

COURSE OUTLINE AND SCHEDULE
 MAE 250S, Spectroscopy and Molecular Gas Dynamics
 R. M. Spearrin, Winter 2020

Reference Key shows APPROXIMATE location of material in textbooks

HSG: Spectroscopy and Optical Diagnostics for Gases, 1st ed. (2016)

A: Hypersonic and High-Temperature Gas Dynamics, 2nd ed. (2006)

Lect.	Date	Topics	Text	HW
(No.)		(general)	Key	due
1	Tu, 1/7	INTRODUCTION: Light-matter interactions Spectroscopy applications / tools Intro to kinetic theory of gases		
2	Th, 1/9	MOLECULAR GAS DYNAMICS: Collision frequency, mean free path Equipartition of energy Maxwellian velocity distribution	A: 12	
3	Tu, 1/14	Modes of molecular energy: translation, rotation, vibration, electronic Quantum energy states	A: 11.1-3	
4	Th, 1/16	Boltzmann energy distribution Partition functions Thermodynamic properties	A: 11.4-8	HW#1
5	Tu, 1/21	SPECTROSCOPY FUNDAMENTALS Intrinsic and induced dipole moments Energy states and transitions (lines) Planck's Law Types of spectra and characteristic frequencies	HSG: 1	
6	Th, 1/23	SPECTRAL LINE POSITIONS Lines, bands, systems Allowed transitions / selection rules Diatomic rotational spectra (THz)	HSG: 2.1-2	HW#2
7	Tu, 1/28	Diatomic vibration-rotation spectra (IR) Diatomic electronic-vibration-rotation (UV/Vis)	HSG: 2.3-7	
8	Th, 1/30	Polyatomic rotational spectra (THz) Polyatomic rovibrational spectra (IR) Types of vibrational bands / modes	HSG: 4	HW#3
9	Tu, 2/4	Atomic electronic spectra (UV/Vis) Electronic state term symbols Zeeman effect, Nuclear spin	HSG: 9	
10	Th, 2/6	MIDTERM covers through diatomic spectra		

(No.)	(tent.)	(general)	key	
11	Tu, 2/11	Rayleigh scattering Raman scattering (rotational and vibrational)	HSG: 6	
12	Th, 2/13	SPECTRAL LINE INTENSITIES Scattering polarizability, cross-sections Absorption / emission intro.	HSG: 6.1-3 7.1	
13	Tu, 2/18	Quantitative absorption and emission Kirchhoff's Law (emissivity/absorptivity) Beer-Lambert Law	HSG: 7.1-2	HW#4
14	Th, 2/20	Einstein theory of radiation Radiative lifetime Linestrengths (different forms), Band strengths	HSG: 7.3-8	
15	Tu, 2/25	SPECTRAL LINE SHAPES Heisenberg uncertainty principle Doppler broadening and velocity distributions	HSG: 8.1-2	HW#5
16	Th, 2/27	Collisional broadening other broadening mechanisms	HSG: 8.1-2	
17	Tu, 3/3	Line shifting mechanisms Lineshape profiles: Gaussian Lorentzian, Voigt, Rautian	HSG: 8.3-6	
18	Th, 3/5	SPECTROSCOPY MEASUREMENT TECHNIQUES Emission / Chemiluminescence Laser absorption, Cavity Enhancement, FTIR Scattering techniques, CARS	HSG: 12	HW#6
19	Tu, 3/10	Laser Induced Fluorescence, PLIF Other optical methods: Photothermal, Schlieren Applications / Case Studies	HSG: 11	
20	Th, 3/12	Current topics in spectroscopy, course review		HW#7
	M, 3/16	FINAL EXAM: 3:00 – 6:00 pm		