# 기계항공시스템해석 System Dynamics/System Analysis

Spring 2014

Professor Kyongsu Yi ©2014 VDCL

Vehicle Dynamics Control Laboratory Department of Mechanical and Aerospace Engineering Seoul National University

### **Introduction**



Instructor: Professor Kyongsu Yi

301-1502

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http://vdcl.snu.ac.kr

Lectures: Mo/We 12:30-13:45 @301-303

Office hours: We 13:45 to 14:45 or by appointment

#### **References:**

- 1. System Dynamics, 2nd Ed., William J. Palm III, McGraw Hill, 2010. 2. System Dynamics, 4th Ed., K. Ogata, Pearson/Prentice Hall, 2004. 2. 동적시스템 및 제어공학, 김종식, 청문각
- Objective: To provide basic concepts, an overview of dynamic system, modeling, analysis methods and applications to engineering systems Mathematical model, analysis in the frequency and time domains and prediction of the dynamics of systems



Grading:	Midterm Exam 30%, Final exam 45% Homework 15%, Class attendance 10% (과제 제출일에 과제관련 10 minutes 퀴즈/ 퀴즈 성적으로 10%반영) Students absent in a class without instructor's permission prior to the class would be failed.
Homework:	Students will turn in before the end of the class on the due date. Late homework will not be accepted.
	All homework assignments are to be completed on your own.
	You are allowed to consult with other students during
	the conceptualization of a problem but all written and
	programming work are to be generated by yourself.

#### 수강생참고사항

1. 과제는 제출기일 수업시간에 제출해야함

2. 강의에 참석하지 못하는 경우 담당교수에게 사전 사유서 제출해야함. 사전에 사유서를 제출하지 못하는 사정이 있는 경우는 사후에 사유서를 제출하는 것도 인정함. 사유서 제출없이 수업 결석한 경우 -5

- 3. 강의 계획은 수업 진행 상황에 따라 변경될 수 있음
- 4. ETL 사용 장려함 (<u>http://etl.snu.ac.kr</u>)
  - Homework 공고
  - 강의 자료 제공 (Not Complete)
  - 질의 응답
  - TA 문의사항

	주(기간)	강의내용
-	1주	Course overview, Key Concepts, Terminology, System dynamics, system analysis, design, synthesis
	2주	Laplace Transformation, LT Theorems
	3주	Mathematical Modeling of Dynamic Systems, mechanical systems, Friction, work, energy, and power
	4주	Transfer Function Approach to Modeling Dynamic Systems
	5주	State space Approach to Modeling Dynamic Systems, state equation and transfer function, vehicle systems
	6주	Electrical and electromechanical systems: Electrical elements, Circuit Examples
	7주	Electric motors, Motor systems, analysis of motor performance
강의 계획	8주	Power dissipation, mechanical output power, Electric vehicle, Midterm Exam,
9주	9주	Fluid Systems and Thermal Systems: Liquid level systems, thermal systems
	10주	Hydraulic systems, Dynamic models of hydraulic systems
	11주	Time Domain Analysis of Dynamic Systems, First order/second order systems, Transient analysis
	12주	Solution of state equation, system ith additional poles and zeros, Analysis with MATLAB
-	13주	Frequency Domain Analyses of Dynamic Systems: Bode plots
	14주	Vibration absorber, suspension, seismograph and accelometers
	15주	6 Review and Final Examination

Exam : 75-minute midterm exam

on April 9 (we) 12:30-13:45

120-minute final exam

on June 11 (we) 12:30-14:30





### **Major Course Contents**

Part 1: Introduction

Introduction, Concepts, Terminology

Part 2: Laplace Transform

Laplace Transform

Part 3: *Modeling* 

Mathematical Model of Dynamic Systems

**Transfer Function Approach to Modeling Dynamic Systems** 

State space Approach to Modeling Dynamic Systems

**Electrical Systems** 

hydraulic systems, Fluid Systems and Thermal Systems

### **Major Course Contents (contd.)**

Part 4: Analysis

**Time Domain Analysis of Dynamic Systems** 

First Order / Second Order Systems

**Transient Analysis** 

Analysis with MATLAB

**Frequency Domain Analysis of Dynamic Systems** 

Understanding the underlying physics and being able to construct models of dynamic systems to analyze (and,) predict (and control) engineering systems

## Systems

### Antenna azimuth position control system



### **Aircraft**



NASA x-29 forward swept wing aircraft Airbus A320

### **Unstable**



Figure 1. Gripen JAS39 prototype accident on 2 February 1989. The pilot received only minor injuries.

### Fluid power systems : excavators



### Wheel loader







#### **MAGLEV (Magnetic Levitation) Vehicle**



#### **MAGLEV (Magnetic Levitation) Vehicle**







### **Smart Cruise Control**

#### Adaptive Cruise Control with Stop & Go:

ACC S&G.







## Military Robot : 견마로봇 (Autonomous Vehicle)



### **Systems**

An aircraft

A head positioner for a computer hard disk

A vehicle

An engine/transmission/brake/ steering/ suspension systems

An electric rice cooker

An excavator

A room air conditioner

A refrigerator

Electric power plant

Robots

Chemical and Manufacturing Process Control: temperature; pressure; flow rate; concentration of a chemical; moisture contents; thickness.

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### End of Course overview