The University of Southern Queensland

Course specification

The current and official versions of the course specifications are available on the web at <http://www.usq.edu.au/coursespecification/current>.
Please consult the web for updates that may occur during the year.

Description: Computer Controlled Systems

Subject	Cat-nbr	Class	Term	Mode	Units	Campus
ELE	3105	86303	1, 2009	EXT	1.00	Toowoomba

Academic group: FOENS
Academic org: FOES04
Student contribution band: 2
ASCED code: 031399

STAFFING

Examiner: Paul Wen
Moderator: John Leis

REQUISITES

Pre-requisite: ELE2103

SYNOPSIS

To apply control to any 'real' problem, it is first necessary to express the system to be controlled in mathematical terms. The 'state space' approach is taught both for expressing the system dynamics and for analysing stability both before and after feedback is applied. These concepts involve revision and extension of matrix manipulation and the solution of differential equations. By defining a time-step to be small, these state equations give a means of simulating the system and its controller for both linear and nonlinear cases. Many of the implementations of on-line control now involve a computer, which applies control actions at discrete intervals of time rather than continuously. It is shown that discrete-time state equations can be derived which have much in common with the continuous ones. Simulation does not then rely on a very small time step. The operator 'z' is first introduced with the meaning of 'next', resulting in a higher order difference equation to represent the system, then shown to be a parameter in the infinite series which is summed to form a 'z-transform'. It is shown that the discrete-time transfer function in z can be derived from the Laplace transform of the continuous system, with additional terms to represent the zero order hold of the DAC. Analysis of stability in terms of the roots of a characteristic equation are seen to parallel the continuous methods and techniques of pole assignment and root locus are also seen to correspond. Techniques are presented for synthesising transfer functions by means of a few lines of computer code, to make stable control possible for systems which would be unstable with simple feedback.

OBJECTIVES

The course objectives define the student learning outcomes for a course. The assessment item(s) that may be used to assess student achievement of an objective are shown in parenthesis. On completion of this course, students should be able to:

1. design of a computer control feedback loop, including algorithms in software (assignment 1, assignment 2 and exam);
2. analysis and simulation of control systems using state space methods (assignment 1, assignment 2 and exam); and
3. design of systems in which the controllers have dynamics implemented in software (assignment 1, assignment 2 and exam).

TOPICS

	Description	Weighting (%)
1.	Use of the Z-transform for analysis and design of computer control loops	15.00
2.	Representation of discrete time dynamics in software	10.00
3.	Discrete time state equations and stability analysis	10.00
4.	Controller design and 'tuning' with controller dynamics, PID	15.00
5.	Pole assignment, root locus and other methods in the complex plane	10.00
6.	Derivation of state equations	10.00
7.	Modelling and simulation by computer	10.00
8.	Matrix analysis of continuous linear systems and controllers	15.00
9.	Concepts of controllability and observability	5.00

TEXT and MATERIALS required to be PURCHASED or ACCESSED

ALL textbooks and materials are available for purchase from USQ BOOKSHOP (unless otherwise stated). Orders may be placed via secure internet, free fax 1800642453, phone 07 46312742 (within Australia), or mail. Overseas students should fax +61 7 46311743, or phone +61 7 46312742. For costs, further details, and internet ordering, use the 'Textbook Search' facility at http://bookshop.usq.edu.au click 'Semester', then enter your 'Course Code' (no spaces).

MATLAB Student Edition, Version 6.0 (or later).

Nise, NS 2007, *Control systems engineering*, 5th edn, John Wiley & Sons Inc, Hoboken, NJ.

REFERENCE MATERIALS

Reference materials are materials that, if accessed by students, may improve their knowledge and understanding of the material in the course and enrich their learning experience.

Astrom, KJ & Wittenmark, B 1996, *Computer controlled systems theory and design*, 3rd edn, Prentice Hall, New Jersey.

Dorf, RC & Bishop, RH 2004, *Modern control systems*, 10th edn, Pearson Education, Upper Saddle River, NJ.

Kuo, B 1992, *Digital control systems*, 2nd edn, Holt Saunders, Tokyo.

(The 1998 version is a reprint of the 1992 edition.)

Ogata, K 1995, *Discrete time control systems*, 2nd edn, Prentice Hall, Englewood Cliffs, NJ.

Phillips, C & Nagle, H 1995, *Digital control system analysis and design*, 3rd edn, Prentice Hall, Englewood Cliffs, New Jersey.

