

FALL 2026 | MEE4033

Mechatronics

Mechatronics (MEE4033) · Department of Mechanical Engineering

Lecture 1

Introduction of Mechatronics

Sogang University · Department of Mechanical Engineering · Prof. Seokhwan Jeong

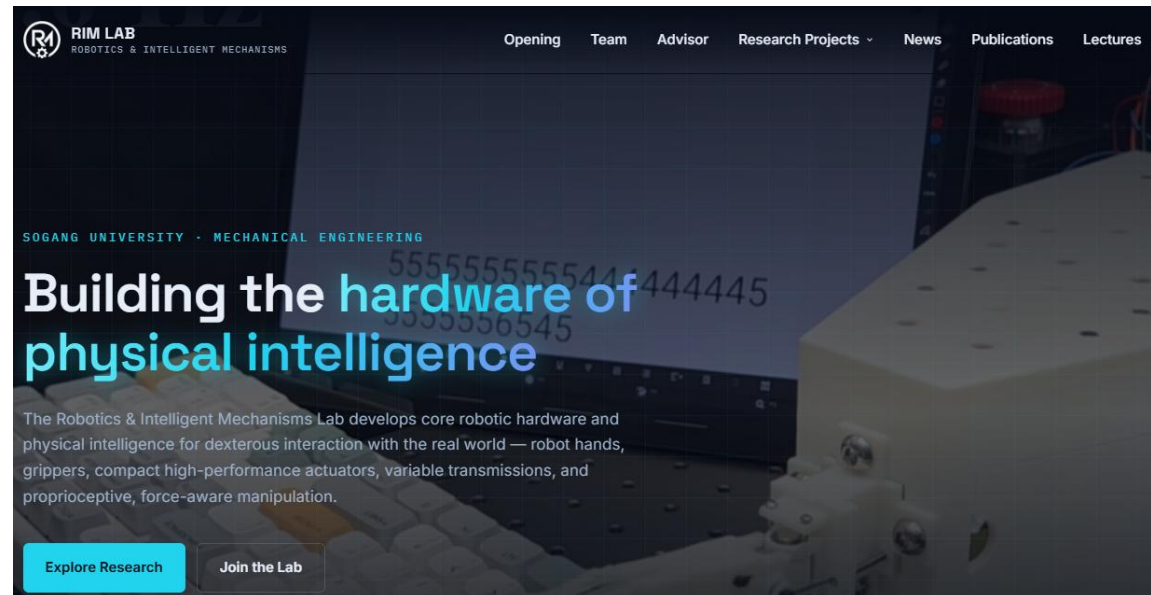
Course introduction

Name : Jeong, Seokhwan

Position : Associate Professor, Mechanical Engineering Dept. Sogang University

Office Hour:

- K236
- appointment by email
- Website: <https://rim.sogang.ac.kr/>



Course introduction

Main Textbook

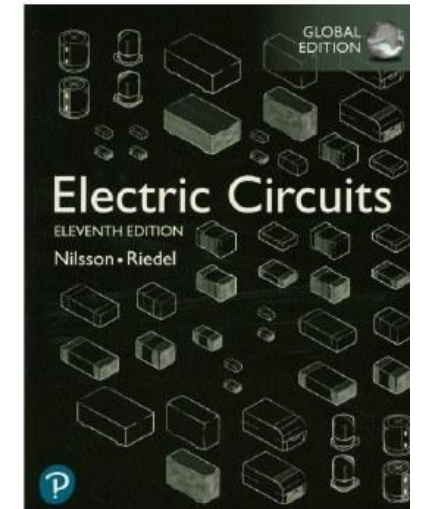
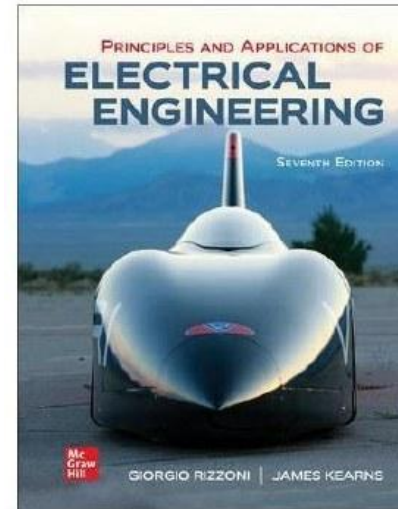
- ✓ ISE Principles and Applications of Electrical Engineering, 7/E, McGraw-Hill Education

