Our Mission
To provide the next generation of combustion researchers with a comprehensive knowledge in the technical areas of combustion theory, chemistry, experiment, computation and applications.

The 2022 Session
The 2022 Princeton-Combustion Institute Summer School on Combustion and the Environment, scheduled for June 19 to June 24, 2022, will offer the following courses: (1) Combustion Theory; (2) Combustion Chemistry; (3) Theoretical and Numerical Combustion; (4) Quantitative Laser Diagnostics for Combustion Chemistry and Propulsion.

Application

Program Dates
Arrival & Welcome Dinner: Sunday, June 19, dinner at 6:30pm; Class Schedule: Monday-Friday, June 20-24; Celebration & Farewell Banquet: Thursday, June 23; Departure/Check Out: Friday, June 24.

Course Description

**Combustion Theory** (Monday-Friday AM)
Lecturer: Prof. Moshe Matalon, University of Illinois at Urbana-Champaign, USA
Course Content: This course provides an introduction to the theoretical foundations of combustion science. The tutorial starts with a comprehensive overview of the general equations that describe the flow of chemically-reacting mixtures and discuss rational approximations used in their analysis, focusing on the physical aspects associated with fluid mechanics and transport phenomena. The covered topics include deflagration and detonation waves, the structure of premixed and diffusion flames, effects of flame stretch and differential diffusion, lifted flames and edge flames, flame instabilities, turbulent flames, ignition and extinction phenomena, burning of condensed fuels and spray combustion.

**Combustion Chemistry** (Monday-Friday PM)
Lecturer: Prof. Alison Tomlin, University of Leeds, UK
Course Content: Accurately predicting chemical changes is fundamentally important for describing combustion within a range of devices including boilers, furnaces, gas turbines and engines, as well as understanding the hazards of combustible materials. Redesigning such devices to operate using low carbon fossil fuel replacements may form an important part of strategies for achieving Net Zero over the coming decades. On the other hand, chemical oxidation processes, particularly for complex fuels such as biofuels, and alternative aviation fuels, involve very large numbers of species and reactions. This poses challenges for including detailed chemistry within models of practical devices. With this in mind, the course will take students on a journey from the fundamentals of reaction kinetics basics through to constructing chemical mechanisms for different fuel types, reducing them to facilitate their use in reactive flow models and finally to quantifying the impact of inherent uncertainties on their predictive quality. Topics will include: chemical mechanism structure; rate equations for basic reactors; temperature and pressure dependence of rate coefficients; determination of rate constants via experimental and theoretical methods; basic thermodynamics; automatic generation of reaction mechanisms; ignition phenomena and low temperature chemistry; pollutant formation mechanisms; future fuels and challenges they pose for combustion systems; model uncertainties and sensitivity analysis; chemical model reduction methods.

**Theoretical and Numerical Combustion** (Monday-Friday PM)
Lecturer: Prof. Thierry Poinsot, Institut de Mécanique des Fluides de Toulouse, CNRS, France
Course Content: This course will present basic tools and recent progress in numerical combustion while establishing important connections with the underlying combustion basics, enabling engineers and research specialists with the knowledge of fluid mechanics to move to an integrated understanding of numerical combustion. The course will cover physics and simulation of ignition, quenching, laminar flames, premixed and diffusion regimes, turbulent flames, high performance computing using DNS and LES, combustion instabilities.

**Quantitative Laser Diagnostics for Combustion Chemistry and Propulsion** (Monday-Friday AM)
Lecturer: Prof. Ronald K. Hanson, Stanford University, USA
Course Content: Fundamentals of laser absorption and laser-induced fluorescence in gases, including summaries of molecular spectroscopy and photophysics. Basics of shock tubes as a primary tool for studying high-temperature gas chemistry, including recent advances to achieve more uniform test conditions and extended test times. Example state-of-the-art applications of (a) species-specific sensing in shock tube studies of the kinetics of combustion and of transforming energy carriers, and (b) of multi-parameter sensing in different types of propulsion flows and engines.

**2022 Princeton-Cl Summer School on Combustion and the Environment**
Further inquiries on the academic program may be made by contacting the Program Co-organizers Prof. Michael E. Mueller (muellerm@princeton.edu) and Prof. Ran Sui (rsui@mst.edu).
Visit us online at https://cefrc.princeton.edu/combustion-summer-school.