Universidad Carlos III de Madrid
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COURSE: Control Engineering I		
DEGREE:	YEAR: 3	TERM:

La asignatura tiene 29 sesiones que se distribuyen a lo largo de 14 semanas. Los laboratorios pueden situarse en cualquiera de ellas.
Semanalmente el alumnos tendrá dos sesiones, excepto en un caso que serán tres

WEEKLY PLANNING

WEEK	SESSION	DESCRIPTION	GROUPS (mark X)		SPECIAL ROOM FOR SESSION (Computer class room, audio-visual class room)	Indicate YES/NO If the session needs 2 teachers	WEEKLY PROGRAMMING FOR STUDENT		
			LECTURES	SEMINARS			DESCRIPTION	CLASS HOURS	HOMEW HOUR (Max. week
1	1	Presentation of the subject Introduction to the signals and systems 1. Concept of Signal 2. Type of Signals 3. Introduction to the Systems 4. Type of Systems Laplace Transforms: 1. Concept of of Laplace Transforms 2. Properties of the Laplace Transforms 3. Utility of the Laplace Transforms 4. Table of Laplace Transforms	X					1,66	4

1	2	Solution of proposed exercises. Exercises of Laplace Transform. One or two transforms will be solved using the definition, obtaining the rest using the application of the properties.		X			Personal work about lesson. Proposed exercises. Discussion	1,66	
2	3	Mathematical Modelling of physical systems 1 Concept of Model of a System 2 Modelling of Mechanical Systems 3 Modelling of Electrical Systems 4 Modelling of Electromechanical Systems 5 Modelling of Hydraulic Systems 6 Modelling of Chemical Systems 7 Modelling of Thermal Systems Transfer Function. 1. Transfer function 2. Linear systems of constant coefficients 3 Systems Linealization. Concept of point of balance 4. Transfer function for systems of continuous time 5. Transfer function and impulsional response	X					1,66	
2	4	Solution of proposed exercises. Modeling and Transfer Function of linear systems.		X			Personal work about lesson. Proposed exercises. Discussion	1,66	4
3	5	Transfer Function and Linealization. 1. Linealization. Concept of equilibrium point 2. Transfer function of linarized systems of continuous time	X					1,66	
3	6	Solution of proposed exercises. Linealization and Transfer Function. The linealization of different systems with non-linearities will be realized calculating the balance points		X			Personal work about lesson. Proposed exercises. Discussion	1,66	4
4	7	Graphical models of representation of systems and obtaining of the Transfer Function 1. Block Diagram 2. Operations with blocks 3. Flowchart of a System 4. Mason's method	X					1,66	
4	8	Transfer Functions of complete Physical systems with linearization and simplification of block diagrams and flowchart.		X			Personal work about lesson. Proposed exercises. Discussion	1,66	4

5	9	Introduction to the Analysis of Systems in the time domain 1. Introduction to the time domain analysis 2. Standard signals of input 3. Relation between the time response and the situation of poles and zero in continuous time systems 4. Concept of dominant pole 5. Equivalent systems of reduced order 6. Additional poles and zeros 7. Algebraic methods for the stability analysis: Routh criterion.	X					1,66	
5	10	Solution of proposed exercises. Exercises of reduced system equivalent and analysis of the stability will be realised applying the Criterion of Routh. Responses to different inputs of the systems of first order and second order. Also exercises about the extraction of the transfer function from the time response.		X			Personal work about lesson. Proposed exercises. Discussion	1,66	4
6	11	Temporary analysis of the systems of continuous time of first order 1. Systems of first order 2. Impulsional answer of systems of first order 3. Answer before signal step of a system of first order 4. Answer before signal incline of a system of first order Temporary analysis of the systems of continuous time of second order 1. Systems of second order 2. Classification of the systems of second order 3. Answer before signals step and the systems of second order 4. Parameters that characterize the systems of second order 5. Impulsional answer and before incline of systems of second order	X					1,66	
6	12	Responses to different inputs of the systems of first order and second order. Also exercises about the extraction of the transfer function from the time response.		X			Personal work about lesson. Proposed exercises. Discussion	1,66	4

7	13	First test of evaluation	X					1,66	
7	14	Lab Practice 1: Continuous Systems Temporary Study 1st and 2nd Order. We performed a timing analysis for systems of first and second order, in its response to a step input. As a first order system uses a DC motor whose angular velocity depends on the voltage.As a second-order system will be studied again the same engine but with a unity feedback of position. The student must complete the engine identification obtaining the values of static gain and time constant. This is done for three different gains. It should also identify the block encoder (position sensor) with which you can then reduce the block diagram of the second-order system. It is estimated, theoretically, the system response for a step, determining the parameters of second-order system (overshoot, settling time and peak time) for the three amplifier gains. You should verify with the Simulink simulation results and experimentally test them finally seeing the potential differences between the theoretical model and real.		X	Lab		Realization of memory practice	1,66	4
8	15	Introduction to the continuous system analysis in the frequency domain: 1. Frequency response of a system of continuous time 2. Types of graphical representations 3. Diagram of Bode. Meaning and applications 4. Polar diagram. Meaning and applications 5. Diagram magnitude-phase. Meaning and applications Bode Diagrams: 1. Concept of asymptotic Diagram of Bode 2. Diagram of Bode of a constant 3. Diagram of Bode of poles and zeros in the origin 4. Diagram of Bode of poles and zeros real negatives 5. Diagram of Bode of poles and zeros real positives 6. Diagram of Bode of negative complex poles 7. Diagram of Bode of imaginary poles 8. Diagram of a system: set of poles and zero	X					1,66	
8	16	Solution of proposed exercises. Representation of the diagrams of Bode. Also Transition functions from the diagram of Bode will be extracted.		X			Personal work about lesson. Proposed exercises. Discussion	1,66	4

