



DEPARTMENT OF FINANCIAL SERVICES

Division of State Fire Marshal
Bureau of Fire Standards & Training

Fire Chemistry

Title: Master Syllabus

Date: October 19, 2016

Course Title	Fire Chemistry
Course Number	FFP2111, BFST2111, ATPC2111
Prerequisite(s)	None
Revision Date	October 19, 2016
College Credit Recommendation	This course has a college recommendation of 3 credits.
Continuing Education Units (CEU's)	40 hours towards Firesafety Inspector I.
Class Days/Time	Monday – Friday 8:00 a.m. – 5:00 p.m.
Instructional Supervisor	Name: Dr. Barbara Klingensmith Email: Barbara.Klingensmith@myfloridacfo.com
Program Specialist Contact Info	Name: Mike Swartz Email: Mike.Swartz@myfloridacfo.com
Class Location	Room 105
Course Description	This course is designed to show the arson investigator the different forms of matter and energy, common substances, and how they relate to fires. the chemical formulas of flammable and combustible substances, their bondings and separations, as well as the different chemical reactions related to fire and oxidation are covered. Particular emphasis is placed on the specific substances used by arsonists to ignite and accelerate burnings.
Student Learning Outcomes	After the successful completion of this course, the student will be able to do the following: <ol style="list-style-type: none">1. Develop an understanding of why chemistry is important and how it relates to arson investigation and the fire service.2. Develop a basic understanding of chemical compounds.3. Develop an understanding of the terms and laws of matter, energy, density, temperature and heat, pressure, expansion of gases and liquids, the general properties of the gaseous state.4. Develop basic skills necessary for metric conversion and calculations, calculation concerning the density, energy, pressure and expansion of chemical materials.5. Develop the skills necessary to write and understand the principles of chemical reactions and balance basic chemical formulae.6. Identify the differences between the chemical forms of matter and be

	<p>able to relate to elements by their place on the Periodic table, as measured by a variety of homework assignments, exercises and examination.</p> <p>7. Demonstrate the basic calculations necessary for understanding chemical compounds and their reactions using both the English and Metric systems, as measured by a variety of homework assignments, exercises and examination.</p>														
Required Textbook	<i>Fire Dynamics, Second Edition</i> (2016) Brady Publishing ISBN:13:978-0-13-384270-8														
Required Materials	None.														
Method of Instruction	Classroom														
Grading	Passing 70%														
Certification(s)	<p>One of four required courses for Fire Investigator I certification.</p> <table border="0"> <tr> <td><u>FFP2120, BFST2120, or ATPC2120</u></td> <td>BUILDING CONSTRUCTION FOR THE FIRE SERVICE</td> </tr> <tr> <td><u>FFP1510, BFST1510, or ATPC1510</u></td> <td>CODES AND STANDARDS</td> </tr> <tr> <td><u>FFP2521, BFST2521, or ATPC2521</u></td> <td>CONSTRUCTION DOCUMENTS AND PLANS REVIEW</td> </tr> <tr> <td><u>FFP2541, BFST2541, or ATPC 2541</u> (old number RN12285)</td> <td>FFP 2541 PRIVATE FIRE PROTECTION II</td> </tr> <tr> <td><u>FFP1505, BFST1505, or ATPC1505</u></td> <td>FIRE PREVENTION PRACTICES</td> </tr> <tr> <td><u>FFP1301, BFST1301, or ATPC1301</u></td> <td>FIRE SERVICE HYDRAULICS</td> </tr> <tr> <td><u>FFP1540, BFST1540, or ATPC1540</u></td> <td>PRIVATE FIRE PROTECTION SYSTEMS I</td> </tr> </table>	<u>FFP2120, BFST2120, or ATPC2120</u>	BUILDING CONSTRUCTION FOR THE FIRE SERVICE	<u>FFP1510, BFST1510, or ATPC1510</u>	CODES AND STANDARDS	<u>FFP2521, BFST2521, or ATPC2521</u>	CONSTRUCTION DOCUMENTS AND PLANS REVIEW	<u>FFP2541, BFST2541, or ATPC 2541</u> (old number RN12285)	FFP 2541 PRIVATE FIRE PROTECTION II	<u>FFP1505, BFST1505, or ATPC1505</u>	FIRE PREVENTION PRACTICES	<u>FFP1301, BFST1301, or ATPC1301</u>	FIRE SERVICE HYDRAULICS	<u>FFP1540, BFST1540, or ATPC1540</u>	PRIVATE FIRE PROTECTION SYSTEMS I
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Attendance Policy	You are required to attend all sessions of the course and complete all pre-course assignments. Failure to appear in class for a scheduled activity will be considered an absence. Students are allowed to miss 10% of the class and still receive credit. There are no makeup sessions.														
Academic Integrity	<p>Academic integrity is crucial to the learning community and indicates respect for the college, the instructor, the course, your classmates and yourself. Any violation of this trust, including but not limited to cheating, plagiarism, collusion, or using or having any content of an un-administered test, will result in immediate dismissal from the course. Under Florida Statute 633, any student dismissed for academic dishonesty can be refused acceptance for any course administered by FSFC.</p> <p>Qualification FIRESAFETY INSPECTOR 1 Description</p>														

