

Department of Aerospace Engineering , IIT Madras

COURSE TITLE	Spectroscopic Reactive Flow Diagnostics	COURSE NO	AS 6342			
DEPARTMENT	Aerospace Engineering	STRUCTURE	L	T	P	C
			3	0	0	3
OFFERED FOR	Mtech/MS/PhD	STATUS	Elective			
FACULTY	T.M. Muruganandam S.R. Chakravarthy	TYPE	New			
PRE-REQUISITE	AS5300 or COT	TO TAKE EFFECT FROM	Jan 2011			
SUBMISSION DATE	DATE OF APPROVAL BY DCC	DATE OF APPROVAL BY BAC	DATE OF APPROVAL BY SENATE			
Sep 2010	15 Oct 2010					
1. OBJECTIVES	Basic understanding of spectroscopy and its application to diagnostics of fluid flow and combustion problems.					
2. COURSE CONTENTS	Introduction to electromagnetic spectrum, review of quantum mechanics concepts. Absorption, emission, fluorescence, scattering processes. Planck's law, Beer's law, spectra and spectral lines, optical density; line position, line strengths and line shapes of spectral transitions; broadening mechanisms (natural, collision, Doppler, Stark, instrument), line shape functions (Gaussian, Lorentzian, Voigt), line shifting mechanisms (pressure and Doppler shifts). Atomic and molecular spectra (diatomic & polyatomic); electric dipole moment (IR), induced polarization (Raman), elastic (Rayleigh) scattering; rotational (MW), vibrational (IR), ro-vibrational, electronic (UV & VIS) spectra; Rayleigh & Raman spectra. Quantitative emission and absorption, radiative transfer equation, spectral absorption coefficient, temperature dependence; pressure, temperature and species concentration measurements. Diagnostic techniques for gaseous flow and combustion: LIF, PLIF, Rayleigh scattering, spontaneous Raman scattering, coherent anti-Stokes Raman spectroscopy, cavity ring-down spectroscopy, laser absorption spectroscopy, TDLAS, LIBS, FTIR spectroscopy, LII. Spectroscopic softwares (HITRAN, LIFBASE).					
3. TEXT BOOKS	<p>1. C.M. Banwell & E.M. McCash, <i>Fundamentals of Molecular Spectroscopy</i>, 4 Ed. (1995), Tata McGraw Hill, India, ISBN 0-07-462025-8.</p> <p>2. A.C. Eckbreth, <i>Laser diagnostics for combustion temperature and species</i>, Gordon and Breach Publishers, 1996. ISBN 9056995324 (paperback by Taylor & Francis Ltd)</p>					
4. REFERENCES	<p>1. G. Herzberg, "Atomic Spectra and Atomic Structure", 2 Ed. (1944), Dover Publications, New York, ISBN 1443728063.</p> <p>2. G. Herzberg, "Molecular Spectra and Molecular Structure - I. Spectra of Diatomic Molecules", 2nd Ed. (1950), D. Van Nostrand Company, Princeton, New Jersey, ISBN 1443726087.</p> <p>3. G. Herzberg, "Molecular Spectra and Molecular Structure - II. Infrared and Raman Spectra of Polyatomic Molecules", 2 Ed. (1950), D. Van Nostrand Company, Princeton, New Jersey.</p> <p>4. W. Demtröder, "Laser Spectroscopy - Basics and Instrumentation", 3 Ed. (2003), Springer Verlag, Berlin, Germany, ISBN 3-540-65225-6.</p> <p>5. J.M. Hollas, "Modern Spectroscopy", 4 Ed. (2004), John Wiley & Sons, Ltd., West Sussex, England, ISBN 0-470-84416-7.</p>					