Control Engineering 2

Basic Course Information

Course Number	01005088	**Subject Category**	Compulsory (M)
Class Format	Lecture	**Credit Type and Number of Credits**	2
Department	Mechatronics	**Student Category**	Year 5
Period of Study	Semester 2	**Classes per Week**	2
Required Materials	Google Colab, Matlab (Simulink), Internet connection are required.		
Instructor	Takahisa Yamamoto	Worapong Suthiteakarn	

Course Objective

The course provides students with the basis and advance of control engineering. Students will develop their control model for several types of systems such as reverse pendulums, two-wheel pendulums, balancing ball systems, and so on. In addition, students will implement control models based on both classical and modern control theories.

Evaluation(Rubric)	Ideal Level of Achievement (Very Good)	Standard Level of Achievement (Good)	Unacceptable Level of Achievement (Fail)
System representation	Can express the system using state space model	Can express the system using transfer function model	Can not express the system both state space and transfer function models
Control system	Can model advanced PID control models	Can model normal PID control model	Ca not model PID and other control models
Optimization	Can optimize state space model using optimal regulator model	Can optimize transfer function model using Ziegler-Nichols' ultimate gain method and the related methods	Can not optimize control system
Implementation	Can implement control model based on state space model into pendulum systems	Can implement control model based on transfer function model into pendulum systems	Can not implement control models into pendulum systems

Relationship with Learning Outcomes

M(2) Ability to design, propose and develop electrical and electronic systems for robotics/ mechatronic systems

M(3) Ability to design, propose and develop mechanical solutions/ systems for robotic/ mechatronic systems

Teaching Method

Outline:	This subject is about classical and modern control theories. Students will develop
Class Format:	Lecture and Exercise
Please Note :	All materials will be provided on Google Classroom

Course Plan

Semester 2	**Contents and Method of Course**	**Goals**	**Related MCC**
1st week (online)	Introduction of Control Engineering 2	Can express mechanical and electrical systems as functions	V-A 8 170 V-A 8 171 V-A 8 172 V-A 8 173 V-A 8 174 V-A 8 175
2nd week (online)	Review of Control Engineering 1	Can formulate transfer function and calculate step and frequency responses	V-A 8 174 V-A 8 175 V-A 8 176 V-A 8 178
3rd week	Improvement of PID control	Can built I-PD and PI-D controllers and calculate their responses	V-A 8 174 V-A 8 175 V-A 8 176 V-A 8 178
4th week	Gain optimiazation	Can optimize gains of cotroller using Ziegler-Nichols' ultimate gain method and other related methods.	V-A 8 174 V-A 8 175 V-A 8 176 V-A 8 178
5th week	Introduction of modern control theory	Can explain the differences between classical and modern control theories	
6th week	Introduction of modern control theory	Can explain the differences between classical and modern control theories	
7th week	State space model	Can formulate state space model for target system	
8th week	Time response of state space model	Can explain and calculate time response of state space model	
9th week	Mock test and wrap-up of 1st half	Review and summarize learning	
10th week	Midterm examination	for week 1-8th	
11th week	State feedback control 1	Can use pole placement method to optimize feedback gain of state feedback system	
12th week	State feedback control 2	Can use optimal regulator method to optimize feedback gain of state feedback system	
13th week	State feedback control 3	Can use integral servo model to optimize feedback gain of state feedback system	
14th week	Theory of two wheel pendulum system	Can formulate kinetic equation of two wheel pendulum system and derive state space model	
15th week	Development of two wheel pendulum 1	Can design two wheel pendulum system (select appropriate electronic parts)	
16th week	Development of two wheel pendulum 2	Can model transfer function model and state space model for two wheel pendulum system	
17th week	Development of two wheel pendulum 3	Can optimize controller for two wheel pendulum system	
18th week	Mock test and wrap-up of 2nd half	Review and summarize learning	
19th week	Final exam	For week 11-18th	
20th week	Return exam papers, feedback and special sessions	Review and summarize learning	

Do not

	Examination	**Quiz**	**Mutual (Evaluations between students**	**Report**	**Portfolio**	**Other**
Basic Ability	20			20		
Technical Ability	20			20		
Interdisciplinary Ability	10			10		