Course description: Fuels and combustion; combustion stoichiometry; chemical equilibrium; adiabatic flame temperature; reaction kinetics; transport processes; conservation laws; ignition processes; gas flames classification; premixed flames; laminar and turbulent regimes; flame propagation; deflagrations and detonations; diffusion flames; pollutant formation; atmospheric impacts; engine combustion; solid phase combustion; combustion diagnostics; combustion applications.

Prerequisite(s): MEEN 3110 or equivalent or consent of department.


Reference Books: Instructor provided course notes, reading and viewing materials will be available on Canvas.


Course objectives: Course objectives are: (1) to provide students with fundamental concepts of combustion science and engineering; (2) to introduce them to experimental and mathematical descriptions of combustion processes; (3) to provide case-study analysis of environmental impacts and applications related to energy industries.

Learning Outcomes:

1. Knowledge of the fundamental concepts of combustion science and engineering
2. Ability to identify, formulate, and solve engineering problems
3. Knowledge of global and societal issues related to fossil fuels and energy production
4. Knowledge of industrial applications of combustion in energy engineering applications
5. Ability to evaluate and use principles of chemical kinetics, thermodynamics, heat, mass and momentum transfer
6. Knowledge of theoretical and mathematical descriptions of combustion processes
7. Ability to analyze and synthesize the environmental impacts of combustion processes

Course content:

I. Introduction
   1. Historical Perspective
   2. U.S. and Global Energy Production and Demand
   3. Emissions, Climate Change and Sustainability Issues
   4. Pollution and Impacts

II. Basic Concepts
   1. Fuels
      a. Gaseous Fuels
      b. Liquid Fuels
      c. Solid Fuels
   2. Thermodynamics of Combustion
      a. Review of Laws and Properties
      b. Combustion Stoichiometry
      c. Chemical Energy
      d. Chemical Equilibrium
      e. Adiabatic Flame Temperature
   3. Chemical Kinetics
      a. Elementary Reactions
      b. Chain Reactions
      c. NOx Kinetics
      d. Surface Reactions

III. Combustion of Gaseous Fuels
   1. Flames
      a. Laminar
      b. Turbulent
      c. Diffusion
      d. Explosion Limits
   2. Applications
      a. Furnaces and Boilers
      b. Gas Turbines

IV. Combustion of Liquid Fuels
   1. Spray and Droplets
      a. Spray Formation
      b. Droplet Size Distribution
      c. Fuel Injector
d. Vaporization

2. Applications
   a. Furnaces and Boilers
   b. I/C Engines
   c. Diesel Engines

V. Combustion of Solid Fuels
   1. Solid Fuels Combustion Mechanism
      a. Drying
      b. Char Combustion
      c. Ash Formation
   2. Applications
      a. Fixed Bed Combustion
      b. Suspension Burning
      c. Fluidized Bed

VI. Case-study Analysis
   1. Review of scientific literature for -
      a. Environmental impacts from combustion
      b. Aerospace applications
      c. Utility scale applications
      d. Forest fires

Grading Rubric:  

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<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Class participation</td>
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<tr>
<td>Quizzes and Assignments</td>
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<tr>
<td>Unit exam I</td>
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<tr>
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<td>Project</td>
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Instructor:  
Dr. Kuruvilla John  
Professor  
Department of Mechanical Engineering  
University of North Texas  
Denton, Texas 76207  
Kuruvilla.John@unt.edu  
(940) 565-2400

Teaching Assistant:  
Mr. Kade Wagner  
Department of Mechanical Engineering  
University of North Texas
Denton, Texas 76207
Kade.Wagner@unt.edu

Course format: 3 hours of lecture and interactive sessions per week on T & Th 10:00 a.m. – 11:20 a.m. in UNTDP-F119

Office hours: T & Th 1:00 – 3:00 p.m. via Zoom appointment. Connect with me or the TA through email and/or by attending office hours. During busy times, my inbox becomes rather full, so if you contact me and do not receive a response within two business days, please send a follow up email. A gentle nudge is always appreciated.

Attendance Policy: Students are expected to attend class meetings regularly and to abide by the attendance policy established for the course. It is important that you communicate with the professor and the instructional team prior to being absent, so you, the professor, and the instructional team can discuss and mitigate the impact of the absence on your attainment of course learning goals. Please inform the professor and instructional team if you are unable to attend class meetings because you are ill, in mindfulness of the health and safety of everyone in our community. If you are experiencing any symptoms of COVID (https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html) please seek medical attention from the Student Health and Wellness Center (940-565-2333 or askSHWC@unt.edu) or your health care provider PRIOR to coming to campus. UNT also requires you to contact the UNT COVID Team at COVID@unt.edu for guidance on actions to take due to symptoms, pending or positive test results, or potential exposure.

Academic Integrity Standards and Consequences: Every student in my class can improve by doing their own work and trying their hardest with access to appropriate resources. Students who use other people’s work without citations will be violating UNT’s Academic Integrity Policy. Please read and follow this important set of guidelines for your academic success (https://policy.unt.edu/policy/06-003). According to UNT Policy 06.003, student academic integrity, academic dishonesty occurs when students engage in behaviors including, but not limited to cheating, fabrication, facilitating academic dishonesty, forgery, plagiarism, and sabotage. A finding of academic dishonesty may result in a range of academic penalties or sanctions ranging from admonition to expulsion from the University. If you have questions about this, or any UNT policy, please email me or come discuss this with me during my office hours.

Acceptable Student Behavior: As members of the UNT community, we have all made a commitment to be part of an institution that respects and values the identities of the students and employees with whom we interact. UNT does not tolerate identity-based discrimination, harassment, and retaliation so we will work as a class to collaborate in ways that encourage inclusivity. Every student in this class should have the right to learn and engage within an environment of respect and courtesy from others. Student behavior that interferes with an instructor’s ability to conduct a class or other students' opportunity to learn is unacceptable and disruptive and will not be tolerated in any instructional forum at UNT. Students engaging in unacceptable behavior will be directed to leave the classroom and the instructor may refer the student to the Dean of Students to consider whether the student's conduct violated the Code of Student Conduct. The University's expectations for student conduct apply to all instructional forums, including University and electronic classroom, labs, discussion groups, field trips, etc. We will discuss our classroom’s habits of engagement and I also encourage you to review UNT’s student code of conduct so that we can all start with the same baseline civility understanding (Code of Student Conduct) (https://deanofstudents.unt.edu/conduct)

Disabilities Accommodation: The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking reasonable accommodation must first register with the Office of Disability Access (ODA) to verify their eligibility. If a disability is verified, the ODA will provide you with a reasonable accommodation letter to be
delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request reasonable accommodations at any time; however, ODA notices of reasonable accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of reasonable accommodation for every semester and must meet with each faculty member prior to implementation in each class. Students are strongly encouraged to deliver letters of reasonable accommodation during faculty office hours or by appointment. Faculty members have the authority to ask students to discuss such letters during their designated office hours to protect the privacy of the student. For additional information, refer to the Office of Disability Access website (http://www.unt.edu/oda). You may also contact ODA by phone at (940) 565-4323.

**Emergency Notification & Procedures:**
UNT uses a system called Eagle Alert to quickly notify students with critical information in the event of an emergency (i.e., severe weather, campus closing, and health and public safety emergencies like chemical spills, fires, or violence). In the event of a university closure, please refer to Canvas for contingency plans for covering course materials.