

Stellenbosch University Faculty of Engineering

Module Framework

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This document should be read with the following documents: Stellenbosch University Calendar Parts 1 and 11, Faculty of Engineering Assessment Rules¹, Faculty of Engineering General Stipulations for Undergraduate Modules¹

Module: 23965 Control Systems 414 2016	Lecturer(s): Prof WH Steyn Room: E402, whsteyn@sun.ac.za	Date: 29/01/2016 Programme Coordinator
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1. Assessment Details

- Major assessment dates and venues are provided at firga.sun.ac.za and mymatrics.com
- Note that awarding a pass mark is subject to meeting each the ECSA Exit Level Outcomes assessed in this module, as stated in Faculty of Engineering's Assessment Rules

Calculation of final marks (according to formulas in the Faculty of Engineering's Assessment Rules):

Assessment Method: Flexible: $w_{SM} = 10\%$; $w_{A1} = 40\%$; $w_{A2} = 50\%$

SM=average(Tut tests), A1=test during test week, A2=test in first examination period

Note that both A1 and A2 are compulsory.

2. Module Objectives

Aim: The module serves as an introduction to optimal digital control, optimal estimation and non-linear systems theory.

A student who has successfully completed this module can:

- Analyse the closed loop stability and response of a plant with non-linearities using describing functions, the phase plane and Lyapunov techniques.
- Design feedback controllers to stabilise non-linear systems using describing functions and phase plane methods
- Design a stable adaptive controller for simple linear and non-linear plants.
- Obtain discrete state space models for sampled plants, do pole placement and estimator designs for regulator and servo control systems.
- Design LQR and Kalman Filter observers for sampled systems.

3. Module Content and Schedule

Prescribed textbook: Digital Control and State Variable Methods, 3rd edition by M. Gopal

Other resources: Additional notes for subjects that are not covered in the textbook

Week	Topic	Contact Session/Assignments
1 (01/02)	Discrete state variable modelling	Tutorial 1 (E203)
2 (08/02)	State feedback for discrete systems	Tutorial 2 (E203)
3 (15/02)	Discrete state observers	Tutorial 3 (E203)
4 (22/02)	Discrete servo system design	Practical 1 (E451-EOLAB)
5 (29/03)	Optimal LQR state feedback	Tutorial 4 (E203)
6 (07/03)	Optimal observers (Kalman filters)	Practical 2 (E451-EOLAB)
7 (12-18/03)	Test week (A1: CS414 @ 08h00 on Thursday 17 th March)	
8 (19-28/03)	Holiday	
9 (29/03)	Describing functions: Analysis	Tutorial 5 (E203)
10 (04/04)	Describing functions: Stability and Applications	Tutorial 6 (E203)
11 (11/04)	Phase plane: Analysis	Tutorial 7 (E203)
12 (18/04)	Phase plane: Stability and Applications	Practical 3 (E451-EOLAB)
13 (25/04)	Lyapunov: Analysis	Tutorial 8 (E203)
14 (02/05)	Lyapunov: Stability and Applications	Practical 4 (E451-EOLAB)
15 (09/05)	Adaptive Control Introduction	
June Exams	A2: CS414 @ 14h00 on Monday 30 th May	
	A3: CS414 @ 14h00 on Monday 20 th June	

¹ Available on SUNLearn for modules offered by Faculty of Engineering, in the block titled "General Programme Information" on the left-hand side

4. ECSA Knowledge Area Credits

Mathematical Science	Basic Science	Engineering Science	Design and Synthesis	Complementary Studies
0	0	12	3	0

Engineering Science: Not discrete part of module. All theoretical components of the module.

Design and Synthesis: Not discrete part of module. Design and synthesis is the end-point of all theoretical components in the module, including control system design and four laboratory/practical design and synthesis sessions.

5. ECSA Exit Level Outcomes

This module is not used to assess any ECSA Exit level Outcomes.

6. Other Module Specific Information

Lectures, Practicals (Labs) and Tutorials:

- All lectures, practicals, tutorials and tasks are compulsory for all students. An INCOMPLETE mark will be registered for students who fail to attend all contact sessions. This rule also applies to students repeating the module.
- Handing in of practical results is compulsory: non-compliance will result in an INCOMPLETE mark for the module.
- Tasks must be handed in individually as separate reports.

Tests:

- Prescribed pocket calculators may be used in tests. No written material or electronically stored information may be brought into test or examination rooms. All the necessary tables and formulas will be provided.
- Students who miss any assessment opportunity (e.g. tutorials, practicals, reports, projects, tests, etc.) without permission or acceptable reason will receive an INCOMPLETE mark.
- Students may be required to write unannounced tests during the semester. These tests may count towards the class mark.
- The Main Assessments (Tests) will be scheduled during the Engineering Test Week and the formal University exam periods (May/June). The Main Assessments, taken during the Engineering Test Weeks and the First Examination periods are compulsory for all students.

General:

BE VIGILANT IN LECTURES AND ASK THE LECTURER FOR HELP IF YOU DO NOT UNDERSTAND THE WORK!