Combustion is a multi-disciplinary subject in which thermodynamics, chemistry, heat and mass transport, and fluid mechanics play equally important roles. Analysis of a combustion system most often requires carefully developed models that incorporate concepts from these disciplines. Except for idealized problems for which solutions can be obtained analytically, computational methods are used to obtain solutions of more realistic models.

The course starts with a review of some physics, chemistry and dynamics: thermodynamic, chemical kinetics, transport processes, and conservation laws of reacting flows, including the use of analytical and computational methods to facilitate problem solving. Four canonical combustion phenomena are analyzed: combustion in homogeneous gaseous mixtures, laminar-diffusion flames, laminar-premixed flames, and detonation waves. More complex phenomena, such as multiphase combustion, turbulent combustion, combustion instability, etc., are covered. Time permitting, applications to combustion engines, internal and external, uncontrolled combustion (fires) and other applications are considered. Codes are used to compute phenomena of progressively more complex physics.

The course is taught in lecture format, and problem sets/projects are discussed during the lecture hours. My lecture notes will be posted on the Web. Problem sets and projects will also be posted. Computer programs will be available on Athena.