COURSE: Advanced Techniques in Signal Processing and Communications		
PROGRAM: Master in Telecommunications Engineering	YEAR: 2º	SEMESTER: 2º

COURSE PLANNING

Week	Session	DESCRIPTION	Group (mark X) LARGE	Group (mark X) SMALL	Indicate different room (computer, lab, etc.)	Indicate Yes/No for a session with 2 professors	STUDENT'S WORK DESCRIPTION	STUDENT'S WORK CLASS HOURS	STUDENT'S WORK WORK HOURS
1	1	Unit 0 - Introduction • Presentation of the contents and syllabus of the course	X			No	Review of some material from the course Statistics: the notion of random variable, stochastic process...	1,66	4
1	2	Unit 1 - Sensors networks • Introduction • Dijkstra algorithm • Detection • Neyman–Pearson lemma	X			No	Review theory	1,66	
2	3	Unit 1 - Sensors networks • Estimation • Dynamic system in state-space format • The Kalman filter • Non-linear dynamic systems	X			No	Review theory	1,66	6
2	4	Unit 1 - Sensors networks • The extended Kalman filter • The *unscented* Kalman filter • Stochastic filtering • Monte Carlo methods	X			No	Review theory	1,66	

3	5	Unit 1 - Sensors networks • Importance sampling • Particle filtering • Exercises - I	X			No	Review theory Resolution of related exercises.	1,66	6
3	6	Unit 1 - Sensors networks • Exercises - II Unit 2 - Coding • Channel models • Soft decoding	X			No	Review theory Resolution of related exercises.	1,66	
4	7	Lab session: filtering - Session 1	X		Computer room	No		1,66	8
4	8	Lab session: filtering - Session 2	X		Computer room	No		1,66	
5	9	Unit 2 - Coding • Hard decoding • Coding gain • Linear block codes – Definition – Properties	X			No	Review theory	1,66	6
5	10	Unit 2 - Coding • Linear block codes – Coding – Syndrome decoding – Systematic codes – Hamming codes • Cyclic codes • Convolutional codes – Codes with memory – Definition	X			No	Review theory	1,66	

6	11	Unit 2 - Coding • Convolutional codes – "D" transform – Viterbi algorithm – BCJR – Turbo codes • BEC channel • Channel coding theorem • LDPC codes – Definition – Optimal decoding – Belief propagation	X			No	Review theory	1,66	
6	12	Unit 2 - Coding • LDPC codes – Density evolution – Regular codes • Exercises - I	X			No	Review theory Resolution of related exercises.	1,66	8
7	13	Unit 2 - Coding • Exercises - II	X			No	Review theory Resolution of related exercises.	1,66	
7	14	Lab session: coding - Session 1	X		Computer room	No		1,66	7
8	15	Lab session: coding - Session 2	X		Computer room	No		1,66	
8	16	**Midterm exam** - Units 1 and 2	X			No		1,66	5
9	17	Unit 3 - Channel Estimation and Equalization • Introduction	X			No		1,66	
9	18	Unit 3 - Channel Estimation and Equalization • Channel models • Receivers • Communication standards	X			No	Review theory	1,66	3

10	19	Unit 3 - Channel Estimation and Equalization • Channel estimation • Classical and adaptive estimation	X			No	Review complex derivatives	1,66	
10	20	Unit 3 - Channel Estimation and Equalization • Channel equalization • Linear equalizers: zero forcing and MMSE • Optimal sequence detection	X			No	Review theory	1,66	6
11	21	Unit 3 - Channel Estimation and Equalization • Exercises	X			No	Recommended exercises of Unit 3	1,66	
11	22	Unit 4 - Receivers with Diversity • Introduction • OFDM systems	X			No	Review theory Review theory. Exercises from slides	1,66	8
12	23	Unit 4 - Receivers with Diversity • MIMO channels • Channel estimation in OFDM-MIMO systems	X			No	Review theory Review matrix and vector derivatives.	1,66	
12	24	Unit 4 - Receivers with Diversity • Equalization in OFDM-MIMO systems	X			No	Review theory	1,66	8
13	25	Unit 4 - Receivers with Diversity • Non-linear receivers • V-BLAST decoding	X			No	Recommended reading	1,66	
13	26	Unit 4 - Receivers with Diversity • Exercises	X			No	Recommended exercises of Unit 4	1,66	8

14	27	Lab session: equalizer implementation - Session 1	X		Computer room	No		1,66	8
14	28	Lab session: equalizer implementation - Session 2	X		Computer room	No		1,66	