# Bachelors of Science in Engineering For Fire Protection Engineering Technology Model Curriculum

Society of Fire Protection Engineers

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# Recommendations for a Model Curriculum for a BS Degree in Fire Protection Engineering Technology (FPET)

**June 1, 2018**

## Society of Fire Protection Engineers (SFPE)

### SCOPE

This document is intended to provide recommendations for the development of a model curriculum for a bachelor of science (BS) Degree in Fire Protection Engineering Technology (FPET). It is not intended to imply that this is the only acceptable combination of courses that should be offered for such a program. Also noted in the model curriculum are suggestions for elective courses. Also, this document is not intended to provide a detailed list of individual topics to be covered within each course. For more specific information on individual topics, see the paper referenced below. That publication was reviewed and used as foundation for the development of this document.

### OBJECTIVE

An accreditable Fire Protection Engineering Technology program will prepare graduates to work in one or more of the areas of fire protection engineering technology including fire protection analysis, knowledge of codes and standards, fire science and human behavior, fire protection systems, and passive building systems and construction as they relate to fire protection. Graduates of associate degree programs typically will have knowledge in the areas of fire science, fire suppression and detection systems, fire protection hydraulics, and fire prevention. Baccalaureate degree graduates, in addition to the knowledge required in associate degree programs, will be able to apply the basics of fire protection engineering technology to practical environments involving the fire safety of buildings and occupants.

[1]This is based on the definition of 'Credit Hour' as stated in Title 34 of the Code of Federal Regulation, Article 600.2

## GENERAL

This model is based on a four-year program. The model is formatted such that a school can utilize this in conjunction with ABET accreditation criteria (Engineering Technology Accreditation Commission). Each school year is divided into two semesters (fall and spring). Each semester is typically 14 weeks of instruction followed by one additional week for final exams. A credit hour is the basic unit of measure for college credit that is used to measure the relative weight of a given course toward the fulfillment of a degree. A credit hour is usually represented by one hour of class per-week-per-semester with a minimum of two hours out of class student work each week. This time outside of class could be lab, internships, practical, or other academic work leading to the award of credit hours[1]. With the exception of courses that have a laboratory requirement, most courses are worth three credit hours and meet for three hours per-week. Courses that have a laboratory requirement are usually worth four credits – three hours in the classroom and one hour in the laboratory. Typically, one school year is equivalent to 30 - 32 credits.

[1]This is based on the definition of 'Credit Hour' as stated in Title 34 of the Code of Federal Regulation, Article 600.2

**REFERENCES**

*April 15, 2010 SFPE Recommendations for a Model Curriculum for a BS Degree in Fire Protection Engineering.*

*"A Proposal for a Model Curriculum in Fire Safety Engineering", Fire Safety Journal, March, 1995.*

**RECOMMENDED MODEL CURRICULUM – BS IN FPET**

| Course | Number of Credits | Total Number of subject hours | Course Objective |
|---|---|---|---|
| **Basic Science & Math** | | | Program must develop the ability to apply mathematics to the solution of technical problems. These solutions must be based in basic physical science content with laboratory experience. |
| Physics & Lab | 4 | 12 | Refer to course description for the specific college or university involved. |
| Chemistry, Organic Chemistry & Labs | 8 | 24 | The objective of the course is to provide a basic knowledge of basic chemical concepts & terminology, how to formulate rules of nomenclature for organic and inorganic substances, functional groups in organic compounds & thermodynamic data and expressions and their relationships. |
| Calculus | 9 | 27 | The objective of the course is to provide a basic knowledge of functions using one or more variables, including limits, derivatives and integrals (including double & triple). It must include the application of integral and differential calculus. It is also recommended to include a course covering differential equations. |
| **Total Basic Science** | **21** | **63** | |

| Course | Number of credits | Total Number of Subject Hours | Course Objective |
|---|---|---|---|
| **General Education** | | | A broad education component that complements the technical content of the curriculum and is consistent with the program educational objectives. |
| English | 6 | 18 | Refer to course description for the specific college or university involved. |
| General Electives/ Other Core Requirements[1] | 6 | 18 | Refer to course description for the specific college or university involved. |
| Engineering Economics | 3 | 9 | Refer to course description for the specific college or university involved. |
| Technical Writing | 3 | 9 | Refer to course description for the specific college or university involved. |
| Other General Classes | 14 | 42 | Refer to course description for the specific college or university involved. |
| **Total General Education** | **32** | **96** | |

