DATE	SUBJECT		HOURS	ORDER	FILENAME
	BLOCK 1: INTRODUCTION				
	0. ORGANIZATIVE ISSUES	FR	0,75		
	0.1 Syllabus				
	0.2 Group problems and R+D works				
23/2	**1. INTRODUCTION TO OPTICAL REMOTE SENSING (ORS)**				
S1	1.1 What and how?		2,25		
	1.2 ORS active: Laser radar systems: Classification and applications				
	1.2.1 Motivation, historical background, optical considerations			guided S2	ORS_2_Measuring_Optical_Power.pdf
	1.2.2 Classification and applications (summary)				
	1.3 ORS passive: Radiometers: Classification and applications		1		
	1.3.1 Motivation, historical background, optical considerations	MS			
	1.3.2 Classification and applications (summary)				
	BLOCK 2: OPTICAL AND TECHNOLOGICAL CONSIDERATIONS				
	or OPTICS, ELECTRO-OPTICS, PROPAGATION AND SUBSYSTEMS				
2/3	**2. RADIOMETRY FUNDAMENTALS**				
S2	2.1 Basic concepts		2		
	2.1.1 Emissivity of a source				
	2.1.2 Reception magnitudes				
	2.1.3 Emission and reception				
	2.1.4 Through optical systems				
	2.2 Natural radiation			guided S3	ORS_2_palmer2003.pdf
	2.3 Absorption				
	2.4 Surface properties (emissivity, absorption, reflec, Lambert)				
	2.5 Scattering mechanisms (Rayleigh, Mie, Raman, Fluorescence,...)				
9/3	2.6. ATMOSPHERIC PROPAGATION OF RADIATION	MS	3		
S3	2.6.1 Atmospheric windows			guided S4	ORS_3_MS_HAMAMATSU_AN2001.pdf
	2.6.2 Beer's intensity law for active remote sensing				
	2.6.3 The radiative-transfer equation for passive remote sensing				
	3. OPTICAL AND ELECTRO-OPTICAL SUBSYSTEMS				
	3.1 Optical components (lenses, telescopes, beam-splitters,...)	MS	3		
	3.2 Laser sources for active remote sensing				
	3.2.1 Laser sources and bands				
	3.2.2 Eye-safety considerations				
16/3	3.3 Detectors				
S4	3.3.1 Types				
	3.3.2 Characteristic parameters				
	3.3.3 Noise in photodetectors (PIN, APD, PMT)				
	3.3.4 Signal-to-noise ratio				
	3.4 Signal conditioning, acquisition and processing				
	3.4.1 Signal conditioning (moved to 4.1.2.1, 4.2.2)				
	3.4.2 Acquisition systems: Photon counters (moved to 4.1.2.2)			guided S5	ORS_4a_LICEL_Transient_recorder.pdf
	3.4.3 Raw-data processing (moved to 6.1)				ORS_4b_pmtphotoncount.pdf
	BLOCK 3. ACTIVE REMOTE SENSING (LIDAR)				
	4. ELASTIC LIDAR SYSTEMS				
	4.1. Architecture	FR	3		
	4.1.1. Basic design parameters: Elastic lidar equation				
	4.1.1.1. Optical (OVF, background radiance)				
23/3	4.1.2. Signal conditioning and acquisition				
S5	4.1.2.1. Signal conditioning: Receiv. chain				
	4.1.2.2. Acquisition systems: Photon counters				
	4.2. Examples of real systems				
	4.2.1 Rsch. Agencies and lidar				
	4.2.2. Signal Conditioning: Advanced configurations				
	4.3. Pseudo-random systems				
	5. LINK BUDGET				
	5.1. Receiving chain: OE conversion and resolution (review)	FR	3		
30/3	5.2. Generalised signal-to-noise ratio (noise-dominant modes)				
S6	*5.3. Example problem I*			guided S7	ORS_6a_MS_KLETT_AO1981.pdf
