



Università degli Studi di Roma "Tor Vergata"

Scheda Insegnamento

Mod. Scheda Insegnamento v. 1.1

Docente responsabile dell'insegnamento/attività formativa

Nome Cristiano Maria

Cognome Verrelli

Denominazione insegnamento/attività formativa

Italiano

Inglese Mathematics of Feedback Control (ex Feedback Control Systems)

Informazioni insegnamento/attività formativa

A.A. 2026/27

☐ L

☒ LM

☐ LM CU

CdS Mechatronics Engineering

Codice 80300696

Canale

CFU 6

Lingua Inglese

Docente del modulo didattico (compilare solo per attività formative articolate in moduli)

Nome

Cognome

Denominazione modulo didattico (compilare solo per attività formative articolate in moduli)

Italiano

Inglese



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Obiettivi formativi e risultati di apprendimento attesi

Italiano

Inglese

LEARNING OUTCOMES: Theory of differential equations to be used to gain profound insight into the fundamental mathematical control design techniques for linear and nonlinear dynamical systems.

KNOWLEDGE AND UNDERSTANDING: Students are envisaged to understand how to manage differential equations for analysis and control design purposes.

APPLYING KNOWLEDGE AND UNDERSTANDING: Students are envisaged to apply broadly and to personalize the design techniques and algorithm approaches taught during the lessons. Tutor-guided computer simulations and lab experiments invite an intensive participation.

MAKING JUDGEMENTS: Students are envisaged to provide a reasoned description of the design and algorithm techniques and tools, with proper integrations and connections.

COMMUNICATION SKILLS: Students are envisaged to describe analytically the theoretical elements and to provide a description of the design techniques and the algorithm steps, also providing examples.

LEARNING SKILLS: Students are envisaged to deal with analytical and design tools. Connection of different topics through different mathematical approaches is crucial.



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Prerequisiti

Italiano

È richiesta una conoscenza preliminare di analisi matematica e algebra lineare.

Inglese

Preliminary knowledge of mathematical analysis and linear algebra is required.

Programma

Italiano

- 6 CFU
1. Proportional Control for first order systems (current-fed DC motors).
 2. Proportional-Integral Control for first order systems (current-fed DC motors).
 3. State-space representations and modes.
 4. Adaptive Control (current-fed motors and cruise control) and input-output models.
 5. Phase portraits for planar systems and excitable/observable modes.
 6. Response to sinusoidal inputs and transfer function.
 7. Bode plots, and compensator circuits.
 8. Response to constant inputs and transfer function representations.
 9. Impulsive response and transfer function (simplifications and zeroes).
 10. Proportional-Integral-Derivative Control and state feedback.
- +3 CFU
11. Output feedback: asymptotic observer and dynamic compensator.
 12. Output feedback: controller design & root locus (connection to Nyquist plot), realization.
 13. Generalized application of the Proportional-Integral-Derivative Control.
 14. A grain of nonlinearity (linear approximation).

Inglese

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Modalità di valutazione

- ☒ Prova scritta
- ☒ Prova orale
- ☒ Valutazione in itinere
- ☐ Valutazione di progetto
- ☐ Valutazione di tirocinio
- ☐ Prova pratica
- ☐ Prova di laboratorio

Descrizione delle modalità e dei criteri di verifica dell'apprendimento

Italiano

Inglese

a) Combination of: written exam (one final or three intermediate ones) and oral exam.

b) The written exam includes exercises with open answers to be finalized in one hour. The written exam includes also the development of Matlab codes. The book can be used during the written exam. The oral exam involves questions on the entire program. The written exam and the oral concur almost evenly to the final score (x/30).

c) The final score is based on the level of knowledge of the theoretical, design and algorithm elements and tools; in particular, the final evaluation refers for 70% to the student's knowledge level and for 30% to her/his capability of expressing the knowledge and providing an autonomous judgment in the design and oral exam phases.

The detailed final evaluation criteria are as follows:

Failed exam: deep lack and/or inaccuracy of knowledge and comprehension of topics and design techniques; limited capabilities in analysis and synthesis, critical ability, and judgment; designs and topics are presented with a non-coherent and technically inadequate approach.

18-20: sufficient knowledge and comprehension of topics and design techniques with possible imperfections; sufficient capabilities in analysis, synthesis, and autonomous judgment; designs and topics are presented with a not too much coherent and technically appropriate approach.

21-23: flat knowledge and comprehension of topics and design techniques; appropriate capabilities in analysis and synthesis with fair autonomous judgment; designs and topics are presented with sufficient coherency and technically appropriate approach.

24-26: more than fair knowledge and comprehension of topics and design techniques; good capabilities in analysis and synthesis with good autonomous judgment; designs and topics are presented with a coherency and a technically appropriate approach.

27-29: complete knowledge and very good comprehension of topics and design techniques; remarkable capabilities in analysis and synthesis with very good autonomous judgment; designs and topics are presented with a rigorous and technically very appropriate approach.

30-30L: excellent knowledge and complete comprehension of topics and design techniques; excellent capabilities in analysis and synthesis with excellent autonomous judgment and originality; designs and topics are presented with a rigorous and technically excellent approach.



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Testi adottati

Italiano

Inglese

- [1] C.M. Verrelli, Linear Control Design for Linear Systems. A Primer, Esculapio.
[2] C.M. Verrelli, Linear Control Design for Linear Systems. Practice book, Esculapio.

Bibliografia di riferimento

Italiano

Inglese



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Modalità di svolgimento

- ☒ Modalità in presenza
☐ Modalità a distanza

Descrizione della modalità di svolgimento e metodi didattici adottati

Italiano

Inglese

Lessons take place in a classroom equipped for both slide projection and blackboard-based activities. Lessons include both theoretical topics and design activities on specific examples as well as exercise sessions on the various topics of interest for the design.

Modalità di frequenza

- ☐ Frequenza facoltativa
☒ Frequenza obbligatoria

Descrizione della modalità di frequenza

Italiano

Inglese

Class participation envisages also an active and interactive involvement of students.