	Training Provider Message	You must be certified by the State of Florida as an Instructor I, II, or III, or a State of Florida recognized Fire Department, or hold a certification as a Single Course Exemption Instructor. Applications can be made through the Bureau of Fire Standards and Training. Organization Providers are Schools, Government Entities, and Businesses that need to apply and be approved by the Florida State Fire College.
	Instructor Message	You may teach courses for this type of Certification or Competency only if you hold the certification, and the appropriate disciplines.
	Pre-Certification Message	To be certified as a Firesafety Inspector I in the State of Florida, an individual must; never have been convicted of felony, successfully complete 200 hours of basic certification training for firesafety inspectors, or have received equivalent training in another state, and pass a state written examination. To apply for this certification, login as a student, click on Apply, select certification exam and follow the process to submission. Supporting documentation may be scanned and attached or faxed to 352-732-1374. When faxing, note "on-line application" on the fax along with a contact phone number. You will need to have your fingerprints digitally taken and submitted. Directions on how to do this are on the home page. NOTE*** WHEN YOU ARE APPROVED TO TEST OR IF ADDITIONAL INFORMATION IS REQUIRED, A MESSAGE WILL BE SENT TO YOUR INBOX. PLEASE CHECK YOUR INBOX ON A REGULAR BASIS.
	Renewal Message	You must complete 54 hours of continuing education within your 4-year time frame. You may opt to take the examination in place of the 54 hours as indicated on your renewal application. In the event that the applicant for renewal fails the examination he/she shall be required to repeat the Firesafety Inspector Training Program, per FAC 69A-39.009. When taking a state exam, please ensure that your personal profile matches the identification that you plan to produce at Pearsonvue.
	NFPA Subject and Level	Fire Safety Inspector I/II
<i>Students with Disabilities</i>	Any student who has a permanent or temporary disability that may require a reasonable accommodation to participate in the course must present documentation of the disability and requested accommodation no later than the beginning of the course.	
<i>Emergency Evacuation Policy</i>	Occupants of buildings on the Florida State Fire College campus are required to evacuate and assemble outside when a fire alarm is activated or an announcement is made. Please be aware of the following policies regarding evacuation. <ul style="list-style-type: none"> • Familiarize yourself with all exit doors of the classroom and the building. • Remember that the nearest exit door may not be the one you used when you entered the building. • If you require assistance to evacuate, inform the instructor on the first day of 	

