AYDIN ADNAN MENDERES UNIVERSITY
COURSE INFORMATION FORM

Course Title		Statistical Signal Processing							
Course Code		EEE541		Couse Level		Second Cycle (Master's Degree)			
ECTS Credit	8	Workload	200 *(Hours)*	Theory	3	Practice	0	Laboratory	0
Objectives of the Course		The course objectives are to provide the understanding of: 1. Stochastic signal models and their use in signal processing applications 2. Optimal linear-time invariant (LTI) filtering of stochastic processes 3. Estimation theory using classical and Bayesian approaches.							
Course Content		Random processes. Power spectral density. Auto-regressive processes. Moving-average processes. Periodic processes. Spectral decomposition. Whitening filter. Innovations. Stochastic signal models. Yule-Walker equations. Linear-time invariant filtering of random processes. Estimation. Linear Estimators. Linear minimum mean square error estimator. Wiener filter. Optimal FIR filters. Optimal IIR filters. Filtering, prediction, smoothing applications. Reduced dimension stochastic signal representation. Karhunen-Loeve transform.							
Work Placement		N/A							
Planned Learning Activities and Teaching Methods				Explanation (Presentation), Demonstration, Discussion, Case Study, Project Based Study, Individual Study, Problem Solving					
Name of Lecturer(s)									

Assessment Methods and Criteria		
Method	Quantity	Percentage (%)
Midterm Examination	1	30
Final Examination	1	40
Project	1	30

Recommended or Required Reading	
1	M. H. Hayes, Statistical Signal Processing and Modeling, Wiley, New York, NY, 1996
2	Therrien, Charles W., Discrete random signals and statistical signal processing, Prentice Hall, c1992.
3	Louis L. Scharf, Statistical Signal Processing, Addison-Wesley Publishing Company, Inc., Reading, MA, 1991.

Week	Weekly Detailed Course Contents	
1	Theoretical	Review of Some Linear Algebra Concepts: Matrices as Transformations, Matrices as Linear Combiners, Matrices as Equation Systems
2	Theoretical	Review of Some DSP Concepts: Discrete time processing of continuous time signals, Discrete Time Operations,
3	Theoretical	Random Processes.
4	Theoretical	Random Processes.
5	Theoretical	Signal Modeling : LS methods, Pade, Prony (Deterministic methods), AR, MA, ARMA Processes (Stochastic approach), Yule-Walker Equations,
6	Theoretical	Signal Modeling : Non-linear set of equations for MA system fit, All-pole modeling, Covariance Method, Auto-correlation Method, Harmonic Processes, Wold decomposition, Decorrelating transforms such as Fourier Transforms for Harmonic Processes and KL transform in general
7	Theoretical	Signal Modeling : Applications: Signal Compression, Signal Prediction, System Identification, Spectrum Estimation.
8	Intermediate Exam	Midterm Exam
9	Theoretical	Estimation Theory: Cost Functions: Mean Square, Mean absolute, max error,
10	Theoretical	Estimation Theory: MSE, ML, absolute error estimators, Min MSE estimators, Regression line, orthogonality
11	Theoretical	Estimation Theory: Linear min MSE estimators, Linear unbiased min MSE estimators.
12	Theoretical	Estimation Theory: Bias, consistency, efficiency, bias-error variance trade-off. Discussion of LS estimator for Ax=b + n systems.
13	Theoretical	Estimation Theory: Wiener Filters as optimal estimators, Linear predictors defined from Wiener filters, Levinson-Durbin recursion for efficient solution of Wiener-Hopf equations.
14	Theoretical	Estimation Theory: Lattice Structures for efficient implementation of Wiener filters.
15	Theoretical	Estimation Theory: IIR Wiener Filters, Non-causal, Causal
16	Final Exam	Final Exam

Workload Calculation				
Activity	Quantity	Preparation	Duration	Total Workload
Lecture - Theory	14	5	3	112
Project	1	49	3	52
Midterm Examination	1	10	3	13
Final Examination	1	20	3	23
			Total Workload (Hours)	200
			[Total Workload (Hours) / 25*] = **ECTS**	8
*25 hour workload is accepted as 1 ECTS				

Learning Outcomes	
1	To analyze WSS stochastic processes using first and second moments
2	To analyze WSS stochastic processes that are processed by LTI systems
3	To analyze estimators
4	To derive optimal linear filters
5	To use linear models to analyze WSS stochastic signals

Programme Outcomes *(Electrical and Electronics Engineering Master)*	
1	Developing and intensifying knowledge that requires expertise in the area of Electrical-Electronics Engineering, and gaining the skills necessary to analyze and solve problems using this knowledge
2	Grasping the inter-disciplinary interaction related to Electrical-Electronics Engineering, interpreting and forming new types of knowledge by combining the knowledge from Electrical-Electronics Engineering and the knowledge from various other disciplines
3	Developing new approaches to solve the complex problems arising in Electrical-Electronics Engineering, coming up with solutions while taking responsibility and carrying out a specific study independently
4	Assessing the knowledge and skill gained in the area of Electrical-Electronics Engineering with a critical view
5	Transferring the current developments and one’s own work in Electrical-Electronics Engineering, to other groups in written, oral and visual forms
6	The ability to control the collecting, interpreting, practicing and announcing processes of the Electrical-Electronics Engineering related to data taking into consideration scientific, cultural and ethical values and the ability to teach these values to others
7	Developing application plans concerning the subjects related to Electrical-Electronics Engineering and the ability to evaluate the end results of these plans within the frame of quality processes

Contribution of Learning Outcomes to Programme Outcomes *1:Very Low, 2:Low, 3:Medium, 4:High, 5:Very High*

	L1	L2	L3	L4	L5
P1	4	4	4	4	4
P2	4	4	4	4	4
P3	4	4	4	4	4
P4	4	4	4	4	4
P5	4	4	4	4	4
P6	4	4	4	4	4
P7	4	4	4	4	4