COURSE NUMBER: ME 5446, 4 credits	**COURSE TITLE:** Introduction to Combustion
TERMS OFFERED: Fall	**PREREQUISITES:** Thermodynamics, Fluid Mechanics (ME 3331, 3332) upper div. or Grad
TEXTBOOKS/REQUIRED MATERIAL: An Introduction to Combustion by S.Turns; 2nd Ed. McGraw Hill, 2000 (Required) Combustion by J. Warnatz, U. Maas & R.W. Dibble, 4^{th} Ed. Springer, 2006 (reference)	**PREPARED BY:** P. Strykowski **DATE OF PREPARATION:** May 2007
COURSE LEADER(S): P.J. Strykowski	**CLASS/LABORATORY SCHEDULE:** Four 50-minute lectures per week **CONTRIBUTION OF COURSE TO MEETING PROFESSIONAL OBJECTIVES:** 100% Engineering topics
CATALOG DESCRIPTION: Thermodynamics, kinetics and mass transport and pollutants in reacting systems. Reactors, laminar and turbulent flames. Ignition, quenching and flames stability. Diffusion flames. Combustion in engines, furnaces and turbines.	**COURSE TOPICS:** 1. Review of thermodynamics, adiabatic flame temperatures, chemical equilibrium. 2. Computer calculation of equilibrium species distribution and adiabatic temperatures. 3. Mass Transfer: Derivation of transport coefficients from kinetic theory, Fick's law, prototype problems: Stefan problem, drop evaporation. 4. Chemical Kinetics: Rate laws, elementary reactions, rate constants from simple kinetic theory, 5. Chain reaction mechanisms. 6. H_2/O_2, CO and hydrocarbon combustion mechanisms. 7. Prototype Combustors/Reactors: batch, plug flow and perfectly stirred reactors. 8. Computer calculation using models of prototype reactors. 9. Statement of mass, momentum, species and energy conservation. 10. Premixed Laminar Flames: flame speed, propagation, ignition, and extinction, flame stabilization. 11. Brief introduction to turbulent premixed flames; turbulent flame speeds, wrinkled flames, flames in eddies. 12. Droplet and Spray Flames: heat and mass transfer effects, d^2 law.

COURSE OBJECTIVES	1. Teach principles of reacting flows, based on thermodynamics, kinetics, and transport. 2. Teach concepts of chemical kinetics 3. Teach concepts in mass transfer 4. Teach the physical/chemical basis behind combustion phenomena. 5. Expose students to modern methods of reaction engineering through simulation tools.
COURSE OUTCOMES	**(Letters shown in brackets are linked to program outcomes a-k)** 1. Computation of energy release and temperature during combustion [a, k] 2. Computation of species distribution under various pressure, temperature, volume combustion conditions using computer codes. [b, c, k] 3. Able to mathematically describe the rate of species formation based on arbitrary set of reactions and equilibrium constants. [a, e] 4. Ability to model simple mass and heat transfer problems involving multiple species and phase change. [a, e] 5. Ability to estimate flame speeds under a variety of conditions. [a, e, k] 6. Ability to compute detailed flame structure. [a, e, k] 7. Ability to compute quenching distances for the safe design of burners. [a, e, k] 8. Ability to compute minimum ignition energies. [e, k] 9. Ability to compute droplet burning rates. [a, e, k] 10. Qualitative understanding of the role of turbulence in combustion
ASSESSMENT TOOLS:	1. Regular homework assignments including computer solutions 2. Midterm exams; final exam

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Nature of changes:
The Thermodynamics and Heat Transfer division discussed the curricular content of Introduction to Combustion, ME 5446. The prerequisites for the course were changed to reflect the current course numbering system. Course outcomes were modified to reflect that turbulent combustion would be introduced, but that the ability to compute turbulent burning conditions would not be expected.