Course Code, Course Title: **ENFP426, Computational Methods in Fire Protection**

Credits: **Three (3)**

Contact hours: **Two lectures per week, 75 minutes each**

Instructor, term: **A. Tohidi, A. Trouvé, Spring 2026**

Textbook: **Karlsson B., Quintiere J.G., *Enclosure Fire Dynamics*, CRC Press LLC, 2000 (1st Ed.) or 2022 (2nd Ed.).**

Other supplemental materials: ***SFPE Handbook of Fire Protection Engineering*, 5th Ed., M.J. Hurley (Ed.), New York: Springer, 2016; *SFPE Handbook of Fire Protection Engineering*, 6th Ed., Society of Fire Protection Engineers (Ed.), New York: Springer, 2026.**

CFAST: https://pages.nist.gov/cfast/; Peacock, R.D., Reneke, P.A., Forney G.P. (2025) "*CFAST - Consolidated Model of Fire Growth and Smoke Transport (Version 7) – Volume 2: User's Guide*", NIST Technical Note 1889v2.

FDS: https://pages.nist.gov/fds-smv/; McGrattan, K., Hostikka, S., Floyd, J., McDermott, R., Vanella, M., Mueller, E., Paul, C., "*Fire Dynamics Simulator – User's Guide,*" NIST Special Publication 1019, Sixth Ed., National Institute of Standards and Technology, Gaithersburg, MD, USA, 2025; McGrattan, K., Hostikka, S., Floyd, J., McDermott, R., Vanella, M., Mueller, E., Paul, C., "*Fire Dynamics Simulator – Technical Reference Guide, Volume 1: Mathematical Model; Volume 2: Verification; Volume 3: Validation; Volume 4: Configuration Management*" NIST Special Publication 1018, Sixth Ed., National Institute of Standards and Technology, Gaithersburg, MD, USA, 2025.

PyroSim: https://www.thunderheadeng.com/pyrosim/; "*PyroSim User Manual*," Thunderhead Engineering, MD, USA, 2025. (https://www.thunderheadeng.com/docs/2026-2/pyrosim/)

Catalog description: **Introduction to computer-based fire modeling: zone modeling and Computational Fluid Dynamics (CFD); documentation of input data, validation and verification tests.**

Prerequisites and Corequisites: **Prerequisite: ENFP312**

Specific outcomes of instruction: **Upon completion of this course, students should be able to:**

- **Demonstrate an understanding of current fire models and their role in the practice of fire protection engineering.**

- **Identify the different approaches used in current fire models: CFD modeling versus zone modeling.**
- **Apply quality control methods to evaluate the accuracy of simulation results produced by fire models: verifications tests versus validation tests.**
- **Apply current fire models (FDS, PyroSim, CFAST) to the simulation of representative fire configurations (compartment fires and wildland fires).**

Student outcomes assessed (ABET SOs if applicable):

- **SO3: An ability to communicate effectively with a range of audiences.**
- **SO7: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.**

Brief list of topics covered:

- **Introduction to computer-based fire modeling and comparison between the zone modeling and CFD modeling approaches.**
- **Quality control tests: Verification and Validation.**
- **Introduction to zone modeling software used by professional fire engineers (CFAST).**
- **Introduction to CFD modeling software used by professional fire engineers (FDS and PyroSim).**
- **Series of case studies: the students use zone and CFD models to simulate different representative fire problems, including configurations featuring fire growth, over- and under-ventilated fires, natural convection, pressure build-up, HVAC systems, heat conduction in solids, thermal radiation, pyrolysis, and wildland fire spread.**