the flame plume;
7. compare and contrast flashover and back draft in a compartment fire;

**IV. Course Content**

**Total Faculty Contact Hours = 48**

A. Introduction to Chemistry and Physics

7 hours

1. Matter and energy
2. The atom and its parts
3. Chemical symbols
  - a. Chemical equations

- b. Periodic chart
    - c. Atomic weight, atomic mass
  - 4. Molecules
  - 5. Energy and work
  - 6. Forms of energy
    - a. Sources of energy
    - b. Sources of ignition
  - 7. Transformation of energy
  - 8. Laws of energy
  
- B. Evolution of Fire Science 7 hours
  - 1. Define fire
  - 2. Fire in history
  - 3. Factors in fire research
  - 4. Visualization and scale models in fire research
  - 5. International (SI) Systems of measurement
    - a. Units of measurement for mass, energy
    - b. English units of measurement
    - c. Length, size, area, volume
    - d. Weight, flow rates, pressure
  
- C. Combustion in Natural Fires 3 hours
  - 1. Forms of natural fire
  - 2. Candle flame as a basic diffusion flame
  - 3. Natural forms of fire
  
- D. Heat Transfer 5 hours
  - 1. Energy vs. heat
  - 2. Conduction, convection, radiation
  - 3. Heat flux significance in heat transfer
  - 4. Heat transfer computations
  
- E. Ignition 3 hours
  - 1. Piloted and auto-ignition
  - 2. Ignition temperatures of solids
  - 3. Formulas to predict ignition time of solids
  
- F. Flame Spread 5 hours
  - 1. Different types
  - 2. Theory of distance heated and ignition time
  - 3. Computation of flame spread speeds on solids
  
- G. Burning Rate 5 hours
  - 1. Factors influencing energy release rate<sup>0</sup>
  - 2. Formulas
    - a. Burning rate

- b. Energy release rate
  - 3. Heat
    - a. Gassification
    - b. Combustion
  - 4. Energy release rate signatures
  
- H. Fire Plumes 4 hours
  - 1. Calculating flame height
  - 2. Estimating temperature above a fire
  - 3. Behavior of flame plumes
  - 4. Buoyancy
  
- I. Combustion Products 3 hours
  - 1. Nature and levels
  - 2. Yield and concentration in smoke
  - 3. Hazards of combustion products in smoke
  
- J. Compartment Fires 3 hours
  - 1. Fire development
  - 2. Flashover
  - 3. Fully developed fires
  - 4. Ventilation factors
  - 5. Fire-induced flows
  - 6. Function computation
    - a. Vent flow rates
    - b. Compartment smoke temperatures
  
- K. Fire Analysis 3 hours
  - 1. Analytical applications
    - a. Fire safety design
    - b. Fire investigation
    - c. Fire modeling

**V. Methods of Instruction**

The following methods of instruction may be used in the course:

- 1. lecture;
- 2. demonstrations;
- 3. controlled burns at refinery site.

**VI. Out of Class Assignments**

The following out of class assignments may be used in the course:

- 1. individual projects (i.e. written assignments, reading reports);
- 2. group projects (i.e. homework problems, problem solving demonstrations, discussion on textbook topics).

## **VII. Methods of Evaluation**

The following methods of evaluation may be used in the course:

1. daily verbal evaluation by instructor;
4. quizzes;
5. written mid-term examination;
6. final examination.

## **VIII. Textbooks**

Mahoney, Eugene E. *Fire Suppression Practices and Procedures [2nd edition]*. Upper Saddle River, NJ: Prentice Hall Inc., 2007.  
10<sup>th</sup> Grade Textbook Reading Level. ISBN: 0131517732

## **IX. Student Learning Outcomes**

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4. Student will be able to explain the three physical states of matter and how each is affected by fire.
5. Student will be able to analyze and evaluate manner in which fire changes the physical states of matter.
6. Student will be able to identify various methods and techniques of extinguishing fires based on development of the flame plume.
7. Student will be able to compare and contrast flashover and back draft in a compartment fire.