Sub Textbook

- ✓ 1) Electric Circuits 11th edition, James W. Nilsson, Susan Riedel, Pearson Education
- ✓ 2) Microelectronic Circuits, 8 ed, Adel S. Sedra, Kenneth C. (KC) Smith, Tony Chan Carusone, Vincent Gaudet, Oxford University Press
- ✓ 3) Feedback Control of Dynamic Systems, Global Edition (Paperback, 8 ed), Gene F. Franklin, J. David Powell, Abbas Emami-Naeini, Pearson Education Limited
- ✓ 4) Mechatronics with Experiments, Sabri Cetinkunt, Wiley
- ✓ 5) Motor Control (모터제어), 3rd ed.

Course Grade

- ✓ Midterm exam 25%
- ✓ Final exam 25%
- ✓ Report 25%
- ✓ Project 25%



Course introduction

TA

- ✓ Kwon, Hyukjun
- ✓ Contact info: <https://rim.sogang.ac.kr> → Team → Email
- ✓ RA313

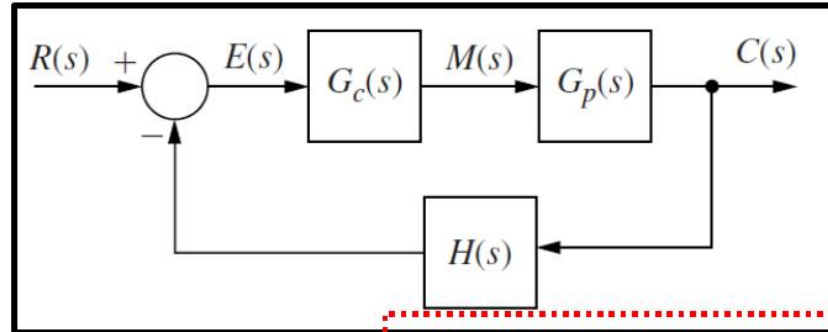
Attendance and grade of exams/reports related inquiry

Course introduction

Week	Contents
Week1	Introduction to Mechatronic Systems
Week2	Signal Acquisition / Measurement
Week3	Basics of Circuits and Electronics
Week4	Diodes, Transistors (BJT)
Week5	Transistors (MOSFET)
Week6	Analog Circuits 1 – Passive Filter
Week7	Analog Circuits 2 – Operational Amplifier
Week8	Midterm Exam
Week9	Active Filter & Digital System Control 1
Week10	Digital System Control 2
Week11	Encoder-based Feedback Control
Week12	Motor Dynamics
Week13	Motor Feedback Control Implementation
Week14	Case Study
Week15	Project Presentation
Week16	Final Exam

Final Goal of this lecture

System (controller) design in continuous domain



Programming - Digital

```
#include <stdio.h>

int main()
{
    printf("Hello world! \n");
    return 0;
}
```