| Course | Number of credits | Total Number of Subject Hours | Course Objective |
|---|---|---|---|
| **Engineering Topics** [3] | | | The objectives of the engineering courses are to: To include a technical core that prepares students for the increasingly complex technical specialties they will experience later in the curriculum; and to develop student competency in the use of equipment and tools common to the discipline. |
| Computer Aided Drafting (CAD) | 3 | 9 | The objective of this course is to provide knowledge for the creation of 2-D CAD and 3-D (wireframe and solid) engineering models for construction of basic shapes, multi view drawings, building information management and graphic design (component and assembly); dimensioning and tolerancing guidelines. |
| Statistics | 3 | 9 | The objective of this course is to provide a basic knowledge in the theory and methods of statistics including descriptive measures, probability, samplings, estimation, hypothesis testing, correlation, and regression. |
| Statics | 3 | 9 | The objective of the course is to provide a basic knowledge of Newton's Laws & their application to engineering problems in statics; includes free- body diagrams, centers of mass, moments of inertia, vector algebra, force, moment of force, couples, resultants of force systems, static equilibrium of rigid bodies, trusses, friction, properties of areas, shear & moment diagrams, flexible cables, screws & bearings. |
| Mechanics of Materials | 3 | 9 | The objective of the course is to provide a basic knowledge of the relationship between internal stresses and deformations produced by external forces acting on a deformable body: concepts of stress, strain, deformation, internal equilibrium, basic properties of engineering materials; analysis of axial loads, torsion, bending, shear and combined loading, buckling of columns; stress transformation, principal stresses, column analysis and energy principles; introduction to failure theories. |

| Course | Number of credits | Total Number of Subject Hours | Course Objective |
|---|---|---|---|
| Fluid Mechanics | 3 | 9 | The objective of the course is to provide a basic knowledge of fluid mechanics (incompressible viscous and inviscid flows): fluid behavior and properties; hydrostatic pressure and force, buoyancy and stability; continuity, momentum and Bernoulli equations; similitude, dimensional analysis and modeling. |
| Thermodynamics | 3 | 9 | The objective of the course is to provide a basic knowledge of the first and second laws of thermodynamics, including work, heat, energy transformation, and system efficiency; the theory and application of reversible and irreversible thermodynamic process, Carnot cycles, entropy, energy balances and ideal efficiencies of steady flow engineering systems. |
| Fire Protection Related Codes & Standards | - | - | The objective of this topic is to provide knowledge of the use and application of building codes and related reference standards, including for both active and passive fire protection. It is expected that this topic will be woven throughout the curriculum, where applicable. |
| Fire Chemistry | - | - | The objective of this topic is to provide background knowledge about combustion reactions and heat transport and increase FPE-related skills and capabilities to construct and analyze models. It is expected that this topic will be woven throughout the curriculum, where applicable. |
| Fire Hazard and Risk Analysis | 3 | 9 | The objective of the course is to provide knowledge in the areas of probability and statistics, of the concepts, tools and methods of hazard assessment and risk analysis, and of the use and application of these concepts, tools and methods to fire safety problems. |

| Course | Number of credits | Total Number of Subject Hours | Course Objective |
|---|---|---|---|
| Water Based Suppression | 3 | 9 | The objective of the course is to provide knowledge of fundamental principles, design criteria and installation requirements for water-based fire suppression systems, including , classification of occupancy hazards in order to establish the proper sprinkler design criteria, the design of a sprinkler and mist systems for the specific construction features and occupancy involved, and the effects of various forms of heat transfer and oxygen displacement characteristics relating to water-based suppression. |
| Special Hazards - Non- water Based Suppression | 3 | 9 | The objective of the course is to provide knowledge of fundamental principles, conceptual design criteria, and installation requirements for non- water based fire suppression (including clean agent, halon, carbon dioxide, inert gas, dry chemical and foam fire suppression agents) used in total flooding, direct application & explosion suppression. |
| Fire Dynamics | 3 | 9 | The objective of the course is to understand the various stages of fire, to provide a knowledge base concerning the different methods and techniques applied in the analysis of a fire sequence and develop ability to critically examine those methods in terms of practical application.<br><br>The course is also aimed at increasing the engineering-related ability to construct and analyze models. |

| Course | Number of credits | Total Number of Subject Hours | Course Objective |
|---|---|---|---|
| Structural Fire Protection | 3 | 9 | The objective of the course is to provide knowledge regarding the impact of fire exposure on materials used in construction assemblies, the role various construction features play in the fire resistance of the assembly. |
| Storage & Transportation of Hazardous Materials | 3 | 9 | The objective of this course is to provide knowledge of the handling, transportation and storage of hazardous materials including limitations of amounts stored, determination of needed separation distances and proper identification. |
| Egress and Life Safety Analysis | 3 | 9 | The objective of this course is to provide knowledge of human behavior in fire, including physiological and psychological response, decision-making and movement, and of approaches, tools and methods to integrate this knowledge with knowledge gained from other courses to evaluate life safety issues in the event of fire. |
| Detection, Alarm & Smoke Control | 3 | 9 | The objective of this course is to provide knowledge of fundamental principles, design criteria and installation requirements for fire detection, occupant notification and smoke control systems, including how to analyze, evaluate, and specify these systems. |

| Course | Number of credits | Total Number of Subject Hours | Course Objective |
|---|---|---|---|
| Fire Risk Management | 3 | 9 | The objective of this course is to provide knowledge of risk management concepts (avoid, accept, mitigate, transfer) and associated strategies, and of the application of these concepts and strategies during facility design and operation so that processes, equipment and storage can be located and managed so as to minimize risk of unacceptable loss. |
| Fire Investigation | 3 | 9 | The objective of this course is to provide knowledge of fire investigation with regard to gathering and interpreting fire scene evidence; researching related codes, standards & technical reports and re-construction of the fire scenario with physical and numerical models. |
| Senior Capstone Project [3] | 4 | 12 | The objective of the project is to demonstrate the capability to apply the knowledge and preparation gained from previous courses to solve a fire protection engineering related problem. This will require independently analyzing and reporting on a relevant topic in a comprehensive and scientifically methodical manner. NOTE: Minimum 3 credits |
| Technical Electives[2, 3] | 52 | 156 | Varies. Refer to course description for the specific college or university involved. |
| **Total Engineering Topics** | **68** | **204** | |
| **Total** | **120** | **360** | |