	<p>class.</p> <ul style="list-style-type: none"> • In the event of an evacuation, follow the guidance of the instructor. • Do not re-enter a building unless you are given instructions by Florida State Fire College personnel to do so.
Requesting Emergency Care	Any request for emergency care should be initiated by calling “911” from any phone on campus of the Florida State Fire College. Phones are located in each classroom. Additionally, in the event of any emergency, immediately contact an instructor or staff member.
Critical Event Procedures	<p>Severe Weather – there is a lightning detection system on campus which has an audible 15 second blast of an air horn. If you are outside, please follow your instructor or move to the closest permanent building. Once the threat is over, there will be three 5 second blasts of the signal.</p> <p>Security – During the daytime, security is handled by full time faculty and staff. There are security guards on duty in the evenings and weekends. Please comply with the requests made of security officers. Failure to do so can result in removal from campus.</p> <p>Student Badges – You will be issued a badge to be worn anytime you are on campus.</p>
Enabling Objectives	<p>Given information from discussion and reading materials, the student will perform the following objectives to a written test accuracy of at least 70% and meet the applicable job performance requirements of NFPA 1021 (2009).</p> <p><u>Features of Matter and Energy</u></p> <ol style="list-style-type: none"> 1. Describe the General features of matter and identify those characteristics that differentiate the three physical states of matter from one another. 2. Note the "English: and metric units in which length, mass and volume are measured and note the equivalent units in each system of measurement that should be memorized. 3. Demonstrate the use of the factor-unit method for converting between the "English" and metric units of measurement. Provide numerous examples of converting between units of measurement using the factor-unit method. 4. Describe the concepts of density, specific gravity, and vapor density. Illustrate how these concepts are useful for evaluating the potentially hazardous nature of specific substances. 5. Define energy and identify the different forms in which energy is manifested in nature. 6. Define temperature and describe the difference between temperature readings on the Fahrenheit, Celsius, Kelvin and Rankine scales. 7. Define pressure and differentiate between gauge pressure and absolute pressure. Identify the units in which pressure is commonly measured

(pounds per square inch, atmosphere, and pascal), note the equivalent units of pressure that should be memorized, and provide examples of converting between the units using the factor-unit method.

8. Define heat and describe how heat is manifested in nature. Identify the units in which heat is commonly measured (BTU, calorie, and joule), note the equivalent unit of heat that should be memorized, and provide examples of converting between the units of heat using the factor-unit method.
9. Discuss each of the three modes by which heat is transmitted from spot to spot or from one material to another. Describe how each mode affects the spread of fire.
10. Describe how the absorption of heat can adversely impact an individual's health.
11. Illustrate how the amount of heat is calculated when a substance undergoes a change in temperature. Demonstrate how the amount of heat is calculated during each step of a process involving the change of one pound of water into one pound of steam over the temperature range from -20 F to 300 F (-29 C to 149 C), and emphasize the significance of these calculations when water is used as a fire extinguisher.
12. Describe the nature of the hazard associated with the expansion of a heated liquid confined within a storage vessel.
13. Describe the nature of the hazard associated with the expansion of a heated gas or vapor confined to its storage vessel. Use Boyle's Law, Charles law, and the combined gas law to calculate the volume occupied by a confined gas at different pressures and temperatures.
14. Define the general hazards of cryogenic liquids.

Flammable Gasses and Liquids

1. Discuss the concept of flammability of a substance. Include the definition of relative terms such as the upper and lower explosive limits, explosive range, flash point, fire point, kindling point and auto-ignition point.
2. Describe a flammable liquid as used by OSHA regulations. From a list of flash point and boiling points of liquids, classify the liquids as flammable or combustible.
3. Describe the concept of ignitability as it is used by the EPA in RCRA regulations.
4. Note the type of vessels in which compressed gases are stored. Identify the safe practices for handling compressed gases, including compressed flammable gases.
5. Identify the common hazards of compressed gases, including liquefied compressed gases.
6. Identify the combination of conditions necessary for a BLEVE to occur

for a flammable liquefied compressed gas.

