Course Title: Fire Dynamics (3087)

Course Number: FST - 3087
Course Credit Hours: (3) Three Semester Hours

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Course Material: The National Fire Academy Fire Dynamics Curriculum

Course Description: This course examines the underlying principles involved in structural fire protection systems, building furnishings, and fire protection systems including water-based fire suppressions systems, fire alarm and detection systems, special hazard suppression systems, and smoke management systems.

Outcomes / Objective: Upon completion of this course, students will be able to:
1. Analyze building structural components for fire endurance and fire resistance.
2. Understand the flame spread and smoke production properties of building furnishings and materials.

Assignment Format: Course assignments/exercises must be submitted following the APA format (6th edition)

Class Participation: Weekly assignment and discussion question postings must be completed each week. Interaction between students is highly encouraged.

Academic Dishonesty: The work you submit for a grade must be your own. I will not tolerate any form of academic dishonesty, especially plagiarism. Simply put, plagiarism is taking credit for someone else's work; taking credit includes receiving some form of favorable compensation for the submitted work. Please review the University of Cincinnati’s statement on academic honesty and follow this accordingly.
Grading Rubric:
Because punctuality and following instructions is a key requirement for a Fire Service Professional, I encourage this quality in you by requiring that you complete your assignment on time, just as if you were in class each week. All assignments are due on their posted due date.

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Total – 100%

WEEKLY ASSIGNMENTS

Week 1 Module I: Definition, Units, Fire Tetrahedron, Heat Transfer, Heat of Combustion, Ideal Gas Law

Subjects Covered:
- Math review and online tutorials
- Fire dynamics definition
- Scientific notation and unit conversion
- Fire tetrahedron

Written Assignment: Fire dynamics and fire modeling

*In a brief essay of 1-2 written pages, outline what you consider the primary potential uses of fire dynamics and fire modeling, both in the general context of the fire and emergency services, and in the specific context of your own current or future professional position. Be sure to describe any potential applications of fire dynamics and fire modeling to the issues of firefighter and civilian safety.*


Subjects Covered:
- Diffusion and premixed flames
- Heat vs. temperature
- Heat transfer, conduction, convection, and radiation
- Heat of combustions
- Ideal Gas Law
Discussion Assignment: Professional goals

Let us take some time to introduce ourselves and learn about each other as classmates and professionals in the field of fire and emergency services. In no less than 250 words, please describe your current career path and/or job position, and discuss some of your professional goals for the future. How will an improved understanding of fire dynamics help you perform more effectively in your current position? How will a background in fire dynamics help you attain some of your professional goals?

Week 3 Module 2: Ignition and Flame Spread of Materials

Subjects Covered:
- Ignition and burning of flammable liquids and gases
- Ignition and burning of solid materials

Written Assignment: "Tunnel effect" fire

London's King's Cross fire of 1987 was a historic event in a number of ways, but its influence on the fields of fire investigation and fire dynamics research was profound. Learn more about the details of this notorious "tunnel effect" fire using the following resources:

http://www.firetactics.com/KINGSCROSS.htm
http://www.pbs.org/wgbh/nova/escape/pioneers.html

Once you have reviewed the specifics of the King's Cross fire, research and select another example of a "tunnel effect" fire, and write a structured essay covering the important points about the fire and its investigation. Include the following topics in your final submission, which must be 3-5 pages in length:
- Briefly describe the fire: Where and how did it start? What losses were incurred?
- Summarize how and when the investigation was conducted, by whom, and what it revealed.
- Analyze the "tunnel effect:" How has this concept influenced fire suppression, investigation, and prevention research efforts?
- Demonstrate how the data related to the fire and the investigation could be used to enhance the fields of fire dynamics and fire modeling.

Week 4 Module 2: Ignition and Flame Spread of Materials (Continued)

Subjects Covered:
- Flame spread in flammable liquids
- Flame spread in solid materials

Discussion Assignment: Combustible ignition
Consider the following statement: "Combustible ignition can result when any combustible material is heated by a low temperature source over a long period of time."

Interview a fire investigator in your jurisdiction or community about their experience with this concept. Next, independently research the published and/or online literature related to this concept. In no less than 250 words, discuss whether your research findings support or refute the information revealed in your interview(s) with professionals in the field.

Week 5 Module 2: Ignition and Flame Spread of Materials (Continued)

Written Assignment: (Following the APA format)

For this assignment, submit a 1250-1400 word paper in APA format. Your assignment is to research and explain the concepts of “Ignition and Flame Spread of Flammable and Combustible Materials.”

Please use standard essay format including an introduction with a clear thesis statement; body paragraphs that include a topic sentence, supporting details, and transition sentences; and a conclusion that summarizes your paper.

This paper will be graded on how well you present your analysis, the inclusion of specific terms from your reading, evidence of cogent analysis, and an error-free presentation.

Week 6 Module 3: Plumes

Subjects Covered:
- More on Flames
- Plumes

Written Assignment: Cause, origin and confinement effects of a fire

Consider the following excerpt from a description of a residential structure fire:
A call to the local fire department indicates a contained, ground floor fire in a residential structure approximately 150 years old. The only inhabitant home at the time of the fire, a teenage boy, is already evacuated when firefighters arrive on scene. Firefighters attempt an interior attack but are driven out when a flashover occurs. The family reports, in post-event interview, a 2-year history of frequent circuit breaks and light cut-outs within the house's interior. The investigation reveals that the fire began in a well-insulated, poorly vented first floor bedroom with an unobstructed horizontal ceiling, where a power surge to a wall outlet ignited the corner of a nearby upholstered chair. The family reports a smoke detector had been mounted above the only interior doorway of the room. Analyze the information given pertaining to cause and origin and the confinement effects of the fire. In an essay of 3-5 pages, address the following points:
Describe the likely progression of this compartment fire through the four primary stages: fire plume/ceiling jet period; enclosure smoke-filling period; pre-flashover vented period; and post-flashover vented period.

