Course Code, Course Title: **ENFP626, Computational Methods in Fire Protection**

Credits: **Three (3)**

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

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

Textbook: **none**

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

***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.**

**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, 2026; 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, 2026.**

Catalog description: **Introduction to Computational Fluid Dynamics (CFD)-based fire modeling; governing equations of turbulent reacting flows; numerical approaches to the treatment of turbulence (DNS, LES, RANS); numerical methods for partial differential equations; physical modeling of enclosure fires (turbulence, combustion, thermal radiation, pyrolysis, suppression). Development of sample programs (MATLAB) and use of current CFD-based fire models (FDS).**

Prerequisites and Corequisites: **Prerequisite: ENFP312**

Restriction: **Permission of ENGR-Fire Protection Engineering department**

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

- **Demonstrate an understanding of current fire models based on a Computational Fluid Dynamics (CFD) approach.**

- **Demonstrate an understanding of the parameters controlling the numerical performance of CFD-based fire models, in particular the importance of grid resolution.**
- **Apply quality control methods to evaluate the accuracy of simulation results produced by fire models: verifications tests versus validation tests.**
- **Apply a current fire model (the Fire Dynamics Simulator - FDS) to the simulation of representative fire configurations.**

Student outcomes assessed (ABET SOs if applicable): **Not applicable**

Brief list of topics covered:

- **Introduction to Computational Fluid Dynamics (CFD) concepts and algorithms and their application to fire simulations.**
- **Quality control tests: Verification and Validation.**
- **Review of the governing equations used in fire dynamics, including current physical models used to describe turbulent mixing, combustion, radiation and pyrolysis.**
- **The discrete particle model used in simulations of liquid water sprays; hands-on examples using MATLAB.**
- **Parameters controlling the numerical performance of algorithms used to solve partial differential equations; importance of the choice of spatial resolution; hands-on examples using MATLAB.**
- **Introduction to CFD modeling software used by professional fire engineers (FDS).**
- **Physical models used to describe turbulent mixing, combustion, radiation and pyrolysis; hands-on examples using FDS.**
- **Simulation of flame spread along a solid combustible surface.**