Course Name: Fire Behavior and Combustion  
Course Number: FIR-127-FD01  
Course Department: Business  
Course Term: Fall 2019  
Revised: 2/11/2019  
Total Semester Hour(s) Credit: 3  
Total Contact Hours per Semester: 
   Lecture: 45   Lab: 0   Clinical: 0   Internship/Practicum: 0

Catalog Description:

Pre-requisites and/or Co-requisites: None


Materials Required: None

Suggested Materials: Notebook

**Institutional Outcomes:**

*Critical Thinking:* The ability to dissect a multitude of incoming information, sorting the pertinent from the irrelevant, in order to analyze, evaluate, synthesize, or apply the information to a defendable conclusion.

*Effective Communication:* Information, thoughts, feelings, attitudes, or beliefs transferred either verbally or nonverbally through a medium in which the intended meaning is clearly and correctly understood by the recipient with the expectation of feedback.

*Personal Responsibility:* Initiative to consistently meet or exceed stated expectations over time.

**Department Outcomes:**

Business Department students will be able to:

- Apply effective business or career-related communication
- Demonstrate business or career-related human relations skills
• Solve business or career-related problems.

Course Outcomes:

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

• Identify the fundamental theories of fire behavior and combustion.
• Differentiate the various types of extinguishing agents.

Student Learning Outcomes:

• Explain the importance of measurement in understanding fire behavior.
• Name the basic SI units of measurement and convert between values in SI units and English units.
• Understand the precision of a measurement and the reduced precision used in estimations.
• Explain the differences between mass and weight and among energy, heat, and enthalpy.
• List the chemical elements that are especially important in fires.
• Describe atomic mass and dimension.
• Describe molecules, compounds, free radicals, and ions.
• Recognize the bonding features of an organic fuel from its name.
• Find further information about atomic and molecular properties.
• Name the three basic states of matter found in the material world and explain how they are characterized.
• Describe the phase changes among these states and the change in enthalpy associated with each.
• Write and use the ideal gas laws.
• Balance a chemical equation for the combustion of a material during a fire.
• Estimate the heat released during burning based on the balanced chemical equation using the mass of oxygen consumed.
• Understand the meaning of fuel-lean, stoichiometric, and fuel-rich combustion.
• Explain why the outcome of a combustion reaction is determined by thermodynamics, while the rate of the reaction is determined by chemical kinetics.

• Describe ideal and realistic flame temperatures.

• Describe the basic laws of motion and gravitation.

• Calculate the pressures in a standpipe and a stairwell.

• Calculate the velocity of a falling object and the time it takes to reach the ground.

• Describe potential and kinetic energy.

• Describe the effects of fluid viscosity and buoyancy on fire flows.

• Name and explain the three modes of heat transfer.

• Explain why radiative heat transfer in fires is especially important.

• Explain the difference between an intensive property and an extensive property of a material.

• Calculate the heating rate of an object due to heat conduction and radiation.

• Describe the difference between thermally thin and thermally thick materials.

• Describe the structural hazards that can result from loss of fire resistance.

• Calculate the burn hazards to people from exposure to convective and radiative heat.

• Describe how the U.S. fire incidence database enables development of a national profile of fires and fire losses.

• Define the process of combustion.

• Explain flammability, in terms of both fire properties and practical application.

• Explain the nonflaming and flaming stages of fire.

• Discuss the fire tetrahedron and explain how it is a focus for a unified view of fire initiation, growth, and termination.
• Discuss the terms fire consequences, hazard, and risk.

• Describe the categorization of flames.

• Characterize laminar and turbulent flames.

• Define deflagration and detonation, and explain the difference between the two.

• Discuss flammability limits and burning velocity, as well as their relationship to fire hazard.

• Understand the difference between piloted ignition and autoignition.

• Explain the potential hazard from a gas leak.

• Explain the importance of chain branching in combustion chemistry.

• Describe the flash point, fire point, and autoignition temperature of a flammable liquid.

• List the three classes of flammable liquids, based on flash point and potential ambient temperatures.

• Define the linear burning rate of a pool of liquid and explain why it varies with the diameter of the pool.

• Describe the physical considerations that affect the rate of flame spread of flammable liquids.