Chemical Forms of Matter

1. Distinguish between elements and compounds.
2. Describe the general properties of metals, nonmetals, and metalloids.
3. Identify representative physical and chemical changes and distinguish between the physical and chemical properties of a substance.
4. Identify the general structural features of the atom and define the related terms atomic number and atomic weight.
5. Describe the organization of the periodic table. Note the location of the principal families (groups) of elements: the alkali metals, alkaline earth metals, chalcogens, halogens, and the noble gases. Note the location of the main group elements, transition elements, and inner transition elements.
6. Associate chemical reactivity with the electrons in an atom's outermost atomic orbitals. Describe the "Octet rule" and how it applies to chemical reactivity. Note the location of an element in the periodic table and the association of the reactivity of the element with other elements in the table.
7. Describe the molecule as a basic unit of some forms of matter.
8. Differentiate between molecules and ions.
9. Demonstrate the manner by which ions are formed from atoms.
10. Emphasize the importance of Lewis symbols and illustrate how the Lewis symbols can be readily determined using the periodic table and tables in the text.
11. Describe ionic and covalent bonding with multiple examples.
12. Illustrate the production of ionic compounds from their constituent metallic and nonmetallic atoms.
13. Illustrate the manner by which covalent compounds form from their constituent nonmetallic atoms. Illustrate the presence of single, double, and triple bonds in covalent compounds.
14. Describe the procedure for naming ionic compounds. Provide numerous examples of naming ionic compounds when their chemical formulas are provided and vice versa.
15. Describe the manner by which simple covalent compounds are named. Provide numerous examples of naming covalent compounds when their chemical formulas are provided and vice versa.
16. Describe the manner by which the common acids are named.
17. Illustrate the manner by which the molecular weight or formula weight of a substance is determined.
18. Describe the concept of a mole and illustrate how an arbitrary number of moles can be determined when the amount of a substance has been provided.

Principles of Chemical Reactions

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1. Discuss the concept of a chemical change and illustrate how chemists summarize the nature of the occurrence with an equation.
2. Provide multiple examples of balancing equations.
3. Identify the different types of simple chemical reactions.
4. Introduce the concept of oxidation-reduction.
5. Discuss the individual factors that affect the rate of reaction at which a chemical reaction occurs.
6. Describe ordinary combustion of a substance in air.
7. Describe spontaneous combustion.
8. Using the fire triangle and the fire tetrahedron, illustrate the importance of fuel, oxygen, heat and free radicals in ordinary combustion.
9. Using the fire tetrahedron, discuss the manner by which each of the following suppressants effectively function when it extinguishes a fire: water, carbon dioxide, halons, dry chemicals, and dry powder.

Chemistry of Some Common Elements

1. Discuss the physical and chemical properties of elemental O and its ability to support life and combustion.
2. Discuss the hazard unique to LOX.
3. Discuss the physical and chemical properties of ozone, it's hazard as a pollutant and it's necessity to support life as part of the atmosphere.
4. Discuss the physical and chemical properties of elemental H, including the importance of its vapor density and its flammability.
5. Discuss H not only as a chemical element but also its production by acids/water and certain metals.
6. Discuss H storage methods, hazards, placarding and firefighting precautions.
7. Discuss the physical and chemical properties of elemental F, including the importance of its vapor density and toxicity.
8. Discuss F's chemical reactivity, storage methods, hazards, placarding and firefighting precautions
9. Discuss the physical and chemical properties of elemental Cl, including the importance of its vapor density and toxicity.
10. Discuss Cl's chemical reactivity, storage methods, hazards, placarding and firefighting precautions.

Chemistry of Some Corrosive Mateirals

1. Describe how materials can be corroded upon exposure to the atmosphere.
2. Identify the general types of substances other than atmospheric oxygen that can cause corrosion.
3. Discuss Arrhenius's theory of acids and bases.
4. Distinguish between strong and weak acids and strong and weak bases.
5. Know the difference between mineral acids and organic acids.
6. Discuss Arrhenius's theory of acids and bases.

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| | <ol style="list-style-type: none">7. Describe the format of the PH scale and distinguish between strong and weak acids and strong and weak bases.8. Identify common properties of acids and bases.9. Know what an “acidic anhydride” and “basic anhydride” is. |
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