Footnotes:

[1]Psychology or physiology are preferred. Other courses could include Economics, Physical Education, Language, History, etc.

[2]The technical electives listed below are preferred.

[3]Upper division classes should have a strong emphasis in technical writing and oral presentations.

| Potential Electives | | | |
|---|---|---|---|
| **Course** | **Number of Semesters** | **Number of Credits** | **Course Objective** |
| Fire Service Operations | 1 | - | The objective of this course is to provide knowledge of the challenges, organizational structure, apparatus, emergency operations and capabilities associated with municipal fire departments and industrial fire brigades; and how fire department operations will interface with building fire protection systems and features during an emergency event. |
| Advanced Computational Fluid Dynamics | 1 | - | This course is designed to introduce engineering students to the fundamental concepts, techniques, methods, and algorithms used in Computational Fluid Dynamics (CFD). Students will learn to recognize the physics behind various numerical tools used for solving airflow problems, employ basic numerical methods, apply CFD for airflow simulations in buildings, assess transport of different particulates in indoor environments, and critically analyze and evaluate CFD simulation results. Knowledge of Dif. Eq., heat transfer and fluid dynamics are a prerequisite for this course. |
| Advanced Extinguishing Systems Design and Analysis | 1 | - | The objective of this course is to provide knowledge on automatic fixed fire extinguishing systems and water supply systems. Emphasis on computer assistance through use of existing design programs |
| Dynamics | 1 | - | The objective of the course is to provide a basic knowledge of calculus based vector development of the dynamics of points, particles, systems of particles, and rigid bodies in planar motion; kinematics of points in rotating and non-rotating frames of reference in one, two, and three dimensions; conservation of momentum, and angular momentum; principle of work and energy. |

| Course | Number of Semesters | Number of Credits | Course Objective |
|---|---|---|---|
| Heat Transfer | 1 | - | The objective of the course is to provide a basic knowledge of the theory and application of steady state and transient heat conduction in solids, the concepts and applications of Biot and Fourier numbers, the principals of thermal radiation with application to heat exchange between black and non-black body surfaces, the use of radiation networks (electrical network analogy) & surface radiation properties, principles of convection heat transfer. |
| Fire Testing | 1 | - | The objective of this course is to provide knowledge of terminology and issues related to fire hazards and flammability assessment methods for engineering and research; to classify building construction material with regard to combustibility, non-combustibility, limited combustibility or fire resistivity; and to quantify the combustibility of the occupancy fire load. A laboratory section could provide students with hands-on instruction on methods of quantifying ignition, flame spread, heat release rate and effluent production of common materials. |
| Fire Modeling | 1 | - | The objective of the course is to provide knowledge of zone models and CFD models, including the technical basis for enclosure fire model elements, the limitations of computer-based fire models and the use of current computer-based fire models for practical FPE problems. |
| Explosion Prevention & Protection | 1 | - | The objective of this course is to provide knowledge related to deflagrations and detonations and methods used to prevent ignition and limit the effects of deflagrations, including explosion suppressions systems and pressure resistant & pressure relieving construction; BLEVE theory and prevention. |
| Performance Based Design | 1 | - | The objective of this course is to provide knowledge on how to appraise and measure fire safety through systems analysis, probability theory, engineering economy and risk management. Identification and synthesis of components of fire protection engineering in the development of criteria for the design, evaluation and assessment of fire safety or component hazards. |

| Course | Number of Semesters | Number of Credits | Course Objective |
|---|---|---|---|
| Advanced Life Safety Analysis | 1 | - | The objective of this course is to apply fractional effective dose methods for predicting time to incapacitation or death from fires. Physiology and toxicology of the fire effluent components, decomposition chemistry, and standard experimental approaches. People movement, evacuation models and human behavior in fire situations. |
| Wildland Fires | 1 | - | The objective of this course is to address the variety of engineering aspects of wildland fires. This may include fire investigation, prevention, and suppression approaches. Discussion and analysis of the Wildland Urban Interface. |
| Industrial Fire Protection | 1 | - | The objective of this course is to apply fire scenario analyses for industrial installations using test data, loss experience, and simplified theoretical modeling focusing on warehousing, production and processing facilities, storage of flammable liquids, and safety of electrical equipment and computers. This may include fire risk analysis and process safety. |
| Upper Division Lab Class | 1 | - | Any of the required courses could be further emphasized by adding a lab component such that students may experience and apply theory learned. |