• Explain boilover.

• Explain a boiling liquid/expanding vapor explosion (BLEVE).

• List the three significant differences between the burning of a solid fuel and the burning of gaseous and liquid fuels.

• Describe the thermal and chemical processes that result in the ignition and burning of a solid.

• Describe how char formation and melting occur and how they affect the burning rate.

• List the types of combustible solids.

• Describe the types of polymers and explain how they gasify.
• Describe at least four classes of mechanisms by which fire retardant additives act to modify the ignition and burning of solids.

• Discuss the use of calorimetry to measure the heat-release rates of materials and products.

• Describe the two main types of smoke aerosols and explain why they are important in fire.

• Explain how soot forms.

• Describe the two principal methods for quantifying the aerosol content of smoke produced in an experimental fire.

• Describe the smoke-point height method for estimating the relative sooting tendency of a gaseous fuel.

• List some relationships between fuel chemistry and sooting tendency.

• Estimate the mass of burned fuel that can lead to loss of visibility due to smoke obscuration.

• List the principal combustion products formed in fires.

• Explain the principles of operation for ionization smoke alarms and photoelectric smoke alarms, and identify the differences in what they detect.

• List the hazards to people and property from a fire.

• Explain the following types of harm from a fire: acute effects, postexposure effects, and chronic effects.

• List the most important toxic gases in smoke.

• Explain the differences between narcotic gases and irritant gases.

• Explain the concept of fractional effective dose.

• Explain the underlying principle of Haber’s rule.

• Explain the concept of limiting hazard and its role in fire protection.

• Describe the three zones of the plume of a fire burning in the open and calculate the air entrainment into the flame and the height of the luminous flame.

• List three reasons why the nature of the ceiling jet is important.
• Calculate the mass outflow from a room in which a steady-state fire is burning.

• Estimate the minimum rate of heat release that leads a room to flashover.

• List nine reasons why calculating the smoke flow through most buildings requires a computational fire model.

• Distinguish among fire extinguishment, fire control, and fire inerting.

• List the four classes of fires, as used in the United States.

• Describe the different ways in which water suppresses a fire, depending on its method of delivery and the geometry of the fire, and list the types of fires on which water should not be applied.

• Describe the role of suppression-enhancing additives to water.

• List the types of nonaqueous fire suppressants.

• Understand why the use of halon fire extinguishants has been curtailed.

• Explain how powdered fire extinguishers are effective on a fire.

• Explain the value in using computer fire modeling.

• Describe the difference between a deterministic and a probabilistic fire model.

• Describe the characteristics of both zone and field models.

• Describe the difference between retrospective and prospective use of a fire model.

• Explain model validation, model verification, and model accuracy.

• Explain the limitations of computer fire models.

**College Procedures:** All College-wide procedures are located in the Iowa Central Community college Student Handbook

**Weighting of Assessments:**
- Participation: 10% of final grade
- Exams: 70% of final grade
- Final Exam 20% of final grade

*Please note that assessments are subject to change*
**Non-Discrimination Statement**


If you have questions or complaints related to compliance with this policy, please contact Kim Whitmore, Director of Human Resources, phone number 515-574-1138, whitmore@iowacentral.edu; or the Director of the Office for Civil Rights, U.S. Department of Education, Citigroup Center, 500 W. Madison, Suite 1475, Chicago, IL 60661, phone number 312-730-1560, fax 312-730-1576.

**Disability/Accommodation Services:**

If you have a request for an accommodation based on the impact of a disability, it is Iowa Central’s policy that you contact the Academic Assistance & Accommodations Coordinator to discuss your specific needs and to provide supporting information and documentation, so we may determine appropriate accommodations. The office for accommodations is located in the Academic Resource Center, and it can be reached by calling 515-574-1045. For online information about accommodations, please go to www.iowacentral.edu/accommodations.

**Bias-Free Classroom Statement:**

Iowa Central Community College maintains high standards of respect in regard to individual beliefs and values when selecting classroom materials including textbooks, project activities, power points, videos, presentations, and classroom discussions.

It is our belief that all people have the right to obtain an education within our department/program courses free of bias, with full respect demonstrated to all who enroll in the courses of this department/program.