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

Course Syllabus: Advanced Combustion Theory - ME 340

Division	Physical Science and Engineering Division
Course Number	ME 340
Course Title	Advanced Combustion Theory
Academic Semester	Fall
Academic Year	2019/2020
Semester Start Date	08/25/2019
Semester End Date	12/10/2019
Class Schedule (Days & Time)	09:00 AM - 10:30 AM | Mon Wed

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Hong Geun Im	Hong.Im@KAUST.EDU.SA	+966128084726		M/W 11:00-12:00

Teaching Assistant(s)

Name	Email
N/A	

Course Information

Comprehensive Course Description	The scope of the ME340 will be largely focused on physical aspects of fundamental laminar flame theory with application of numerical simulations. The course builds on ME244 Combustion which emphasizes on chemical aspects, and complements ME378 Experimental Combustion which focuses on experimental aspects of basic flames. The latter may be taken concurrently. The course will serve as a preparation for ME346 Turbulent Combustion. The topics covered include: conservation equations for reacting flows, transport properties, asymptotic analysis of one-dimensional flames, concept of conserved scalar and coupling function, ignition/extinction, aerodynamics of flames, flame instabilities, fundamental one-dimensional laminar flames and Chemkin applications for premixed flames and opposed diffusion flames.
Course Description from Program Guide	Review of chemical thermodynamics and kinetics. Conservation equations of multi-component reacting flows. Transport properties. Asymptotic analysis of premixed flames. Flame speed and extinction. Theory of laminar premixed and nonpremixed flames. Aerodynamics of premixed flames. Theory of Computational simulations of premixed and nonpremixed flames. Theory of ignition and extinction.
Goals and Objectives	The students will learn basic knowledge and skills on the following subjects: - Fundamental understanding of flame structures and dynamics - Reduced order model description of laminar flames - Basics of large activation energy asymptotics for flame analysis - Review of historical background of classical laminar flame theory - Learn the formulations behind the computational modeling of laminar flames
Required Knowledge	ME244 Combustion or equivalent. Overrides request will be considered on a case-by-case basis.

Reference Texts	**Main Textbooks:** Law, C. K., Combustion Physics, Cambridge University Press, 2006. Liñán, A., Williams, F.A., Fundamental Aspects of Combustion, Oxford University Press, 1993 (Out of print. Handouts will be given). **Useful References:** Glassman, I., Yetter, R. A., Glumac, N. G., Combustion, 5th ed., Academic Press, 2014. Williams, F. A., Combustion Theory, 2nd ed., Westview Press, 1985 (reprinted 1994). Kee, R. J., Coltrin, M. E., Glarborg, P., Chemically Reacting Flow: Theory and Practice, Wiley, 2003.
Method of evaluation	**30.00**% - Course Project(s) **20.00**% - Homework /Assignments **30.00**% - Exam 2 **20.00**% - Exam 1
Nature of the assignments	Independent mini research project on analyzing one-dimensional flames using Chemkin software.
Course Policies	Extension of assignment submission must be requested by email at least 24 hours prior to the due date.
Additional Information	

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Mon 08/26/2019	Review of chemical thermodynamics
1	Wed 08/28/2019	Review of chemical kinetics
2	Mon 09/02/2019	Conservation equations: general derivation
2	Wed 09/04/2019	Conservation equations: description of transport processes
3	Mon 09/09/2019	Asymptotic analysis of premixed flames
3	Wed 09/11/2019	Asymptotic analysis of premixed flames
4	Mon 09/16/2019	Laminar flame speed, flame extinction
4	Wed 09/18/2019	Laminar flame speed, flame extinction
5	Mon 09/23/2019	Saudi National Day
5	Wed 09/25/2019	Laminar flame structure, flame stabilization
6	Mon 09/30/2019	Flame stabilization
6	Wed 10/02/2019	PREMIX: 1D premixed flame simulations
7	Mon 10/07/2019	PREMIX: 1D premixed flame simulations
7	Wed 10/09/2019	Adrodynamics of premixed flames
8	Mon 10/14/2019	Aerodynamics of premixed flames
8	Wed 10/16/2019	Asymptotic analysis of nonpremixed flames
9	Mon 10/21/2019	Laminar nonpremixed flames: Burke-Schumann analysis
9	Wed 10/23/2019	Conserved scalar and flame sheet limit
10	Mon 10/28/2019	Mid-semester break
10	Wed 10/30/2019	OPPDIF: 1D nonpremixed flame simulations
11	Mon 11/04/2019	OPPDIF: 1D nonpremixed flame simulations
11	Wed 11/06/2019	Midterm exam
12	Mon 11/11/2019	Laminar nonpremixed flame structure
12	Wed 11/13/2019	Laminar nonpremixed flame structure
13	Mon 11/18/2019	Theory of ignition and extinction
13	Wed 11/20/2019	Theory of ignition and extinction
14	Mon 11/25/2019	Numerical analysis of ignition and extinction
14	Wed 11/27/2019	Numerical analysis of ignition and extinction
15	Mon 12/02/2019	Review
15	Wed 12/04/2019	Project presentation
16	Mon 12/09/2019	Exams

Note

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