COURSE OUTLINE
Fire Service Hydraulics

Course Description
FS 203. Fire Service Hydraulics. 3 credit hours. Corequisite: Concurrent enrollment in FS 265. This course will enable the student to obtain a foundation of theoretical knowledge in order to understand the principles of water use in fire protection and to apply hydraulic principles to analyze and solve water supply problems.

Required Materials
For complete material(s) information, refer to https://bookstore.butlercc.edu

Butler-assessed Outcomes
The intention is for the student to be able to:
1. Apply water hydraulic principles to fire ground operations.
2. Demonstrate knowledge of water hydraulics as it relates to fire protection.

Learning Outcomes
Taken from the National Fire Academy FESHE Model Curriculum.
1. Apply mathematics and physics to the movement of water in fire suppression activities.
2. Identify the design principles of fire service pumping apparatus.
3. Analyze community fire flow demand criteria.
4. Demonstrate, through problem solving, a thorough understanding of the principles of forces that affect water, both at rest and in motion.
5. List and describe the various types of water distribution systems.
6. Discuss the various types of fire pumps.

Learning PACT Skills that will be developed and documented in this course
Through involvement in this course, the student will develop ability in the following PACT skill areas:

Analytical Thinking Skills
- Critical thinking - Through working mathematical equations that relate to fire service hydraulics, the student will develop critical thinking skills
- Problem solving - Through identifying possible problems of supplying fire service pumpers and fire streams and efficiently utilizing them, the student will develop problem solving skills

Technology Skills
- Discipline-specific technology - Through the application of theories learned in the classroom to actual devices and equipment, the student will develop fire service technology skills
Major Summative Assessment Task(s)
These learning outcomes and the Learning PACT skills will be demonstrated by:
1. Identifying in a prompt manner problems in supplying water to fire service pumpers, applying basic hydraulic principles, and performing basic fire service pumper operations in a simulated fire scene scenario.

Skills or Competencies
Actions that are essential to achieve the course outcomes:
1. Discuss principles of hydraulics
2. Describe fire service pump operations, equipment, and devices
3. Describe and troubleshoot typical problems in pump operations
4. Apply appropriate hydraulic calculations to the operations of fire service hydraulic elements, equipment, and devices

Learning Units
I. Water as an extinguishing agent
   a. Basic characteristics of water
   b. Basic extinguishing properties of water
   c. Advantages and disadvantages of water

II. Water at rest: Hydrostatics
   a. Five basic principles of pressure
   b. Head
   c. Potential energy

III. Water in motion: Hydrokinetics
   a. Principles of kinetic energy
   b. Principles of pressure
   c. Principles of friction loss
   d. Third principle of friction loss
   e. The Darcy-Weisbach formula
   f. The Hazen-Williams formula

IV. Water distribution systems
   a. Water system fundamentals
   b. Water system capacity
   c. Sources of water supply
   d. Water treatment facilities
   e. Means of moving water
   f. Water distribution system
   g. Water main valves
   h. Fire hydrants
   i. Private water supply systems

V. Water flow analysis
   a. Necessity of water flow analysis
b. Water supply analysis equipment
   c. Identification of available water supply
   d. Identification of volume of flow from flow hydrants

VI. Required fire flow calculation
   a. Manual fire-fighting operations
   b. Automatic sprinkler systems
   c. Standpipe systems

VII. Apparatus equipped with a fire pump
   a. Fire department pumpers
   b. Wildland fire apparatus
   c. Mobile water supply apparatus
   d. Aerial apparatus equipped with fire pumps
   e. Rescue vehicles equipped with fire pumps
   f. Aircraft rescue and fire fighting apparatus

VIII. Fire service pump design
   a. Positive displacement pumps
   b. Centrifugal pumps
   c. Pump mounting and drive arrangements
   d. Fire pump components
   e. Pump panel instrumentation

IX. Fire department pumper testing
   a. Preservice testing
   b. Service testing

X. Types of streams
   a. Fire stream production
   b. Solid streams
   c. Fog streams
   d. Broken streams

XI. Fire house nozzles
   a. Solid stream nozzles
   b. Fog stream nozzles
   c. Broken stream nozzles
   d. Nozzle pressure and nozzle reaction

XII. Principles of fire service pressure loss calculations
    a. Historical method of friction loss calculations
    b. Friction loss coefficients
    c. Elevation pressure
    d. Hose layout applications
    e. Fireground hydraulic calculations
f. Condensed “Q” formula

XIII. Pump discharge pressure determination
   a. Simple hose layouts
   b. Complex hose layouts
   c. Aerial master streams
   d. Net pump discharge pressure

XIV. Relay pumping
   a. Relay apparatus, equipment, and terminology
   b. Relay pumping operational concepts
   c. General guidelines for relay operations

XV. Sprinkler and standpipe system support
   a. Automatic sprinkler system operations
   b. Standpipe system operations

Learning Activities
Activities will include, but not be limited to, class discussions, lectures, classroom exercises, course projects, and field trips.

Grade Determination
The student will be graded on completion of assessment tasks, assignments, and written exams.