Universidad Carlos III de Madrid

COURSE: Communication Channels and Systems		
DEGREE: Bachelor in Communication System Engineering	YEAR: 3rd.	SEMESTER: 2nd.

WEEK	SESSION	DESCRIPTION	Class Method		STUDENT WORK		
			Lecture	Exercise	DESCRIPTION	Class Hours	Student Workload
1	1	**Unit 1. Link Budget** • Power Spectrum Density. Power. • Logarithmic units. : dB, dBW, dBm	X			1,5	5,5

1	2	• Atenuattion
		  ○ Guided Media
		  ○ Unguided Media: Friis Transmission Eq.
				X		1,5	

2	3	• Noise
		  ○ Signal-to-Noise Ratio.
		  ○ Noise Figure
		  ○ Equivalent Noise Temperature
		  ○ Noise in cascade systems
			X			1,5	5,5

2	4	• Exercises on noise in communication systems.		X		1,5	

3	5	• Link Budget
		  ○ Sensitivity
		  ○ Eb/N0
		  ○ Link Margin.
			X			1,5	5,5

3	6	• Exercises		X		1,5	

4	7	**Unit 2. Optical Fibre Systems.**
		• Attenuation
		• Dispersion
		  ○ Chromatic
		  ○ Waveguide
		  ○ Multimode
			X			1,5	4

4	8	• Exercises on optical fibre systems ○ Attenuation and dispersion-limited systems.		X		1,5	

5	9	• Noise in optical communications systems
		  ○ Thermal Noise
		  ○ Shot Noise
		  ○ Optical Signal to Noise ratio.
		• Sensitivity
			X			1,5	5,5

5	10	• Exercises		X		1,5	

6	11	**Unit 3.Large-scale radio propagation models.** • Free-space • Log-distance: Okumura Hata • Log-normal: Parameters. • Coverage and planning.	X			1,5	5,5
6	12	• Exercises		X		1,5	
7	13	• Reflection: 2-ray model • Difraction: Knife-edge model • Absorption	X			1,5	5,5 4
7	14	• Exercises		X		1,5	
8	15	• Mid-term Exam	X			1,5	
8	16	**Unit 4. Small-scale propagation models** • Multipath o Delay dispersion. o Coherence Bandwidth o Flat and frequency-selective fading. o Intersymbol Interference • Doppler effect o Frequency dispersion. o Coherence Time. • Fading classification: slow, fast, flat, frequency selective		X		1,5	
9	17	• Slow and Flat Fading channels o Statistical behavior ▪ Amplitude: rayleigh and rice model ▪ SNR: exponential o Charanacterization. ▪ Average Bit error rate. ▪ Threshold crossing rate ▪ Average Fading duration	X			1,5	5,5
9	18	• Exercises		X		1,5	
10	19	**Unit 5. Discrete Channel Model.** • Discrete Memoryless Channels o Binary Symmetric Channel (BSC) • Models for Channels wtih Memory o Memory representation ▪ Finite-state diagram ▪ Transition Matrix ▪ Steady-state vector probability.	X			1,5	5,5
10	20	o Distortion representation. ▪ Probability Matrix. ▪ Probability of data patterns. ▪ Probability of error patterns.		X		1,5	
11	21	• Gilbert's Model o Estimation of its parameters. o Application to slow flat fading channels.	X			1,5	5,5
11	22	• Exercises		X		1,5	

12	23	**Unit 6. Channel Capacity**
		• Continuous channels
		  ○ Shannon's Theorem on Channel Capacity.
		  ▪ Bandlimited gaussian channel capacity.
		  ○ Frequency-dependent signal-to-noise ratio channels.
		  ▪ ADSL channels.
		  ○ Channel capacity
		  ▪ Optimization of the transmitted Power Spectrum Density
		  ▪ Waterfilling
			X			1,5	4

12	24	• Exercises		X		1,5	

13	25	• Discrete Channels.
		  ○ Capacity for the Binary Symmetric Channel.
		  ▪ Entropy, Mutual Information
		  ○ Capacity for Discrete Channels with Memory.
		  ▪ Channel Side Information
		  ○ Cut-off rate
		  ▪ Channel coding.
			X			1,5	5,5

13	26	• Exercises		X		1,5	
14	27	Projects: Oral Presentations.	X			1,5	4
14	28	Presentación de Proyectos		X		1,5	
SUBTOTAL						**42 + 71 = 113**	
15		Make-up classes, delivery of homework, office hours			Course study and review		7
16-18		Exam preparation. Exam.			Course study and review	3	21
TOTAL						**150**	

Laboratory sessions agenda

WEEK	SESSION	DESCRIPTION	Laboratory	STUDENT WORK		
				DESCRIPTION	Class Hours	Student Workload
1	4	Lab Session 1: Link Budget	4.2 B01	Preparation of the Laboratory session. Preparation and delivery of a written report .	1,5	
2	8	Lab Session 2: Slow Flat Fading simulation	4.2 B01	Preparation of the Laboratory session. Preparation and delivery of a written report .	1,5	
3	11	Lab Session 3: Discrete Models for Communication Channels	4.2 B01	Preparation of the Laboratory session. Preparation and delivery of a written report .	1,5	
4	15	Lab Session 4: Estimation of Gilbert's Model parameters.	4.2 B01	Preparation of the Laboratory session. Preparation and delivery of a written report .	1,5	
TOTAL					**6**	