

Las Positas College  
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### Course Outline for FST 3

### FIRE BEHAVIOR AND COMBUSTION

Effective: Fall 2019

#### I. CATALOG DESCRIPTION:

FST 3 — FIRE BEHAVIOR AND COMBUSTION — 3.00 units

Theory and fundamentals of why fires start, spread, and are controlled. An in-depth study of fire chemistry and fire physics, characteristics of materials, extinguishing agents, and fire control techniques.

3.00 Units Lecture

#### Grading Methods:

Letter Grade

#### Discipline:

- Fire Technology

|   | <b>MIN</b> |
|---|------------|
| <b>Lecture Hours:</b>                       | 54.00      |
| <b>Expected Outside<br/>of Class Hours:</b> | 108.00     |
| <b>Total Hours:</b>                         | 162.00     |

#### II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: 1

#### III. PREREQUISITE AND/OR ADVISORY SKILLS:

#### IV. MEASURABLE OBJECTIVES:

**Upon completion of this course, the student should be able to:**

- Identify the fundamental theories of fire behavior and combustion
- Differentiate the various types of extinguishing agents, methods and techniques to the theory of fire extinguishment base on development of the flame plume
- Identify Physical properties of the three states of matter
- Categorize the components of fire
- Explain the physical and chemical properties of fire
- Describe and apply the process of burning
- Define and use basic terms and concepts associated with the chemistry and dynamics of fire
- Discuss various materials and their relationship to fires as a fuel
  - Explain the characteristics of water as a suppression agent
- Articulate other suppression agents and strategies
- Compare other methods and techniques of fire extinguishments
- Describe the basic laws differentiating matter and energy
- Explain basic terminology, definitions and terms associated with basic fire chemistry
- Identify some of the basic chemical symbols used in chemical formula writing
- Identify how physical forces caused by fire can affect the changes in the physical states of matter
- Identify the Department of Transportation warning placard and labeling system
- Describe the Department of Transportation Hazard Class System
- Compare and contrast flashover and backdraft in a compartmentalized fire

#### V. CONTENT:

- Introduction: Fire Chemistry and Physics
  - Matter and energy
  - The atom and its parts
  - Chemical symbols
  - Molecules
  - Energy and work
  - Forms of energy
  - Transformation of energy
  - Laws of energy
- Units of Measurement
  - International units of measurement
  - English units of measurement
- Chemical Reactions
  - Physical states of matter

- 2. Compounds and mixtures
- 3. Solutions and solvents
- 4. Process of reactions
- D. Fire and the Physical World
  - 1. Characteristics of fire
  - 2. Characteristics of solids
  - 3. Characteristics of liquids
  - 4. Characteristics of gases
- E. Heat and its Effects
  - 1. Production and measurement of heat
  - 2. Different kinds of heat
  - 3. Methods of heat transfer
  - 4. Sources of heat
- F. Properties of Solid Materials
  - 1. Common combustibles
  - 2. Plastics and polygons
  - 3. Combustible metals
  - 4. Combustible dusts
- G. Common Flammable Liquids and Gases
  - 1. Fire characteristics
  - 2. General properties of gases
  - 3. The gas laws
  - 4. Classification of gases
  - 5. Compressed gases
- H. Fire Behavior
  - 1. Structure and other physical barriers to fire
  - 2. Fire flow characteristics due to air movement
- I. Fire Extinguishment
  - 1. Types of suppression agents
- J. Extinguishing Agents
  - 1. Application of various suppression agents and their affects on fire
- K. Hazards by Classification Types (chemicals)
  - 1. Hazards of explosives
  - 2. Hazards of compressed gases
  - 3. Hazards of flammable liquids
  - 4. Hazards of flammable solids
  - 5. Hazards of oxidizing agents
  - 6. Hazards of poisons
  - 7. Hazards of radioactive substances
  - 8. Hazards of corrosives
- L. Burning rate
  - 1. Factors
  - 2. Formulas
  - 3. Heat
  - 4. Energy release signatures
- M. Fire Plumes
  - 1. Calculate flame height
  - 2. Estimate temperature above fire
  - 3. Behavior of flame plumes
  - 4. Buoyancy
- N. Combustion products
  - 1. Nature and level
  - 2. Yield smoke
  - 3. Hazards
- O. Compartment fires
  - 1. Fire development
  - 2. Flashover
  - 3. Fully developed fires
  - 4. Ventilation factors
  - 5. Fire induced flows
  - 6. Computation
- P. Analytical applications
  - 1. Fire safety
  - 2. Fire investigation
- Q. Fire modeling

#### VI. METHODS OF INSTRUCTION:

- A. **Written exercises and case studies** - Individual assigned essay
- B. **Lecture** -
- C. **Student Presentations** - Assigned subject presentation
- D. **Discussion** -
- E. Group Project

#### VII. TYPICAL ASSIGNMENTS:

- A. Student presentations of selected common flammable liquids and combustible liquids or gasses
- B. Individual essays regarding heat and its effects on molecular compounds
- C. Group presentation on fire and the physical world and methods of various control and common extinguishment tools available to fire suppression personnel

#### VIII. EVALUATION:

##### **Methods/Frequency**

- A. Exams/Tests
  - one midterm and final exam
- B. Quizzes
  - weekly
- C. Papers
  - one essay
- D. Oral Presentation

- one
- E. Group Projects
- one
- F. Class Participation
- daily
- G. Home Work
- weekly

IX. TYPICAL TEXTS:

1. Gann, Richard, and Raymond Friedman. *Principles of Fire Prevention and Chemistry*. 4th ed., Jones and Bartlett Learning, 2016.
2. Shackelford, Raymond. *Fire Behavior and Combustion Processes*. 1st ed., Cengage Learning, 2008.
3. Quintiere, James. *Principles of Fire Behavior*. 2nd ed., Taylor and Francis Group, 2016.
4. IAFC and NFPA . *Fundamentals of Firefighter Skills*. 4th edition ed., Jones and Barlett Publishing, 2018.

X. OTHER MATERIALS REQUIRED OF STUDENTS:

- A. LPC Fire Service Technology Uniform