Implementation

Microcontrollers



Arduino Series

Source: <https://www.arduino.cc/>



Ti MCU series

Source: <https://www.ti.com/>



Sensors



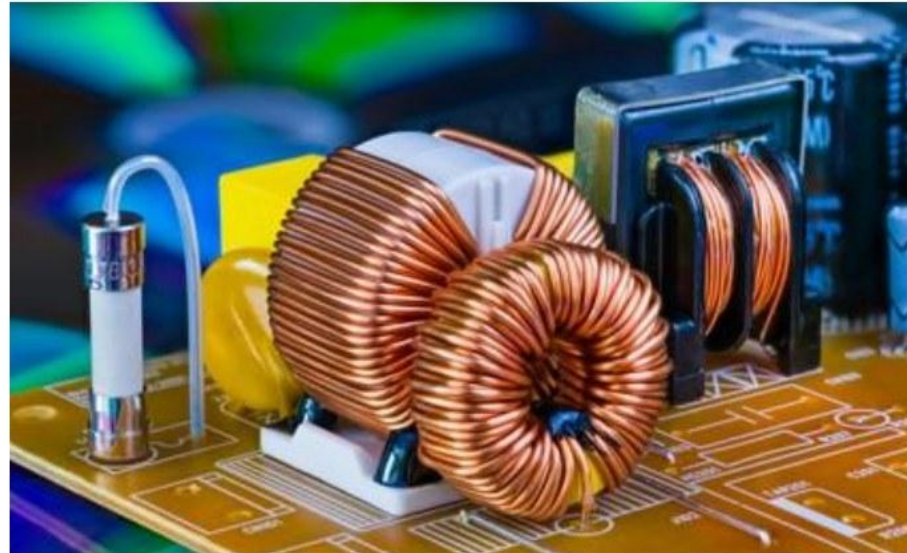
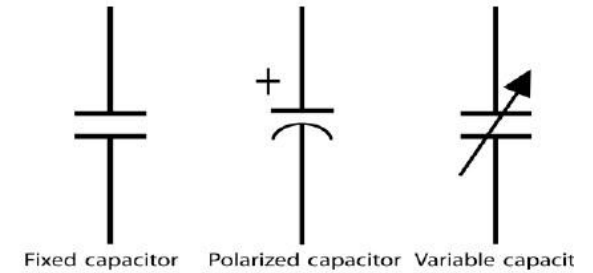
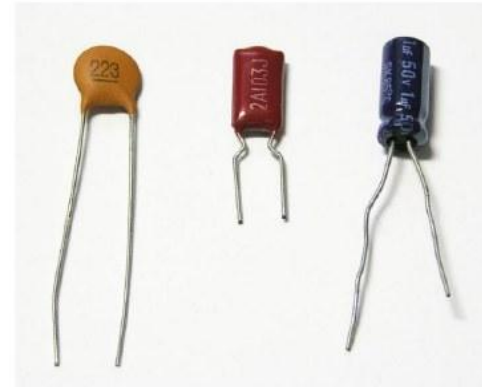
Actuators



