

<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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Advanced Systems Dynamics and Control

College: Engineering

Department: Mechanical Engineering

First: Course Definition

١- **Course Code: ME 661**

2- **Units : 3 credit hrs**

3 – **Semester:**

٤ -**Prerequisite**

5- **Co-requisite**

6- **Location** (if not on main Campus):

Second: Course Objectives

1. *To predict the dynamic behavior of mechanical systems by analytical methods and computer simulation*
2. *To synthesize/design mechanical systems to achieve desired performance goals.*
 1. *To provide students with the fundamentals of modern control theory.*
 2. *To train students in the use of MATLAB for control design and simulation.*

Third: Course Specifications

1- Topics to be covered		
Subject	No of Weeks	Units
Modeling and Simulation	2	6
Linearization	1	3
Review of the classical Control Theory	1	3
State space representation	1	3
Controllability and observability,	1	3
State feedback and linear quadratic regulator,	2	6
State observers	2	6
Kalman filters	2	6
Modeling/performance trad-offs in control system	2	6

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design		
Real Application	1	3

2- Course components (Total hrs in the Semester)

Lecture	Exercise or lab	Other
45	---	---

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

a. Knowledge

i) Description of the knowledge to be acquired:

- Understanding the concept of operating point and linearization.
- Understanding the concept of controllability and observability.

ii) Teaching strategies to be used to develop that knowledge

- Lectures and tutorials
- Home assignments
- Open class discussions and forums
- Case study report using data collection, internet search, numerical computation, simulation, and reporting
- Matlab sessions

iii) Methods of assessment of knowledge acquired

- Home assignments
- Quizzes
- Midterm Exams
- Term Project
- Final Exam

b- Cognitive (Intellectual) Skills

i) Cognitive skills to be developed

- Ability to model and simulate dynamic systems.
- Ability to represent the dynamic system in state space form
- Ability to apply the small perturbation technique to linearize nonlinear systems.

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- Ability to determine the controllability and observability of linear dynamic systems.
- Ability to design classical and modern controllers for linear dynamic systems.
- Ability to design state estimator
- Ability to integrate and simulate various components of automatic control system (plant, controller, and state estimator)

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

- Lectures and tutorials
- Home assignments
- Open class discussions and forums
- Case study report using data collection, internet search, numerical computation, simulation, and reporting
- Matlab sessions

iii) Methods of assessment of students cognitive skills

- Home assignments
- Quizzes
- Midterm Exams
- Term Project
- Final Exam

c. Interpersonal Skills and Responsibility

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

- Team work in Term project and Assignments

ii) Teaching strategies to be used to develop these skills

- Home assignments (group)
- Open class discussions and forums
- Case study report using data collection, internet search, numerical computation, simulation, and reporting

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

- Home assignments.
- Quizzes.

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- Term Project.

d. Communication, Information Technology and Numerical Skills

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

- Ability to use the internet to search for specific information in the area of modeling and automatic control
- Ability to use the available numerical computational tools such as Matlab and Simulink to analyze and design feedback control systems
- Ability to use the modern presentation techniques to demonstrate the students' ideas and work.

ii) Teaching strategies to be used to develop these skills

- Lectures.
- Assignments, at home.
- Case study report using data collection, internet search, numerical computation, simulation, and reporting

iii) Methods of assessment of students numerical and communication skills

- Home assignments.
- Term Project.

e. Psychomotor (if applicable) & Other Non-cognitive Skills

i) Description of the psychomotor or other skills to be developed and the level of performance required

ii) Teaching strategies to be used to develop these skills

iii) Methods of assessment of student's psychomotor skills

4- Student Assessment Schedule

Assessment	Assessment task (test, group project, examination etc.)	Week due	Weight of
1	Quiz 1	Week 2	4%

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2	Quiz 2	Week 4	4%
3	Quiz 3	Week 6	16%
4	Mid Term Exam1	Week 7	15%
5	Case Study Term project & Regular Assignments	Week 8	5%
6	Quiz 4	Week 9	4%
7	Quiz 5	Week 11	4%
8	Mid Term Exam2	Week 13	15%
9	Quiz 6	Week 14	4%
10	Final Exam	Week 16	50%

5- Student Support

- Arrangements for availability of faculty for individual student consultations and academic advice. (include amount of time faculty are available each week.
- Three (3) Office hours per week are offered by the instructor to aid the students and support them.

6- Learning Resources

i) Essential Books (References)

1. Katsuhiko Ogata , "Modern control engineering" , 4th ed., NJ, Prentice Hall, 2010.
2. J.S. Bay, "Fundamentals of Linear State Space Systems", McGraw Hill, 1999.
3. P.M. DeRusso, R.J. Roy, C.M. Close, A.A. Desrochers, "State Variables for Engineers", (2nd Ed), Wiley, 1998

ii) Course Notes

Course notes will be prepared in handled to the students through the web

iii) Recommended Books

1. William L. Brogan "Modern control theory", 3rd ed., Englewood Cliffs, N.J., Prentice Hall, 1991.
2. Raymond T. Stefani, Bahram Shahian, Clement J. Savant and Gene H. Hostetter, " Design of Feedback Control Systems", Oxford University Press, USA; 4 edition (August 30, 2001)

iv) Electronic Books & Web Sites:

www.mathworks.com

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v) Periodicals

IEEE Conferences and Journals

7- Course Evaluation and Improvement Processes

i) Strategies for Obtaining Student Feedback on Effectiveness of Teaching

- Questionnaire,
- Observing the students opinions recorded in the college student sit
- Appeal box
- Carrying out extensive questioners by a sample of the distinguished students just after the graduation from the college

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

- Periodical review of the teaching methods by both the department council and the education affairs vice dean
- Questionnaire,
- Observing the students opinions recorded in the college student site.

iii) Processes for Improvement of Teaching

- Evaluation of the course outlines by external staff member from outside the university
- Periodical contact with the different engineering authorities and industries for evaluating and getting their feedback and suggestions concerning the course outlines .

iv) Processes for verifying standards of student achievement (e.g. check marking by an independent faculty member of a sample of student work, periodic exchange and remarking of a sample of assignments with a faculty member in another institution)

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

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

- Assessment and evaluation of the level of achieving the course outcomes through a continuous improvement process (part of a quality assurance system established by the university).

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- Consequently, actions are to be taken to improve the course delivery when necessary.
- Review of the course objectives, outcomes and curriculum each 2 years.