Course Title	Linear System Theory	Course Code	ELEC731001	Credits	3-3-0
Department		Term and Year	20192	Course Categories	Major
Instructor	Hur Sung ho	Class Hours	Wed.6A6B Wed.7A7B Wed.8A8B	Classroom	IT 대학 1 호관(공대 10 호관)613 IT 대학 1 호관(공대 10 호관)613 IT 대학 1 호관(공대 10 호관)613
Phone / E-mail	** 통합정보시스템 로그인- 수업/성적- 수업-"강의담당교수조회"에서 확인 가능함.			Classroom Language	English
Office & Office Hours	After class and by appointment at other times				
Educational Objectives	Fostering creative Glocal Leaders capable of directing future innovations of IT engineering and associate industries				

[Syllabus]

Course Outline

- The objective of this course is to provide the students with the basics of linear systems theory and modern control engineering.

- The topics covered include linear algebra, state-space representations, stability analysis, controllability/observability, and state feedback control and estimations.

- We will also investigate the application of state-space methods and state feedback control to various engineering systems.

Core Competencies

Innovativeness		Reflection		Character	
Creativity ☐	Convergence ☐	Critical Thinking ☐	Exploration ☐	Communication ☐	Responsibility ☐

Course Objectives

Competencies	Course Objectives	Representative Competence
Exploration	Learn the Basics of Linear Systems	☑

Prerequisites

Automatic Control (recommended but not compulsory)

Recommended Subsequent Courses

Nonlinear System

Grading Scale(100%)

Attendance	Midterm Exam	Final Exam	Assignment	Presentation	Discussion	Others
10%	35%	35%	20%	0%	0%	0%

Evaluation Methods

- Midterm exam: 35%

- Final exam (or Term project): 35%

- Homework: 20%

- Attendance: 10%

Total: 100%

Textbook and Other References

- Textbook:

Chi-Tsong Chen, Linear System Theory and Design, (3rd or 4th) Edition, Oxford University Press.

- References:

N. S. Nise, Control Systems Engineering (5th ed.), Wiley, 2008.

R. L. Williams II and D. A. Lawrence, Linear State-Space Control Systems, Wiley, 2007.

W. J. Rugh, Linear System Theory (2nd ed.), Prentice Hall, 1996.

Notice to Students

The students should be familiar with the notion of automatic control, electronic circuits, and signals and systems theory.

Support Available for Disabled Students

A. Hearing Impaired : first row priority seating, Class transcripts may also be provided.

B. Developmentally Challenged : Extended Test Period

C. Brain lesions : Extended Test Period, Class transcripts may also be provided

D. Visually Impaired : Larger Font test will be provided

Other : Aid offered dependant on specific disabilities

※ Support Center for Disabled Students 053-950-7697, support@knu.ac.kr

[Course Content and Schedule]

no	Unit Goals and Learning Content	Teaching Methods	Assignments and Research Questions	비고
1	Introduction - Introduction - Overview	Ch. 1		
2	Review of automatic control - Transfer function - Stability	Ch. 1		

	- Root locus - Frequency response			
3	Mathematical Descriptions of Systems I - Introduction - Causality, Lumpedness, and Time-Invariance - Linear Time-Invariant (LTI) Systems - Linear Time-Varying Systems - RLC circuits--Comparisons of Various Description	Ch. 2		
4	Mathematical Descriptions of Systems II - Mechanical and Hydraulic Systems - Proper Rational Transfer Functions - Discrete-Time Linear Time-Invariant Systems	Ch. 2		
5	Linear Algebra I - Introduction - Basis, Representation, and Orthonormalization - Linear Algebraic Equations - Similarity Transformation - Diagonal Form and Jordan Form	Ch. 3		
6	Linear Algebra II - Functions of a Square Matrix - . Lyapunov Equation - Some Useful Formula - Quadratic Form and Positive Definiteness - Singular Value Decomposition - Norms of Matrices	Ch. 3		
7	State-Space Solutions and Realizations - Introduction - General Solution of CT LTI State-Space Equations - Computer Computation of CT State-Space Equations - Equivalent State Equations - Realizations - Solution of Linear Time-Varying (LTV) Equations	Ch. 4		

	- Equivalent Time-Varying Equations - Time-Varying Realizations			
8	Midterm exam	Ch. 1-4		
9	Stability - Introduction - Input-Output Stability of LTI Systems - Discrete-Time Case - Internal Stability - Lyapunov Theorem - Stability of LTV Systems	Ch. 5		
10	Controllability and Observability I - Introduction - Controllability - Observability - Canonical Decomposition	Ch. 6		
11	Controllability and Observability II - Conditions in Jordan-Form Equations - Discrete-Time State-Space Equations - Controllability After Sampling - LTV State-Space Equations	Ch. 6		
12	Minimal Realizations and Coprime Fractions - Introduction - Implications of Coprimeness - Computing Coprime Fractions - Balanced Realization - Realizations from Markov Parameters - Degree of Transfer Matrices - Minimal Realizations- Matrix Case - Matrix Polynomial Fractions - Realization from Matrix Coprime	Ch. 7		
13	State Feedback and State Estimators - Introduction - State Feedback - Regulation and Tracking - State Estimator - Feedback from Estimated States - State feedback--MIMO case - State Estimators--MIMO case	Ch. 8		

	- Feedback from Estimated States--MIMO Case			
14	Pole Placement and Model Matching - Introduction - Preliminary--Matching Coefficients - Unity-Feedback Configuration-Pole Placement - Implementable Transfer Functions - MIMO Unity Feedback Systems - MIMO Model Matching--Two-Parameter Configuration	Ch. 9		
15	Final exam	Ch. 5-9		

[Course Evaluation]

Categories	Questions	Note
Self-Rating	1.I participated actively in the course. 2.I have made a lot of effort while taking the course.	
Standard Questions	3.The course syllabus contained the detailed information about the operation of the course. 4.The professor ran the course according to the course syllabus. 5.The professor clearly stated the course plan in the first class. 6.The professor stated objectives of each lecture clearly and explicitly. 7.The professor stimulated my interest in the field. 8.The professor had expertise on the course contents. 9.The professor delivered the class contents adapting to student abilities and learning levels. 10.The professor used various teaching methods considering course contents. 11.The professor encouraged students to ask questions, and responded properly. 12.The professor gave assignments to deepen the course contents. 13.The professor provided meaningful and timely feedback on the students performances. 14.Overall, I would like to recommend this lecture to other students. 15.The course helped me to develop [the representative competency].	
Course Specific Questions	E-1. The course was taught in English. (5: over 80%, 4: over 60%, 3: 40-60%, 2: 20-40%, 1: under 20%) E-2. The course increased my English competency in the field.	

Cheating, plagiarism, and other dishonest practices will be punished as harshly as Kyungpook National University policies allow. The University specifies that cheating is grounds for dismissal. Penalties less severe may be imposed instead. A list of possible disciplinary actions is given below. Actions by the university:

- Failure in course

- Suspension from university for a designated period

- Expulsion from university