STUDENT WORKLOAD REQUIREMENTS

ACTIVITY	HOURS
Assessments	36.00
Directed Study	39.00
Examinations	2.00
Private Study	78.00

ASSESSMENT DETAILS

Description	Marks out of	Wtg (%)	Due date
ASSIGNMENT 1	200.00	20.00	20 Apr 2009
ASSIGNMENT 2	100.00	10.00	01 Jun 2009
2 HOUR RESTRICTED EXAMINATION	700.00	70.00	END S1 (see note 1)

NOTES

1. Student Administration will advise students of the dates of their examinations during the semester.

IMPORTANT ASSESSMENT INFORMATION

1 Attendance requirements:
There are no attendance requirements for this course. However, it is the students' responsibility to study all material provided to them or required to be accessed by them to maximise their chance of meeting the objectives of the course and to be informed of course-related activities and administration.

2 Requirements for students to complete each assessment item satisfactorily:
To satisfactorily complete an assessment item a student must achieve at least 50% of the marks or a grade of at least C-. Students do not have to satisfactorily complete each assessment item to be awarded a passing grade in this course. Refer to Statement 4 below for the requirements to receive a passing grade in this course.

3 Penalties for late submission of required work:
If students submit assignments after the due date without extenuating circumstances then a penalty of 5% of the assigned mark may apply for each working day late up to a maximum of ten working days at which time a mark of zero can be recorded for that assignment.

4 Requirements for student to be awarded a passing grade in the course:
To be assured of receiving a passing grade in a course a student must obtain at least 50% of the total weighted marks for the course.

5 Method used to combine assessment results to attain final grade:
The final grades for students will be assigned on the basis of the weighted aggregate of the marks (or grades) obtained for each of the summative assessment items in the course.

6 Examination information:
In a Restricted Examination, candidates are allowed access to specific materials during the examination. The only materials that candidates may use in the restricted examination for this course are: writing materials (non-electronic and free from material which could give the student an unfair advantage in the examination); a hand-held, battery-operated, non-programmable calculator (students must indicate on their examination paper the make and model of any calculator(s) they use during the examination).

7 Examination period when Deferred/Supplementary examinations will be held:
Any Deferred or Supplementary examinations for this course will be held during the examination period at the end of the semester of the next offering of this course.

8 University Regulations:
Students should read USQ Regulations 5.1 Definitions, 5.6. Assessment, and 5.10 Academic Misconduct for further information and to avoid actions which might contravene University Regulations. These regulations can be found at the URL http://www.usq.edu.au/corporateservices/calendar/part5.htm or in the current USQ Handbook.

ASSESSMENT NOTES

1 The due date for an assignment is the date by which a student must despatch the assignment to the USQ. The onus is on the student to provide proof of the despatch date, if requested by the Examiner.

2 Students must retain a copy of each item submitted for assessment. This must be produced within five days if required by the Examiner.

3 In accordance with University's Assignment Extension Policy (Regulation 5.6.1), the examiner of a course may grant an extension of the due date of an assignment in extenuating circumstances.

4 The Faculty will normally only accept assessments that have been written, typed or printed on paper-based media.

5 The Faculty will NOT accept submission of assignments by facsimile.

6 Students who do not have regular access to postal services or who are otherwise disadvantaged by these regulations may be given special consideration. They should contact the examiner of the course to negotiate such special arrangements.

7 In the event that a due date for an assignment falls on a local public holiday in their area, such as a Show holiday, the due date for the assignment will be the next day. Students are to note on the assignment cover the date of the public holiday for the Examiner's convenience.

8 Students who have undertaken all of the required assessments in a course but who have failed to meet some of the specified objectives of a course within the normally prescribed time may be awarded one of the temporary grades: IM (Incomplete - Make up), IS (Incomplete - Supplementary Examination) or ISM (Incomplete -Supplementary Examination and Make up). A temporary grade will only be awarded when, in the opinion of the examiner, a student will be able to achieve the remaining objectives of the course after a period of non directed personal study.

9 Students who, for medical, family/personal, or employment-related reasons, are unable to complete an assignment or to sit for an examination at the scheduled time may apply to defer an assessment in a course. Such a request must be accompanied by appropriate supporting documentation. One of the following temporary grades may be awarded IDS

(Incomplete - Deferred Examination; IDM (Incomplete Deferred Make-up); IDB (Incomplete - Both Deferred Examination and Deferred Make-up).

OTHER REQUIREMENTS

1 A basic familiarity with a programming language or MATLAB is assumed.