Source: <https://www.bostondynamics.com/>

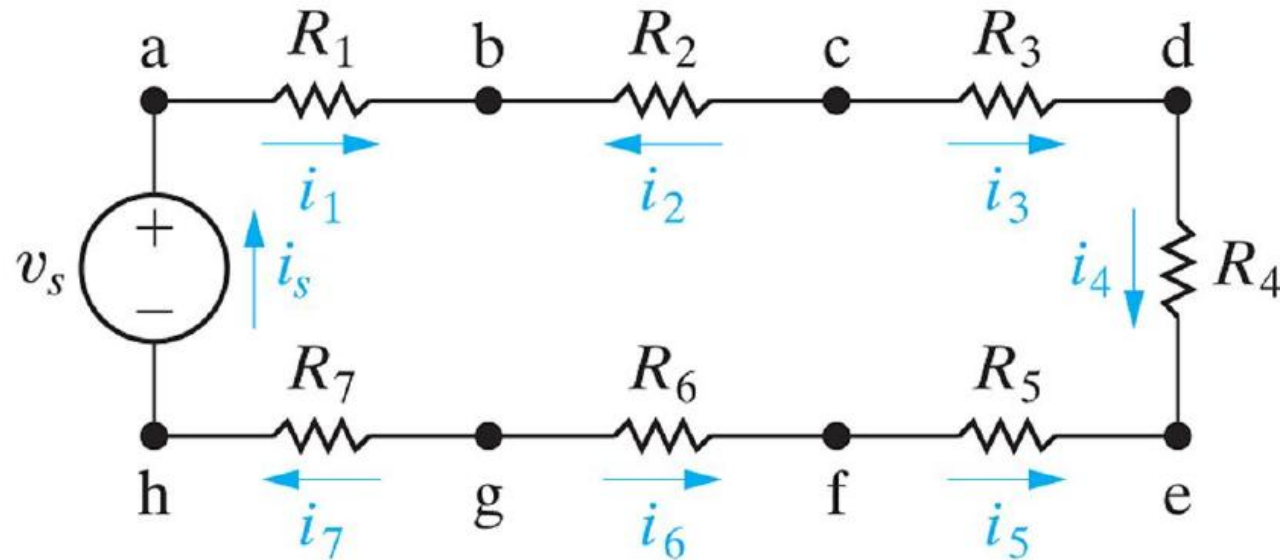
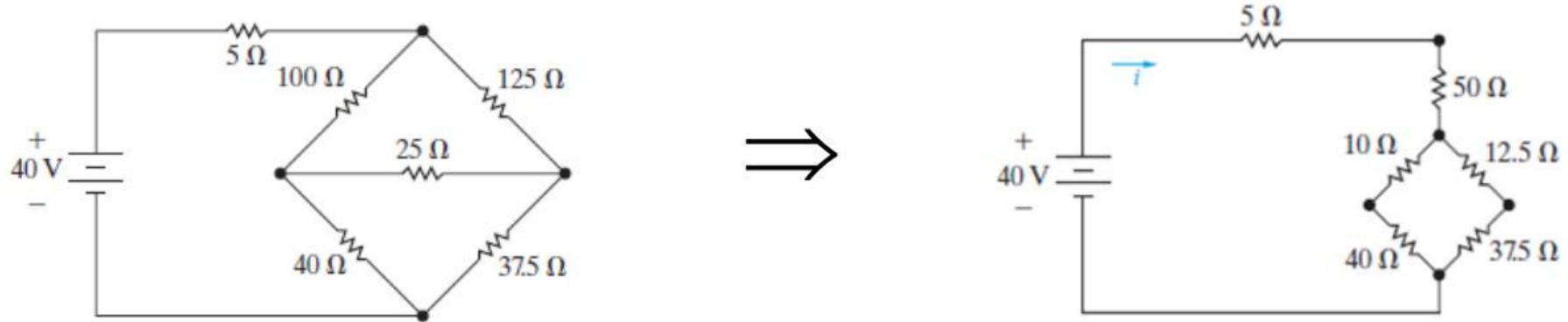
Actuation

Passive Electric components



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Passive Electric components



Circuits

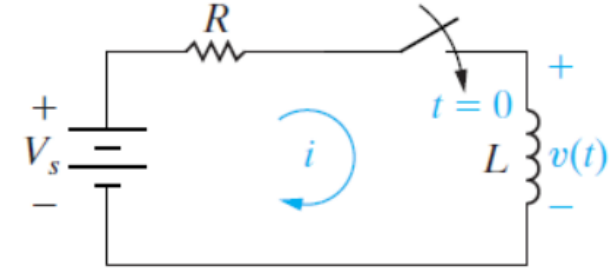
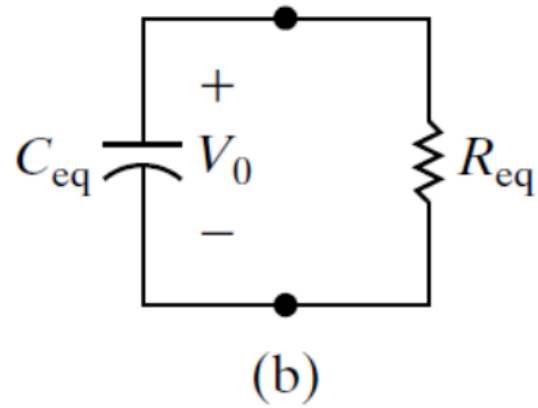
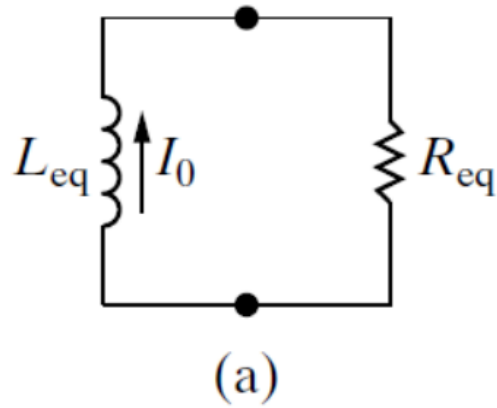


