COURSE NUMBER: ME 5344, 4 credits	**COURSE TITLE:** Thermodynamics of Fluid Flow with Applications
TERMS OFFERED: Spring, Fall (night via extension)	**PREREQUISITES:** Thermal Science I, Thermal Science II, or equivalent. IT upper division or graduate student.
TEXTBOOKS/REQUIRED MATERIAL: Instructor prepared notes	**PREPARED BY:** E.M. Sparrow **DATE OF PREPARATION:** May 23, 2007
COURSE LEADER(S): E. M. Sparrow	**CLASS/LABORATORY SCHEDULE:** Four 50 minutes lectures per week **CONTRIBUTION OF COURSE TO MEETING PROFESSIONAL OBJECTIVES:** 100% Engineering topics
CATALOG DESCRIPTION: Conservation of mass, momentum and energy for compressible gas flows. Relevant thermodynamic properties. Nozzles, diffusers, thrust producers, shocks. Fluid-wall interactions. Wall heat transfer, internal heat release. Temperature recovery. Mass addition. Chemical thermodynamics/applications.	**COURSE TOPICS:** 1. Review of thermodynamics & fluid mechanics. 2. Conservative principles of mass, momentum, energy, and entropy balances for gas systems. 3. Introduce sound speed and Mach number. 4. Introduce concept of stagnation state of a fluid 5. Examine isentropic flow of an ideal gas through isentropic converging and converging-diverging passages. Non-ideal gas considerations. 6. Consequences of choking 7. Introduce normal shock function and physics of normal shocks in converging-diverging nozzles. 8. Frictional constant-area flow of a compressible gas; Fanno flow w and w/o shocks; choking 9. Heat transfer in a constant-area duct of a compressible gas; shocks; choking 10. Heat release due to exothermic chemical reaction 11. Generalized flow of a compressible gas through passages including area change, friction, heat transfer, mass addition. Applications 12. Introduction of two-dimensional compressible gas dynamics. 13. Oblique shocks (strong & weak) 14. Prandtl-Meyer expansion. 15. Flow development downstream of over- and under-expanded nozzles.

COURSE OBJECTIVES	1. Apply mass, momentum, energy and entropy balances to compressible gas systems, in one and two dimensions. 2. Apply thermodynamic properties and principles to gas systems using h-s and T-s plane representations and P-x, M-x diagrams. 3. Obtain the physical insight unique to compressible gas systems, in particular the limitations imposed on system design by choking due to area change, friction, heat transfer and/or mass transfer effects. 4. Strengthen understanding of basic thermochemistry and the impact of exothermicity on combusting systems.
COURSE OUTCOMES	**(Letters shown in brackets are linked to program outcomes a-k)** 1. Demonstrate the application of mass, momentum, energy and entropy balances applied to one-dimensional systems of ideal gases with constant specific heats. [a, e] 2. Demonstrate the application of mass, momentum, energy and entropy balances applied to one-dimensional systems of real fluids [a, c, e] 3. Understand the importance of pressure boundary conditions in determining the flow characteristics of practice gas handling systems.[c, e] 4. Apply compressible gas dynamics to subsonic and supersonic nozzle design [c, e, h, j, k] 5. Apply compressible gas dynamics to long subsonic gas pipelines and supersonic combustion chambers. [c, e, h, j, k] 6. Apply compressible gas dynamics to vacuum handling systems [c, e, h, j] 7. Understand importance of and limitations to the presence of choking [a, c, e, k] 8. Understand the impact of shocks on system performance and how to eliminate or minimize their presence. [a, c, e] 9. Apply gas dynamics principles to basic two-dimensional flow systems. [a, c, e, h, j, k]
ASSESSMENT TOOLS:	1. Exams (2 mid-terms and final exam) 2. In class problems & discussion 3. Extensive homework problem sets

ME 5344

Nature of Changes:

1. ***Dr. Sparrow is now the primary course leader.***
2. ***The course is now offered in both the fall and spring, and at night via extension.***
3. ***The course required material is now instructor prepared notes.***
4. ***The course prerequisites have been changed to reflect changes in the department core curriculum.***