Control systems analysis for continuous and discrete systems

- Academic Year
- Faculty of Engineering
- Unit Title: ACS2214
- 20 credits

Full Description:
This module gives a solid theoretical foundation for understanding feedback control system analysis and application and is suitable for general engineering students. This is supported by both PC laboratory activities and other activities.

Content covers the basic analysis of feedback control loops using both the time and frequency domain techniques. Learning is reinforced through computer laboratories. The latter part of the course focuses on common feedback strategies and students will learn both analysis and indicative designs of these and reinforce learning through application to laboratory systems.

Professional Note:
Core for accredited engineering programmes

Pre Uni Qual:
A level Maths (or equivalent)

Restrictions:
No

Pre-requisites:
ACS124 or equivalent advised

Co-requisites:
No formal pre-requisites but MAS244 or ACS217 or equivalent are advised

Contacts:
Dr J A Rossiter and Prof M Mahfouf

Teaching & Learning Methods
50 lecture hours
15 Tutorial hours
25 Lab hours including associated assessment
119 Independent Hours
1 hour (formal examination)

Total Hours – 200

Assessment Methods
Formal Exam 30% - 1 hour
Lab Work and associated assignments – 50%
Project assignment 20%

Aims and Principles of Unit:
The aims of the module are:
1. To explore the time and frequency domain methods for continuous and discrete time control systems analysis.
2. To enhance the students understanding of control systems analysis and design methods through examples and the use of CAD software.
3. To enable students to analyse compensators using both frequency domain and root locus methods in Matlab.
4. To provide a working knowledge of the techniques of sampled data system analysis and design.

Learning Outcomes:
By the end of the unit the student will be able to:

1. Explain the principles of closed-loop control, transfer function models, stability and time response analysis;
2. Interpret practical performance specifications of a control system;
3. Analyse a simple system using the root locus method;
4. Analyse a simple control systems using different forms of frequency response diagrams;
5. Use computer aided design software for control system analysis and design;
6. Convert time-domain design specifications into frequency domain design specifications.
7. Analyse and design common compensator structures (e.g. lead, lag)
8. Implement and evaluate different compensator strategies.
9. Demonstrate the application of control design tools in real applications.
10. Understand the need for the digitisation of systems as well as understand the idea behind digital systems;
11. Understand the Shannon-Nyquist Theorem and be able to select the sampling interval for a given system;
12. Determine the z-transform and its inverse for a given system and get to grips with the concept of mapping between Laplace and z domains;
13. Manipulate and understand the algebra associated with sampled system diagrams;

How teaching methods enable aims and outcomes to be achieved:
We will augment traditional lecturing methods with appropriate resources and direct integration with other systems modules. Hence typical delivery will be via lectures, but these will be augmented with supported laboratory sessions and student home works. We will provide some self assessment material on MOLE so students can test their own learning. During the problem solving classes students will be able to apply their skills to Engineering problems.

During Laboratory Exercises Students will be able to analyse a system in the Continuous Domain and design a solution to the problem. Using their knowledge from the lectures, they should obtain the digital equivalent of the original system, analyse it digitally, then design a digital controller and draw a parallel between the Continuous/Digital Solutions.
How assessment methods enable aims and outcomes to be achieved:
The module would be assessed by three assignments and one end of year exam 30%.
One assignment is a computer laboratory under examination conditions and the other two assignments would entail some research, independent study and the production of a report.

Unit evaluation:
The department has a standard procedure for collecting student feedback on every taught module and communicating the results and staff comments back to the students.

How assessment methods enable aims and outcomes to be achieved:
One hour written examination: 30%

Continuous assessment: 70%

The first assignment comprises tests under examination conditions which also assess students' ability to use software for the analysis and design for continuous control systems. The tests are designed to cover a large proportion of the technical syllabus.

The second assignment is an open-ended project where students are required to research and undertake independent learning to demonstrate the application of the module within Biomedical scenarios.

The third assignment covers the 'analysis' of digital systems, including the choice of an appropriate sampling time and the manipulation of z Transforms and Inverse z Transforms, analysis of the overall system's Transfer function in terms of stability and requirements for compensation.