

<p>Kingdom of Saudi Arabia Ministry of Higher Education Qassim University College of Engineering</p>		<p>المملكة العربية السعودية وزارة التعليم العالي جامعة القصيم كلية الهندسة</p>
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Design of Digital Control Systems

College: Engineering

Department: Mechanical

First: Course Definition

1- Course Code *ME 667*

2- Units: 3 credit hrs

3 – Semester

4 -Prerequisite
-Familiarity with linear algebra is assumed
-Knowledge of modern control theory is assumed

5- Co-requisite -----

6- Location (if not on main Campus):

Second: Course Objectives

- 1- *To give students an understanding of the mathematics of discrete-time systems including z-transforms, pulse-train functions, conversion from continuous-time to discrete-time.*
- 2- *To ensure that students are able to apply the same basic control system analysis and design techniques learned in Control Systems for Mechanical Engineering Applications to digital control systems*
- 3- *To ensure that students are able to analyze discrete-time state-space time-varying and time-invariant systems including assessing Lyapunov stability, assessing controllability and observability, and transforming between various canonical state-space representations*

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Third: Course Specifications

1- Topics to be covered

Subject	No of Weeks	Units
Review of the continuous control	1	3
Introductory digital control	1	3
Discrete time systems analysis	3	9
Sampled-Data Systems	2	6
Discrete Equivalents	1	3
Design Using Transform Techniques	3	9
Design Using State-Space Methods	2	6
Design of a Disk Drive Servo: A Case Study	2	6

2- Course components (Total hrs in the Semester)

Lecture	Exercise and Laboratory	Other
45	---	-----

3- Intended Learning Outcomes of the Course (ILO's)

a. Knowledge

i) Description of the knowledge to be acquired:

On successful completion of this course, students should be able to:

- recall z transform analysis of sampled data feedback loops
- recall stability theorems and root locus techniques
- recall different techniques for digital controller design

ii) Teaching strategies to be used to develop that knowledge

- Lectures
- Exercises

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iii) Methods of assessment of knowledge acquired

- Exams
- Evaluation of exercise assignments

b- Cognitive (Intellectual) Skills

i) Cognitive skills to be developed

On successful completion of this course, students should be able to:

- Expressing real engineering problems as an exercise in linear digital controller design
- Solve digital control problems using Z transform
- Select appropriate design methodology
- Select of performance analysis tools
- Formulate a digital control problem, design a solution, and test the result by simulating it via Matlab

ii) Teaching strategies to be used to develop these cognitive skills

- Lectures
- Exercises
- Case study
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iii) Methods of assessment of students cognitive skills

- Exams
- Evaluation of the design project
- Evaluation of the laboratory assignments

c. Interpersonal Skills and Responsibility

i) Description of the interpersonal skills and capacity to carry responsibility to be developed

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ii) Teaching strategies to be used to develop these skills

iii) Methods of assessment of students interpersonal skills and capacity to carry responsibility

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d. Communication, Information Technology and Numerical Skills

i) Description of the skills to be developed in this domain

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ii) Teaching strategies to be used to develop these skills

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iii) Methods of assessment of students numerical and communication skills

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4- Student Assessment Schedule

<i>Serial</i>	<i>Assessment tool (test, group project, examination etc.)</i>	<i>Week due</i>	<i>Weight</i>
1	Exercises	2-6	20%
2	Design Project	12	15%
3	Laboratory Assignment	5-8	15%
4	Final Exam	16	50%

5- Student Support

- Office hours (2 hours weekly)
- Communication through the course website (Past exam papers and model answers will be provided for the students).
- Revision classes are scheduled towards the end of each part of the course

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6- Learning Resources

i) Essential Books (References)

Gene F. Franklin , J. David Powell , Michael L. Workman , Digital Control of Dynamic Systems, Addison-Wesley; 3 edition, (December 29, 1997)

ii) Course Notes

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iii) Recommended Books

1 -Charles L. Phillips , H. Troy Nagle , *Digital Control System Analysis and Design, Prentice Hall; 3 edition, (November 17, 1994)*

2 -Benjamin C. Kuo, *Digital Control Systems, 2nd edition,(sept 1997)*

iv) Electronic Books & Web Sites:

- <http://www.ac-knowledge.net/qassim/>

v) Periodicals

- IEEE Control Systems Magazine

vi) Other Learning resources

- Lecture room equipped with white board and multimedia projector, internet access
-Control Lab
To support laboratory projects that cover the following topics:-
Sampling effects and digital filters,
Design and implementation of digital controllers for servomechanisms,
State variable control and estimators
-Licensed software package MATLAB® and Simulink® to support both the exercises and the lab assignments.

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7- Course Evaluation and Improvement Processes

i) Strategies for Obtaining Student Feedback on Effectiveness of Teaching-

- Confidential completion of standard course evaluation questionnaire.
- Focus group discussion with small groups of students.

ii) Other Strategies for Evaluation of Teaching by the Instructor or by the Department

- Observations and assistance from colleagues,
- Independent assessment of standards achieved by students,
- Independent advice on assignment tasks

iii) Processes for Improvement of Teaching

- Workshops on teaching methods,
- Review of recommended teaching strategies.

iv) Processes for verifying standards of student achievement

- Check marking by an independent faculty member of a sample of student work

v) Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement.

- Preparing standard semester course report comprises proposed improvement to be investigated by Master Program Committee and then to be discussed and approved by the department council.