Figure 7.16 ▲ A circuit used to illustrate the step response of a first-order RL circuit.

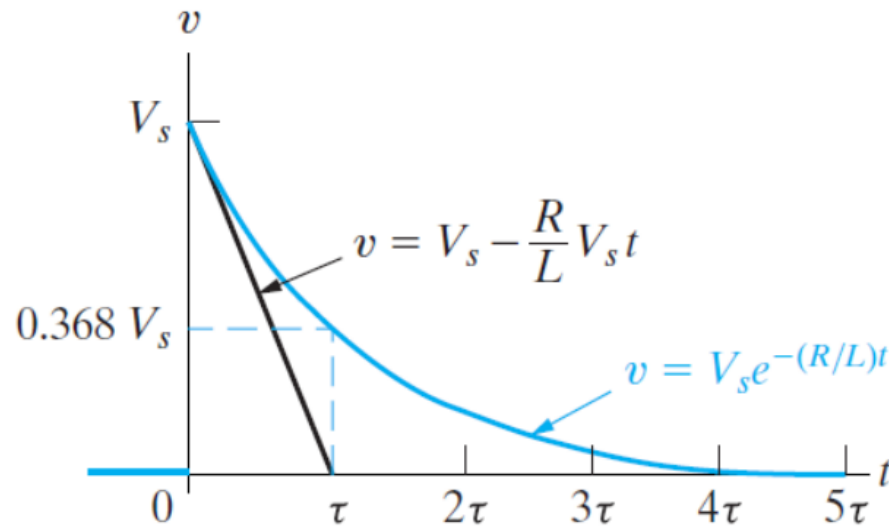
