

230121 - EPSC - Power Electronics and Control Systems

Coordinating unit:	230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit:	710 - EEL - Department of Electronic Engineering
Academic year:	2019
Degree:	BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Teaching unit Optional)
ECTS credits:	7
Teaching languages:	Spanish, English

Teaching staff

Coordinator:	Biel Sole, Domingo Guinjoan Gispert, Francisco Juan
Others:	Biel Sole, Domingo Guinjoan Gispert, Francesc Dominguez Pumar, Manuel

Degree competences to which the subject contributes

Generical:

10 ECI N3. They will have acquired knowledge related to experiments and laboratory instruments and will be competent in a laboratory environment in the ICC field. They will know how to use the instruments and tools of telecommunications and electronic engineering and how to interpret manuals and specifications. They will be able to evaluate the errors and limitations associated with simulation measures and results.

Teaching methodology

Regular class of theory and problems

Written exams:

- 1) Mid course exam
- 2) Final exam

Lab work.

Learning objectives of the subject

Introducing the principles of design of linear control techniques in continuous and discrete time systems and its application to physical systems, focusing in electronic and electromechanical ones

Knowing CAD tools to design and implement controllers to control electronic and electromechanical systems. Applying experimental techniques for the validation of the performance of control systems.

Design oriented analysis, implementation and experimental verification of electrical power conversion circuits and their industrial applications in electronic and electromechanical equipment power supply, communication systems and renewable energy.



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Study load

Total learning time: 175h	Hours large group:	52h	29.71%
	Hours small group:	26h	14.86%
	Self study:	97h	55.43%

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Content

<p>Introduction to linear control systems</p>	<p>Learning time: 8h Theory classes: 2h Laboratory classes: 2h Self study : 4h</p>
<p>Description:</p> <ul style="list-style-type: none"> - Basic components of a control system, reference, control, output and disturbance signals. - Control system goals. - Continuous-time control and discrete-time control. - Dynamic systems classification: linear and nonlinear systems, time-varying and time-invariant systems. - Transfer function of linear systems. 	
<p>Continuous-time control systems analysis</p>	<p>Learning time: 16h Theory classes: 6h Laboratory classes: 2h Self study : 8h</p>
<p>Description:</p> <ul style="list-style-type: none"> - Transient and steady-state time-response of linear systems. - First and second-order systems. - Transient response characterization: settling time, maximum overshoot, etc. - Higher order systems: transient response approximation through dominant poles and zero-pole cancellation. - Routh-Hurwitz stability criteria. - Root locus analysis. - Steady-state error. 	
<p>Continuous-time control systems design</p>	<p>Learning time: 18h Theory classes: 6h Laboratory classes: 2h Self study : 10h</p>
<p>Description:</p> <ul style="list-style-type: none"> - Control design through root locus. - First and second-order controllers. - PID controllers. - Implementation issues of PID controllers. 	

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<p>Analysis of control systems in frequency domain</p>	<p>Learning time: 14h Theory classes: 4h Laboratory classes: 2h Self study : 8h</p>
<p>Description:</p> <ul style="list-style-type: none"> - Frequency response of linear systems. - Nyquist diagram and Bode diagram. - Relative stability: gain margin and phase margin. 	
<p>Frequency-domain control design</p>	<p>Learning time: 16h Theory classes: 4h Laboratory classes: 2h Self study : 10h</p>
<p>Description:</p> <ul style="list-style-type: none"> - Frequency-domain specifications: relative stability margins and bandwidth of a control system. - Lead-lag and phase-lag compensations. 	
<p>Discrete-time control systems</p>	<p>Learning time: 16h Theory classes: 4h Laboratory classes: 3h Self study : 9h</p>
<p>Description:</p> <ul style="list-style-type: none"> - Introduction to discrete-time control systems. - The Z transform. - Z Plane analysis of discrete-time systems. - Design of discrete-time control systems by conventional methods. 	
<p>Introduction to Power Electronics: power conversion circuits</p>	<p>Learning time: 9h Theory classes: 3h Laboratory classes: 0h Self study : 6h</p>
<p>Description:</p> <p>Sources, loads and storage systems electrical characteristics. Power conversion types. Elemental power conversion circuits. Power devices and ancillary circuits.</p>	

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Steady-state analysis and design of power converters	Learning time: 24h Theory classes: 7h Laboratory classes: 4h Self study : 13h
Description: Steady-state specifications of power converters. Components design.	
Dynamical modelling and control of power converters	Learning time: 23h Theory classes: 7h Laboratory classes: 4h Self study : 12h
Description: Controlled sources modelling of switches. PWM modelling. Transfer functions and control design.	
Modelling and design of magnetic devices	Learning time: 9h Theory classes: 3h Laboratory classes: 1h Self study : 5h
Description: Equivalent magnetic circuits. Reluctance and gap concept. Inductors and transformers design.	
Applications of power electronics: power supply of electronic devices, communications renewable energy based systems.	Learning time: 22h Theory classes: 6h Laboratory classes: 4h Self study : 12h
Description: Switching regulators design for electronic devices power supply. battery chargers, photovoltaic applications	

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Qualification system

Written exams:

- 1) Mid course exam
- 2) Final exam

Lab work: evaluation of lab work

Final Mark = $0.3 \cdot (\text{lab work}) + 0.7 \cdot \max \{ \text{Final Exam Mark}; 0.7 \cdot \text{Final Exam Mark} + 0.3 \cdot \text{Mid Course Exam Mark} \}$

This course will also assess on the following skills:

- Ability to identify, state and solve engineering problems (High level)
- Instrumentation knowledge and experimental skills (High level)

Bibliography

Basic:

Ogata, K. Ingeniería de control moderna. 5a ed. Madrid [etc.]: Pearson Educación, 2010. ISBN 9788483226605.

Åström, K.J.; Murray, R.M. Feedback systems : an introduction for scientists and engineers. Princeton: Princeton University, 2008. ISBN 9780691135762.

Golnaraghi, F.; Kuo, B.C. Automatic control systems. 9th ed. New York: John Wiley & Sons, 2010. ISBN 9780470048962.

Erickson, R.W; Maksimovic, D. Fundamentals of power electronics [on line]. 2nd ed. Dordrecht: Kluwer Academic Publishers, 2001 [Consultation: 09/07/2015]. Available on: <<http://link.springer.com/book/10.1007/b100747/page/1>>. ISBN 0792372700.

Kassakian, J.G; Schlecht, M.F.; Verghese, G.C. Principles of power electronics. Reading: Addison-Wesley, 1991. ISBN 0201096897.