Akashi College	Year	2022	Course Title	Control Engineering Ⅱ

Course Information

Course Code	4525	Course Category	Specialized / Elective
Class Format	Lecture	Credits	School Credit: 1
Department	Electrical and Computer Engineering Electrical Engineering Course	Student Grade	5th
Term	First Semester	Classes per Week	2
Textbook and/or Teaching Materials			
Instructor	ENOMOTO Ryuji		

Course Objectives

The objectives of this course are as follows:
1. Can derive the transient response of a system by using the inverse Laplace transform.
2. Can draw a polygonal line approximation of a Bode plot drawing from a transfer function. Conversely, can derive a transfer function from the polygonal line approximation of a Bode plot.
3. Can determine stability criteria of open-loop systems by using the Routh and Hurwitz stability criterion methods.
4. Can find a stability margin.
5. Can design PID control systems
6. Can derive the discrete time model of a system.

Rubric

	Ideal Level	Standard Level	Unacceptable Level
Achievement 1	Can derive the transient response of a system by using the inverse Laplace transform.	Know that the transient response of a basic system can be derived by using the inverse Laplace transform after performing the formula deformation such as partial fraction decomposition and square completion.	Cannot calculate the inverse Laplace transform.
Achievement 2	Can both draw a polygonal line approximation of a Bode plot from a transfer function, and derive a transfer function from a polygonal line approximation of a Bode plot.	Can either draw a polygonal line approximation of a Bode plot from a transfer function, or derive a transfer function from a polygonal line approximation of a Bode plot.	Can neither draw a polygonal line approximation of a Bode plot from a transfer function, or derive a transfer function from a polygonal line approximation of a Bode plot
Achievement 3	Can determine the stability of an open loop system using both the Routh and Hurwitz stability criterion methods.	Can determine the stability of an open loop system using either the Routh or Hurwitz stability criterion methods.	Do not know the Routh nor the Hurwitz stability criterion method.
Achievement 4	Can find a stability margin or to indicate the applicable location in the frequency response.	Can explain the definition of a stability margin.	Cannot find a stability margin.
Achievement 5	Can design PID control systems with both the step response method and limit sensitivity method.	Can design PID control systems with either the step response method or the limit sensitivity method.	Cannot design PID control system
Achievement 6	Can derive the discrete time model of a system both using the solution of a differential equation and a differential approximation.	Can derive a discrete time model of a system using a solution of a differential equation or a differential approximation.	Cannot derive the discrete time model of a system.

Assigned Department Objectives

Teaching Method

Outline	While we are not very aware of in our daily lives, almost every device, including cars, air conditioners, and refrigerators, have a automatic control function. In this course, students will learn the basics of classical controls following Control Engineering I, such as the Routh and Hurwitz stability criterion methods and the design method of PID control systems, and also learn how to simulate the response of control systems by themselves.
Style	They will learn how to determine the transient response of a system, and about stability margins and PID control designs. In addition, as an overall summary of the previous study on control engineering, we will explain and demonstrate how to verify the response of a control system based on a simulation. In almost every class, after the content of the lesson is explained, there will be exercises to review the content.
Notice	Students can expect a large amount of calculations to do in assignments and periodic exams. Therefore, they should actually think and solve exercise problems assigned as appropriate themselves, to get used to doing calculations. Also, because there will be many assignments and exercises, make efforts to finish them quickly. Students who miss 1/3 or more of classes will not be eligible for a passing grade.

Characteristics of Class / Division in Learning

☐ Active Learning	☐ Aided by ICT	☑ Applicable to Remote Class	☐ Instructor Professionally Experienced

Course Plan

			Theme	Goals
1st Semester	1st Quarter	1st	Introduction	Understand the outline of this course and know the content of the study and objectives.

		2nd	Laplace transform and inverse transform	Can describe the expression of the Laplace transform. Can calculate the inverse Laplace transform based on partial fraction decomposition or completing the square.
		3rd	Calculation of transient response	Can derive step responses, impulse responses, etc. using the inverse Laplace transform. Understand the meaning of convolute integrals, and can describe their expressions.
		4th	Polygonal line approximation of a Bode plot 1	Can draw a Bode plot (gain plot) line for a system with a transfer function consisting of the product of the primary element.
		5th	Polygonal line approximation of a Bode plot 1	Can determine a transfer function from the polygonal line approximation of a Bode plot (gain plot)for a system with a transfer function composed of the product of the primary element.
		6th	Stability margins	Can explain a stability margin. Can explain where a stability margin is indicated in the frequency response.
		7th	Review	Review the content of classes in the first half of the semester.
		8th	Midterm exam	
	2nd Quarter	9th	Internal stability, and Hurwitz stability criterion method	Can explain the concepts of external and internal stability and the conditions under which they match. Can determine the stability using Hurwitz stability criterion method
		10th	Routh stability criterion method	Can determine the stability, including special cases, using Routh stability criterion method,.
		11th	PID control	Can explain I/O characteristics of PID controllers (transfer function). Can explain the effect of P action. Can explain the effect of I action. Can explain the effect of D action..
		12th	How to design PID control systems	Can determine PID gain using the ultimate sensitivity method. Can determine the PID gain using the step response method.
		13th	Discretization of the model	Can derive a discrete time model by differentiating the differential equations. Can find a solution of a differential equation, and derive a discrete time model using it.
		14th	Control system design simulation exercise	Can explain how to simulate the response of a control system by discretizing the model of the control target and the control device.
		15th	Review	Review the content of classes in the second half of the semester.
		16th	Final exam	

Evaluation Method and Weight (%)

	Examination	Exercise	Total
Subtotal	80	20	100
Basic Proficiency	0	0	0
Specialized Proficiency	80	20	100
Cross Area Proficiency	0	0	0