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

Course Syllabus: Intro to Spectroscopy & Laser Diagnostic - ME 348

Division	Physical Science and Engineering Division
Course Number	ME 348
Course Title	Intro to Spectroscopy & Laser Diagnostic
Academic Semester	Fall
Academic Year	2018/2019
Semester Start Date	08/26/2018
Semester End Date	12/11/2018
Class Schedule (Days & Time)	10:30 AM - 12:00 PM | Mon Wed

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Aamir Farooq	Aamir.Farooq@kaust.edu.sa	+966128082704	4217, 5, Al-Kindi (bldg. 5)	1 - 3 pm | Mon Wed

Teaching Assistant(s)

Name	Email

Course Information

Comprehensive Course Description	Fundamentals of microwave, infrared, Raman, and electronic spectroscopy. Laser-based diagnostic techniques for measurements of species concentration, temperature, pressure, velocity, and other flow field properties. Topics: rotational, vibrational, and electronic transition frequencies; spectral lineshapes and line-broadening mechanisms; nuclear spin effects; electronic spectra of atoms and molecules; absorption; emission; laser induced fluorescence (LIF); Rayleigh and Raman scattering methods; Mie theory; laser Doppler velocimetry (LDV) and particle image velocimetry (PIV); applications and case studies.
Course Description from Program Guide	Fundamentals of microwave, infrared, Raman, and electronic spectroscopy. Laser-based diagnostic techniques for measurements of species concentration, temperature, pressure, velocity, and other flow field properties. Topics: rotational, vibrational, and electronic transition frequencies; spectral lineshapes and line-broadening mechanisms; nuclear spin effects; electronic spectra of atoms and molecules; absorption; emission; laser induced fluorescence (LIF); Rayleigh and Raman scattering methods; Mie theory; laser Doppler velocimetry (LDV) and particle image velocimetry (PIV); applications and case studies.Laser Diagnostics for Thermal Engineering.
Goals and Objectives	***What is spectroscopy?*** Interaction of radiation (light) with matter (in our case, gases) ***Motivation:*** Spectroscopy is of increasing utility to engineers in a variety of fields both in research and industry ***Example Applications***: Remote sensing, combustion and gasdynamic diagnostics, process control, energy systems, environmental monitoring, biomedical ***Common Measurements***: Species concentrations, temperature (T), pressure (P), density (), velocity (u), mass flux (u)
Required Knowledge	Thermodynamics (required) Statistical Thermodynamics (preferred)
Reference Texts	Spectroscopy and Optical Diagnostics for Gases by Hanson, Spearrin, Goldenstein (available as an e-book at http://link.springer.com/book/10.1007/978-3-319-23252-2) Reference book: Fundamentals of Molecular Spectroscopy, 4thEdition by Banwell and McCash

Method of evaluation	**35.00**% - Final exam **15.00**% - Presentation **25.00**% - Midterm exam **20.00**% - Homework /Assignments **5.00**% - Attendance and Participation
Nature of the assignments	Problem sets.
Course Policies	-Collaborative discussion on homework is encouraged, but each student must do his/her own work. There will be 6 homework sets during the semester. Late HW submission will incur a penalty. -Class participation includes attendance, coming to class on time, asking questions and taking part in class discussions.
Additional Information	

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Mon 08/27/2018	Introduction and Basic Concepts
1	Wed 08/29/2018	Introduction and Basic Concepts
2	Mon 09/03/2018	Diatomic Molecular Spectra
2	Wed 09/05/2018	Diatomic Molecular Spectra
3	Mon 09/10/2018	Diatomic Molecular Spectra
3	Wed 09/12/2018	Diatomic Molecular Spectra
4	Mon 09/17/2018	Polyatomic Molecular Spectra
4	Wed 09/19/2018	Polyatomic Molecular Spectra
5	Mon 09/24/2018	Effects of Nuclear Spin
5	Wed 09/26/2018	Effects of Nuclear Spin
6	Mon 10/01/2018	Rayleigh and Raman Spectra
6	Wed 10/03/2018	Rayleigh and Raman Spectra
7	Mon 10/08/2018	Quantitative Emission and Absorption
7	Wed 10/10/2018	Quantitative Emission and Absorption
8	Mon 10/15/2018	Review
8	Wed 10/17/2018	Midterm Exam
9	Mon 10/22/2018	Spectral Line-shapes
9	Wed 10/24/2018	Spectral Line-shapes
10	Mon 10/29/2018	Electronic Spectra of Atoms
10	Wed 10/31/2018	Electronic Spectra of Atoms
11	Mon 11/05/2018	Electronic Spectra of Molecules
11	Wed 11/07/2018	Electronic Spectra of Molecules
12	Mon 11/12/2018	Laser Induced Fluorescence
12	Wed 11/14/2018	Laser Induced Fluorescence
13	Mon 11/19/2018	Other Diagnostic Techniques and Equipment
13	Wed 11/21/2018	Other Diagnostic Techniques and Equipment
14	Mon 11/26/2018	Case Studies
14	Wed 11/28/2018	Case Studies
15	Mon 12/03/2018	Course Review
15	Wed 12/05/2018	Student Presentations
16	Mon 12/10/2018	Final Exam

Note

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