MEEN 4330
Introduction to Combustion Science and Engineering
Spring 2021

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. Case-study analysis of the environmental impacts of combustion processes
8. Performing on a team-based design evaluation project
   (conceptualization, development and presentation)

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. Engine Combustion

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. Gas Turbines
   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

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>
<td>30%</td>
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<td>Unit exam I</td>
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<td>Unit exam II</td>
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<td>Final Exam/Project</td>
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Instructor:
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Course format:
3 hours of lecture and interactive sessions per week;
M & W 4:00 p.m. – 5:20 p.m.
Office hours: TA: W & F 1:00 – 4:00 p.m. via Zoom appointment.

Disabilities Accommodation:
The University of North Texas complies with Section 504 of the 1973 Rehabilitation Act and with the Americans with Disabilities Act of 1990. UNT makes reasonable academic accommodation for students with disabilities. Students seeking accommodation must first register with the Office of Disability Accommodation (ODA) to verify their eligibility. If a disability is verified, the ODA will provide a student with an accommodation letter to be delivered to faculty to begin a private discussion regarding one’s specific course needs. Students may request accommodations at any time, however, ODA notices of 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 accommodation for every semester and must meet with each faculty member prior to implementation in each class. For additional information see the ODA website at http://disability.unt.edu.

Academic Integrity Standards and Consequences:
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.

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 Blackboard for contingency plans for covering course materials.

Acceptable Student Behavior:
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. The Code of Student Conduct can be found at deanofstudents.unt.edu/conduct.