Next, identify and specifically explain how each of the following elements of the enclosure fire likely contributed to the fire's spread: the fire source; the ceiling jet, the ventilation, the boundaries, and targets.

What factors would determine when flashover occurred?

How could the transition of the fire to flashover have been prevented?

Week 7 Module 3: Plumes (Continued)

Subjects Covered:
- Ceiling Jet
- Flashover

Discussion Assignment: Flashover

In no less than 250 words, describe the details of an experience you've had, be it professional or personal, with flashover, and describe the specific conditions that led to the flashover occurring. If you have not had a direct experience, research a fire in your jurisdiction or community and present the factors that influenced flashover. Then, analyze how your experience with or research on flashover has impacted your individual understanding of each of the following areas of professional fire service:
  - Pre-fire planning
  - Firefighting
  - Fire investigation
  - Fire modeling

Week 8 Module 3: Plumes (Continued)

Subjects Covered:
- Sprinkler activation

Written Assignment: (Following the APA format)

For this assignment, submit a 1250-1400 word paper in APA format. Your assignment is to research, (defend or deny) the concepts of “Residential Sprinkler Systems.”

Please use standard essay format including an introduction with a clear thesis statement; body paragraphs that include a topic sentence, supporting details, and transition sentences; and a conclusion that summarizes your paper.

This paper will be graded on how well you present your analysis, the inclusion of specific terms from your reading, evidence of cogent analysis, and an error-free presentation.
Week 9 Module 4: Smoke

Subjects Covered:
- Hazards of Smoke Including Toxicity and Visibility
- Smoke Filling

Written Assignment: Venting Practices

In the Fire Protection Handbook, Volume II, in Section 12 of Chapter 7, "Venting Practices," there is a discussion on the advantageous use of automatic sprinklers with automatic heat and smoke venting as a mechanism for reducing smoke damage to a building and its occupants. The passage also indicates, however, that there may be some drawbacks to the combined use of sprinklers and venting. In an essay that is 3-5 pages in length, use this section of the literature to present and support your professional opinion on the subject of combined systems.

Week 10 Module 4: Smoke (Continued)

Subjects Covered:
- Smoke Control

Discussion Assignment: Non-thermal forces

Click on the following link to read a short descriptive essay about the Cook County Administration Building Fire in Chicago, IL, in October 2003. The essay provides a brief description of the Cook County fire and introduces several important lessons learned by firefighters and public officials pertaining to "non-thermal forces," and the serious threat they pose to civilian lives.

https://www.ideals.uiuc.edu/bitstream/2142/97/2/Cook%20County%20Administration%20Building%20Fire%2c%202003.pdf

After reading Grove's essay, research and present to the class another fire incident with significant "non-thermal" forces at work. Propose answers to the following questions, and support your findings by citing any sources used. Please be sure your original post is 250 words or more in length.
- How did the movement of smoke from a fire enclosure to other spaces within the building result in risk to the safety of the building occupants?
- Which of the smoke movement causes we have examined in this course were at work during the fire: smoke buoyancy, stack effect, wind effects, or mechanical ventilation?
- How were "non-thermal forces" a threat to firefighter and/or civilian lives?
- What steps have been taken to reduce the chance of a similar occurrence?
Week 11 Module 5: Explosions

Subjects Covered:
• Explosions

Written Assignment: Explosions Question 3

In an essay of 3-5 pages, provide information on the following topics covered in this module, in your own words:

• Analyze the factors affecting dust explosions, and outline at least three techniques currently used to prevent or alleviate dust explosions.

Week 12 Module 5: Explosions (Continued)

Subjects Covered:
• Deflagrations

Written Assignment: Explosions and deflagrations Question 1

In an essay of 3-5 pages, provide information on the following topics covered in this module, in your own words:

• Discuss the difference between detonations and deflagrations, and their effects. Give specific examples of each.

Week 13

Written Assignment: (Following the APA format)

For this assignment, submit a 1250-1400 word paper in APA format. Your assignment is to describe the history of a room fire from inception to flashover. Assume that it is a moderate fire. In your description, discuss the following listing applicable equations:

• Heat release rate (Show a plot of the heat release rate curve.)
• Flame height (Be sure to discuss corner and wall fires as well as fires in the center of the room.)
• Fire plumes including plume temperatures.
• Ceiling jet, including its temperature and velocity.
• Sprinkler and detector activation times
• Thermal penetration time
• Effect of openings on a room fire.
• Flashover, including time to flashover.
Please use standard essay format including an introduction with a clear thesis statement; body paragraphs that include a topic sentence, supporting details, and transition sentences; and a conclusion that summarizes your paper.

This paper will be graded on how well you present your analysis, the inclusion of specific terms from your reading, evidence of cogent analysis, and an error-free presentation.

Week 14 Final Examination

The final exam will automatically open on the scheduled date. The student(s) will have a five day window which to take the exam. Only one attempt will be provided to take the final examination.