Bachelors of Science in Engineering For Fire Protection Engineering Model Curriculum

Society of Fire Protection Engineers

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Recommendations for a Model Curriculum for a BS Degree in Fire Protection Engineering (FPE)

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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 (FPE). It is not intended to imply that this is the only acceptable combination of courses that should be offered for such a program. The model curriculum also suggests elective courses and appropriate core courses for minors in fire protection engineering. Additionally, 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.

GENERAL

This model is based on a four-year program. The model is formatted such that a school can utilize it in conjunction with ABET accreditation criteria (Engineering 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 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, practicum 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 FPE

Course	Number of Credits	Total Number of Subject Hours	Course Objective
Basic Science			A minimum of 30 semester credit hours (or equivalent) of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program.
Physics & Lab	12	36	Refer to course description for the specific college or university involved. Note: 3 semesters x 4 credits or 4 semesters x 3 credits.
Chemistry, Organic Chemistry & Labs	6	18	The objective of the course is to provide a basic knowledge of basic chemical concepts and terminology, how to formulate rules of nomenclature for organic and inorganic substances, functional groups in organic compounds and thermodynamic data, and expressions and their relationships. Note: 6-8 credits.
Calculus, Differential Equations for Engineers	12	36	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 and triple).
Total Basic Science	**30**	**90**	
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	Varies. 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.

Course	Number of credits	Total Number of Subject Hours	Course Objective
Other General Classes	18	54	Varies. Refer to course description for the specific college or university involved.
Total General Education	**72**	**216**	
Engineering Topics [3]			A minimum of 45 semester credit hours (or equivalent) of engineering topics appropriate to the program, consisting of engineering sciences, engineering design, and utilizing modern engineering tools.
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 and their application to engineering problems in statics, including 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 and moment diagrams, flexible cables, screws and bearings.

Course	Number of Credits	Total Number of Subject Hours	Course Objective
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.
Dynamics	3	9	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.
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.

Course	Number of Credits	Total Number of Subject Hours	Course Objective
Heat Transfer	3	9	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) and surface radiation properties, and the principles of convection heat transfer.
Fire Protection Related Codes and 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 [a,b]	3	9	The objective of the course is to provide knowledge in the areas of probability and statistics; the concepts, tools, and methods of hazard assessment and risk analysis; and the use and application of these concepts, tools, and methods to fire safety problems.

Course	Number Credits	Total Number of Subject Hours	Course Objective
Water-Based Suppression [a,b]	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 to establish the proper sprinkler design criteria, the design of 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, 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, and explosion suppression.
Fire Dynamics [a]	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. The course is also aimed at increasing the engineering-related ability to construct and analyze models.
Fire Modeling	3	9	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.

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, and the application of mechanics and heat transfer engineering principles.
Storage and 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 [a,b]	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 approaches, tools, and methods to integrate this knowledge with knowledge gained from other courses to evaluate life-safety issues in the event of fire.
Fire Testing	3	9	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.
Detection, Alarm, and Smoke Control [a,b]	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
Explosion Prevention and Protection	3	9	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-suppression systems, pressure-resistant and pressure-relieving construction, and BLEVE theory and prevention.
Fire Risk Management [b]	3	9	The objective of this course is to provide knowledge of risk management concepts (avoid, accept, mitigate, transfer) and associated strategies and the application of these concepts and strategies during facility design and operation so that processes, equipment, and storage can be located and managed to minimize risk of unacceptable loss.
Senior Capstone Project [3]	3	9	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]	6	18	Varies. Refer to course description for the specific college or university involved.
Total Engineering Topics	**69**	**207**	
Total	**123**	**369**	

Footnotes:

[1] Psychology or physiology courses are preferred. Other courses could include economics, physical education, language, history, etc.

[2] Building construction, advanced technical writing, advanced fire modeling, or plan review skills are preferred.

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

[a] Recommended engineering track minor course

[b] Recommended non-engineering track minor course

Potential Electives			
Course	**Number of Semesters**	**Number of Credits**	**Course Objective**
Fire Investigation	1	-	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, and technical reports; and re-construction of the fire scenario with physical and numerical models.
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, as well as 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.
Advanced Extinguishing Systems Design and Analysis	1	-	The objective of this course is to provide knowledge of automatic fixed fire extinguishing systems and water supply systems with emphasis on computer assistance through use of existing design programs.

Course	Number of Semesters	Number of Credits	Course Objective
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, risk management, and 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.
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, including physiology and toxicology of the fire effluent components, decomposition chemistry, and standard experimental approaches, as well as 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, as well as discussion and analysis of the Wildland Urban Interface.
Upper Division Lab Class	1	-	Any of the required courses could be further emphasized by adding a lab component such that students could experience and apply theory learned.