	5.4. Lidar range estimation: Simulation.				ORS_6b_MS_KLETT_AO1985.pdf
	5.5. Elastic-Raman link budget (problem proposal for Chap.12.1)				ORS_6c_MS_KUNZ_AO1993.pdf
EASTER					

	6. INVERSION ALGORITMS				
	6.1. Inversion of opto-atmospheric parameters	MS	3		
	6.1.1. 1-D algorithms				
20/4	6.1.1.1. Semi-quantitative methods (R2P from clean data)				
S7	6.1.1.2. The slope method				
	6.1.1.3. Klett's method				
	6.1.2. 2-D algorithms				
	6.1.2.1. Dual-beam inversion				
	6.1.2.2. Multi-beam inversion				
	6.2. Examples: Inversion of physical parameters				
	6.2.1. Example 1: ABL height retrieval				
	6.2.2. Example 2: Ceilometry			guided S8	ORS_7a_Whiteman_TempSens2_2003.pdf
	6.3.3. Example 3: Chimney-stack emission flux				ORS_7b_Mattis_Raman_RH1.pdf
27/4	**7. RAMAN SYSTEMS**				
S8	7.1. Raman Lidar	FR	6		
	7.1.1. Basics about the Raman effect				
	7.1.2. Atmospheric probing and system layout				
	7.1.2.1. Temperature measurement				
	7.1.2.2. Molecular species (gas) detection				
4/5	7.1.2.3. Water vapor and RH measurement	FR			
S9	7.2. Elastic-Raman systems				
	7.2.1. Independent inversion of the optical parameters				
	7.2.2. DEMO: Link budget				
	7.2.3. DEMO: Variable-resolution inversion algorithms				
	5.3 Problem discussion I			guided S10	ORS_8_Menzies & Hardesty Coherent wind lid
11/5	*No classes*				
	8. WIND LIDAR SYSTEMS				
14/5	8.1. Coherent Doppler Lidar	AR	3		
S10	8.1.1. Architecture				
	8.1.2. Design considerations				
	8.1.2.1. Consequences of the Van Cittert Zernicke's theorem				
	8.1.2.2. Basics of atmospheric turbulence				
	8.1.3. Quality parameters				
	8.1.4. Inversion algorithms				
	8.1.4.1. The VAD technique				
	8.1.4.2. Spectral estimation				
	8.2. Direct-detection Doppler systems				
	8.2.1. Edge-technique (ET) and double edge-technique (DET)				
	8.2.2. Fringe Technique (FT)				
	8.3. Wind measurement using incoherent techniques			guided S12	ORS_9_ELIGHT_510M_DIAL_C.pdf
	9. OTHER LASER RADAR SYSTEMS		3		
	9.1. DIAL: Detection of molecular pollutants	FR			
18/5	9.2. Fluorescence Lidar: Oil-spill detection and identification				
S11	9.3. Other systems: Bathymetry				
	9.4. Other systems: Industrial applications (laser metrology and imaging)				

	BLOCK 4. PASSIVE REMOTE SENSING		
	10. GENERAL CHARACTERISTICS OF PASSIVE SYSTEMS		3
	10.1 Physical Considerations	MS	
25/5	10.2 Spectral Signature		
S12	10.3 Classification of Radiometers		
	10.4 Imaging Radiometers		
	10.4.1 Imaging system		
	10.4.2 Spatial Resolution		
	10.4.3 Angular resolution		
	10.4.4 Modulation Transfer Function (MTF)		
	10.4.5 CCD Cameras versus Photographic films		
	10.5 Power link-budget		guided S13
	11. REAL EXAMPLES: LANDSAT, METEOSAT		3
2/6	11.1 Operative Satellites and Missions	MS	
S13	11.2 LANDSAT		
	11.3 NOAA Satellites		
	11.4 MODIS (NASA)		
	11.5 Image Interpretation		
	12. EXAM		3
19/6	*12.1 (5.5 Collect Problem II)*		
S14	12.2 Exam	MS	