9	17	Introduction to the control systems 1. Static analysis of the feedback systems 2. Concept of error in permanent regime 3. Concepts of gain of position, speed and acceleration 4. Type of a system 5. Relation between type and gains of a system -Calculation of the error in the feedback systems 1. Calculation of errors in systems with unitary feedback 2. Calculation of errors in systems with nonunitary feedback 3. Errors dues to disturbances	X					1,66	
9	18	Lab Practice 2: Basic Frequential Study of Continuous Systems 1st and 2nd Order. It intends to perform a frequency analysis for systems of first and second order, through analysis of their response to a sinusoidal input of amplitude A and frequency variable. As a first order system uses the dc motor used in past practice. The motor drive signal is a sine wave of fixed amplitude and variable frequency which is obtained through a signal generator. The student must obtain experimentally the Bode plots (amplitude and phase) for the first-order system (engine) when the entry is submitted a 2V sine signal amplitude and frequency variable gain for three different cases. You must also obtain asymptotic Bode diagrams for the previous case.		X	Lab		Realization of memory practice	1,66	4
10	19	Dynamic analysis of feedback systems 1. Concept of Root Locus 2. Criteria of the module and the argument 3. Rules for the drawn up one of the Root Locus 4. Inverse Root Locus 5. Rules for the layout of the Inverse Root Locus 6. Widespread Root Locus	X					1,66	
10	20	Solution of proposed exercises. In it is session will be realised detailed exercises on the Root Locus. At the end of the same one will set out the students to realise drawing up approximate and fast on different systems.		X			Personal work about lesson. Proposed exercises. Discussion	1,66	

		Exercises designed to draw the Root Locus and inverse problems in which the system parameter that affects its dynamic behavior is different from the static gain.							
11	21	Frequency analysis of feedback systems Nyquist criterion: 1. Introduction to frequency analysis of feedback systems 2. Cauchy argument Principle 3. Introduction to the Nyquist criterion 4. Calculation of Nyquist Path 5. Application of the Nyquist Relative stability: 1. Relative stability 2. Margin and phase margin 3. Relative stability in the Bode diagram 4. Relative stability in the magnitude-phase diagram 5. Relationship between the parameters of relative stability and transient response	X					1,66	
11	22	Performing exercises. Drills in which the Nyquist criterion applies to different systems, including systems with poles at the origin and poles on the imaginary axis.		X			Personal work about lesson. Proposed exercises. Discussion	1,66	4
12	23	1. Basic Control Actions 2. PD and PI Controllers 3. PID Controllers 4. Problems of implementation of PID Controllers 5. Modifications to the PID control: other settings 6. Basic design principles temporal 7. Performance specifications on the Root Locus 8. Time domain design of regulators based on the Root Locus	X					1,66	
12	24	In the first part of system errors were calculated in steady and non-unity feedback unit. In the second part will begin exercises designed to adjust regulators on Root Locus		X			Personal work about lesson. Proposed exercises. Discussion	1,66	4
13	25	Frequency design of PID controllers 1. Frequency behavior of a PID controller	X					1,66	4

		2 Basic design principles frequency 3. Relationship between time and frequency characteristics 4. Frequency Design Rules 5. Lead and Lag Compensation							
13	26	Practice 3: Design of PID controllers using root locus and Lead and Lag Networks. They will experiment with different types of controllers (P, PD, PI, and PID) calculated from initial values given by the teacher. Finally, we should compare the results obtained with the various regulators implemented and decide which is best suited for this type of system. Another key objective of this practice is that students acquire the concept of what a regulator.		X	Lab		Realization of memory practice	1,66	
14	27	Solution of exercises. Drills for setting of Lead and Lag Compensation.	X				Personal work about lesson. Proposed exercises. Discussion	1,66	
14	28	Second evaluation test		X				1,66	
	29	Practice 4: Design of PID controllers using root locus and networks and forth. It will experiment with different types of regulators (P, PD, PI and PID) were calculated from initial values given by the teacher. Finally, compare the results with the various regulators implemented and decide which is best suited for this type of system. Another of the key objectives of this practice is that students acquire the concept of what is a regulator.		X	Lab		Realization of memory practice	1,66	4
							Subtotal 1	**48,33**	**60**
		Total 1 *(Hours of class plus student homework hours between weeks 1-14)*						108,32	

15		Tutorials, handing in, etc							
16		Assessment						3	38,68
17									
18									
							Subtotal 2	**3**	

Total 2 *(Hours of class plus student homework hours between weeks 15-18)*	41,68

TOTAL *(Total 1 + Total 2. <u>Maximum 180 hours</u>)*	**150**