جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Course Syllabus: Turbulent Combustion - ME 346

Division	Physical Science and Engineering Division
Course Number	ME 346
Course Title	Turbulent Combustion
Academic Semester	Spring
Academic Year	2016/2017
Semester Start Date	01/22/2017
Semester End Date	05/18/2017
Class Schedule (Days & Time)	10:30 AM - 12:00 PM | Mon Wed

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Hong Geun Im	Hong.Im@KAUST.EDU.SA	+966128084726		Mon/Wed 1:00-2:00pm

Teaching Assistant(s)

Name	Email
N/A	N/A

Course Information

Comprehensive Course Description	This course offers advanced knowledge in fundamental characteristics of turbulent reacting flows encountered in many engineering applications. The course starts with reviews of background subjects – laminar flames, turbulent flows, conservation equations. Subsequently, phenomenological observations scaling laws pertaining to turbulent combustion characteristics will be discussed. More in-depth coverage of mathematical modeling framework will then be reviewed in premixed, nonpremixed, and partially premixed combustion systems. Experimental methods of turbulent combustion research will also be reviewed.
Course Description from Program Guide	Governing equations of reactive fluid flow. Review of fundamental concepts in turbulence. Non-premixed turbulent combustion. Conserved scalar modeling approach and turbulent non- premixed combustion models. Premixed turbulent combustion fundamentals and combustion regimes. Canonical models for premixed turbulent combustion. Partially premixed combustion. Scaling laws for lifted turbulent jet flames.
Goals and Objectives	- Basic physical understanding of turbulent flows. - Basic physical understanding of combustion characteristics in turbulent reacting flows. - Mathematical, experimental, and theoretical approaches to understand turbulent combustion - Understanding turbulent combustion effects in practical systems - Practice literature review and identify original scientific/engineering research project.
Required Knowledge	ME244 Combustion, ME307 Turbulence or equivalent.

Reference Texts	Main Textbook: Peters, N., Turbulent Combustion, Cambridge University Press, 2000 (eBook available). Additional References: *Physical Concepts:* Liñán, A., Williams, F.A., Fundamental Aspects of Combustion, Oxford University Press, 1993 (Out of print. Handouts will be given). Law, C. K., Combustion Physics, Cambridge University Press, 2006 (printed copy available). Pope, S. B., Turbulent Flows, Cambridge University Press, 2000 (printed copy available). *Advanced Modeling:* Echekki, T., Mastorakos, E., Turbulent Combustion Modeling: Advances, New Trends and Perspectives, Springer, 2011 (eBook available). Poinsot, T., Veynante, D., Theoretical and Numerical Combustion, 2nd ed., Edwards, 2005 (printed copy available). Swaminathan, N., Bray, K.N.C. (Ed), Turbulent Premixed Flames, Cambridge University Press, 2011. Fox, R.O., Computational Models for Turbulent Reactive Flows, Cambridge University Press, 2003.
Method of evaluation	**10.00**% - Written report **20.00**% - Presentation **20.00**% - Homework /Assignments **30.00**% - Exam 2 **20.00**% - Exam 1
Nature of the assignments	- Homework problems based on the class materials. - Literature search to review the state of the art in turbulent combustion research - Research proposal - oral presentation and written report - Exam format: in-class, closed book (simple analysis and conceptual questions)
Course Policies	Homework/projects are expected to be submitted by 5pm on the due date. Late submissions are only allowed by advance notice at least by 24 hours. Acceptance of extension will be at instructor's discretion.
Additional Information	

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Mon 01/23/2017 Wed 01/25/2017	Overview of turbulent combustion, review of conservation equations
2	Mon 01/30/2017 Wed 02/01/2017	Conservation equations: Low-Ma approximation, conserved scalars
3	Mon 02/06/2017 Wed 02/08/2017	Statistical description of turbulence
4	Mon 02/13/2017 Wed 02/15/2017	Modeling of turbulent flows
5	Mon 02/20/2017 Wed 02/22/2017	Turbulent premixed combustion: scales and regimes
6	Mon 02/27/2017 Wed 03/01/2017	Review of laminar flame theory: flame stretch, instability
7	Mon 03/06/2017 Wed 03/08/2017	CCRC Combustion Conference
8	Mon 03/13/2017 Wed 03/15/2017	Turbulent burning velocities Exam 1
9	Mon 03/20/2017 Wed 03/22/2017	Turbulent premixed combustion: modeling approaches
10	Mon 03/27/2017 Wed 03/29/2017	Turbulent premixed combustion modeling (continued)
11	Mon 04/03/2017 Wed 04/05/2017	Spring Break
12	Mon 04/10/2017 Wed 04/12/2017	Review of laminar nonpremixed flame theory
13	Mon 04/17/2017 Wed 04/19/2017	Review of laminar nonpremixed flame theory, regimes (continued)
14	Mon 04/24/2017 Wed 04/26/2017	Turbulent nonpremixed combustion: modeling approaches
15	Mon 05/01/2017 Wed 05/03/2017	Turbulent partially premixed combustion Exam 2
16	Mon 05/08/2017 Wed 05/10/2017	Final project presentations
17	Mon 05/15/2017 Wed 05/17/2017	Final report submission
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Note

The instructor reserves the right to make changes to this syllabus as necessary.