SYLLABUS: CONTROL TECHNIQUES

Date / Revision August 22, 2017 / 22.08.17 /MaS
Faculty Engineering
Study Program Mechatronics

SUBJECT: Control Techniques

1 Basic Information

1.01	**Subject Name**	**Control Techniques**
1.02	**Semester**	4
1.03	**Level**	1
1.04	**SKS**	3
1.05	**Mandatory / Curriculum**	Mandatory / D-07
1.06	**Subject Code**	CTRL
1.07	**Subject Code**	MTE-D-CTRL-4107
1.08	**Year**	2017 (7)
1.09	**Quality Control**	Final Test, see evaluation
1.10	**Limitations**	Min 12 and Max 32 students in one class
1.11	**Combined with**	MEE
1.12	**Perquisite**	Applied Mathematics, Electrical Engineering 2, Statics and Mechanics
1.13	**Responsible**	Dean of Engineering Faculty
1.14	**Revision**	22-08-2017/MaS

2 Description of Subject

The subject introduces the the basic ideas about open-loop and closed-loop system. The course starts with the introduction the representation of control system using approaches : transfer function, block diagram and state space. Mathematical modeling to the mechanical and electrical system are also introduced. The course continues with reducing system differential equation into simple transfer function, simplification of block diagram, representation of multiple-input-multiple- output system using block diagram. Next the system response will be explain, in which the students must be analyze the first and second order system, transient response analysis, steady state errors in feedback control system. Routh's stability criterion will also be discussed, as well as effect of zeroes and poles on stability, using Proportional controller , Integral controller and Derivative controller to improve system performance. Furthermore, within the topics, the students will be guided on how to do computation and simulation using computational tool, such as Matlab or Scilab.

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3 Objectives

- Introduces the concept of control technique
- introduce the open loop- and closed loop control system
- learn to use software tools for control techniques analysis and simulation.

4 Competency

After having the course, students are expected have to:

- Explain the basic ideas about open-loop and closed-loop system
- Understand the representation of control system using approaches : transfer function, block diagram and state space.
- Apply mathematical modeling to the mechanical and electrical system.
- Simplify the complex block diagram, also for a MIMO-system
- Understand system response analysis for first and second-order system, steady state error analysis for feedback system
- Apply Routh's stability analysis
- Develop a control system using Proportional controller , Integral controller and Derivative controller
- to improve system performance
- Use computational tool (with Matlab/Scilab or WinFACT 7) to simulate the control system.

5 Learning Approach / Methodology

- Lectures/ Class contact (time-tabled) supplemented with interactive questions and answers;
- Simulation using Matlab / Scilab, and WinFACT7 Software;
- Tutorial/Laboratory/Practice Classes: preview of materials, revision and/or reports writing;
- Discussion, sample problem, group work;
- Student Study Effort: homework/assignment; preparation for test/quizzes/ examination.

6 Evaluation

5.1	**Absence maximum**	25%
5.2	**Participation in Discussion**	05 Points
5.3	**Homework / Classwork**	05 Points
5.4	**Presentation /Simulation**	10 Poins
5.5	**Daily Quiz**	20 Points
5.6	**Final Examination**	60 Points
	Total	100 Points

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7 Text Book and Reference

1	**Main Text Book:** *"Modern Control Engineering- Fifth Edition"*, **Author**: Katsuhiko Ogata, **Publisher**: Pearson Education, Inc, ISBN: 13 : 978-0-13-713337-6
2	**Supplementary Text books:** • "Modern control systems 12th-Edition", **Author**(s): Richard C. Dorf, Robert H. Bishop, Publisher: Pearson, 2011, ISBN-13:978-0-13-602458-3

8 Content / Topics of Lecture

Week	Content/ Topics of Lecturing	Text Book	Remark
1	**Introduction to control technique :** • Lecture objectives, goals. Introduction to definition and terms basic concepts, examples, brief comparison	Ch1	
2	**System representation:** • Terms and basics, transfer function representation, block diagram representation, state-space representation, examples, brief comparison	Ch 2	Quiz - 1
3	**Mathematical foundation :** • Revision on complex numbers and its relationship to Laplace transform, definition and notation of Laplace transform, using Laplace transform to solve differential equation	Ch 2	
4-6	**Mathematical modeling:** • Designing the model for common mechanical system, Designing the model for common electrical system	Ch 3	Exercise Quiz 2
7	**Transfer function and block diagram::** • Reducing system differential equation into simple transfer function, simplification of block diagram,	Ch 4	
8	**MIDTERM SEMESTER BREAK**		
9	**Transfer function and block diagram::** • Representation of multiple-input- multiple-output system using block diagram	Ch 4	
10-11	**System response:** • Response analysis of first order system, Response analysis of second order system, transient response analysis, steady state errors in feedback control system	Ch 6	Exercise Quiz 3
12	**Stability analysis:** • Routh's stability criterion, effect of zeroes and poles on stability, using Proportional controller , Integral controller and Derivative controller to improve system performance	Ch 6	
13-14	**Computational tool using Matlab / Scilab:**	Supplement	Exercise Quiz 4

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15	**Rehearsal and Tutorial:** Rehearsal of all subject and students can ask for more detail.		
16	**Final Examination**		

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