Catalog Description: AE 6412 Turbulent Combustion. Fundamentals of interaction between flow turbulence and reactive scalars. Theoretical, numerical and experimental methods. Physics of premixed, non-premixed and partially premixed turbulent combustion.

Text: *Turbulent Combustion* by Norbert Peters, Cambridge University Press, 2000; and *Theoretical and Numerical Combustion* by T. Poinsot and D. Veynante, Edwards, 2001.

Course Coordinator: Dr. Suresh Menon

Learning Objectives: Introduce students to the state-of-the-art in the field of turbulent combustion. Provide familiarity and understanding of the recent advances in theoretical, numerical and experimental studies and resulting new insight into the physics of combustion when turbulence effects are very important.

Expected Outcomes: Successful students will: a) be able to work with time- and spatial-scale analysis methods for turbulent, combusting flows; b) have the tools needed to determine appropriate analysis and model approaches for various turbulent combustion regimes; and c) have an up-to-date understanding of the physics of turbulent combustion with application to practical combustion issues in real devices.

Prerequisites: Graduate level exposure to thermodynamics, combustion, and shear and turbulent flows.

Topics:

1. **Turbulent Flow and Turbulent Combustion – An Overview (3 hours):** Energy cascade, Kolmogorov's similarity hypotheses, energy and dissipation spectra, coherent structures in turbulent flows, classification by non-dimensional parameters and by flow features.
2. **Linear and Non-Linear Interactions (3 hours):** Acoustic-Vortex-Entropy Interactions, wave reflections from boundaries, boundary conditions
3. **Fundamentals of turbulent combustion (6 hours):** Scale separation and high Reynolds Number independence, statistical description, computation of chemical rate
4. **Theoretical and numerical models in turbulent combustion (9 hours):** Moment closures for reactive scalars, eddy breakup and eddy dissipation models, PDF and conditional moment closure methods, laminar flamelet theory and models, Linear-eddy model
5. **Numerical methods (3 hours):** Reynolds-Averaged Navier Stokes Methods, Large-Eddy Simulations, Direct Numerical Simulations, regions of application, accuracy and limitations
6. **Experimental methods (3 hours):** Velocity Measurements, Passive and Reactive Scalar Measurements, accuracy and limitations
7. **Physics of turbulent premixed combustion (6 hours):** Regimes of premixed