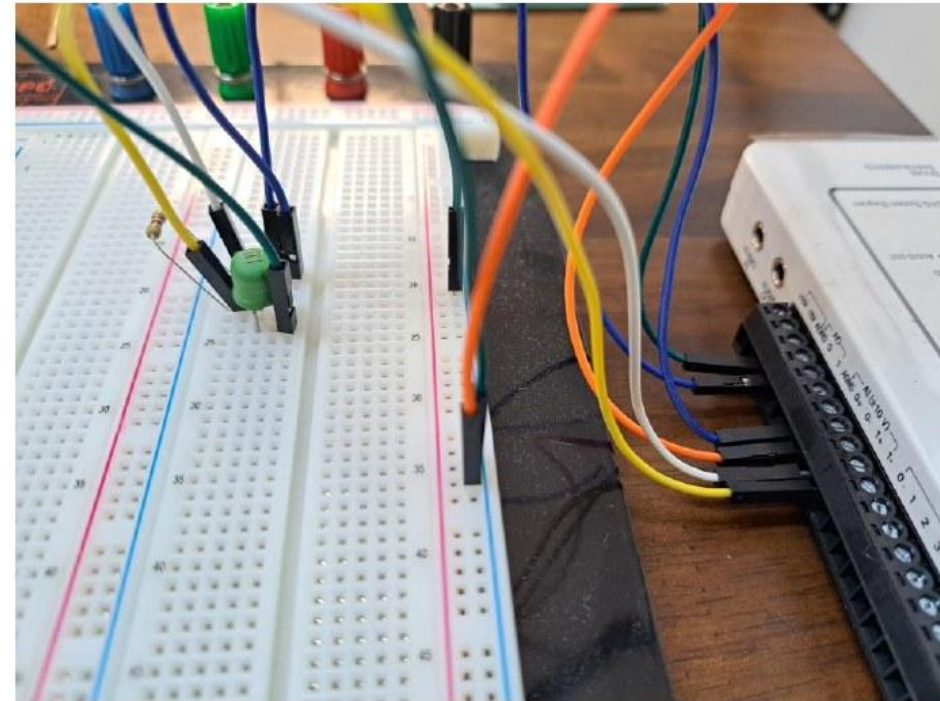
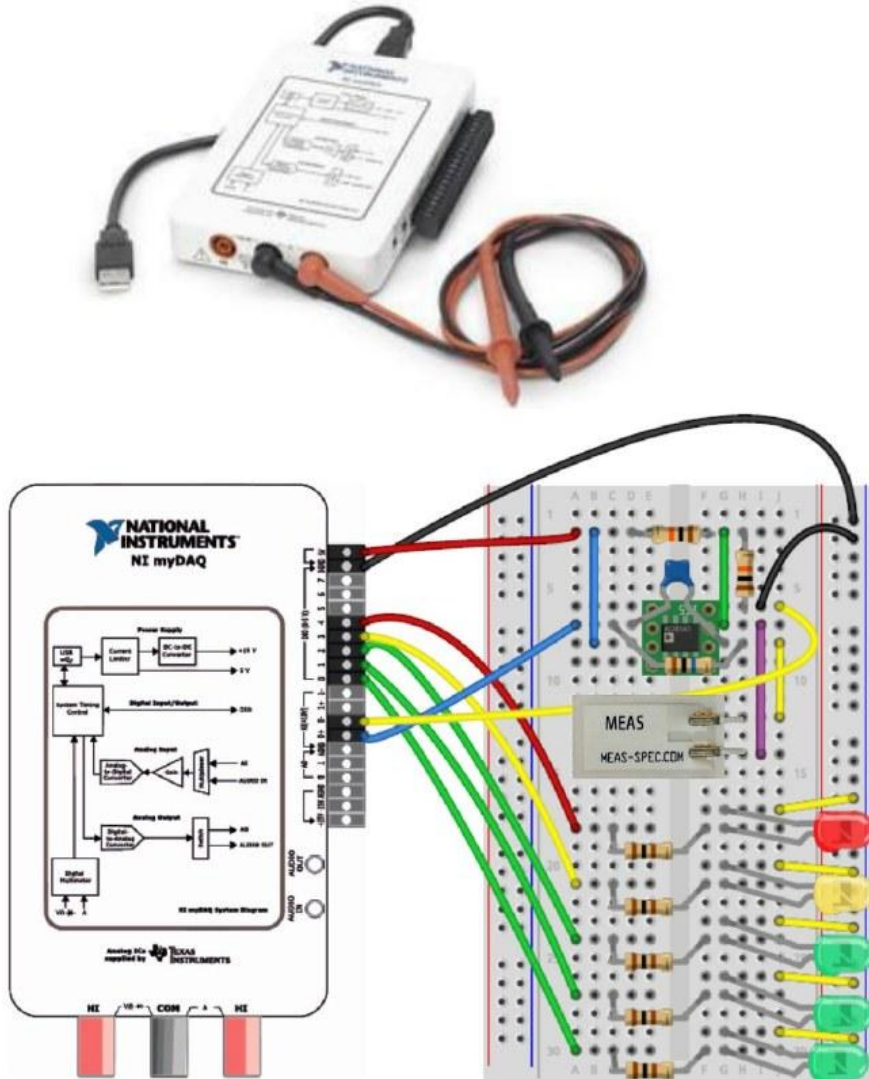


Figure 7.18 ▲ Inductor voltage versus time.

Signal Acquisition

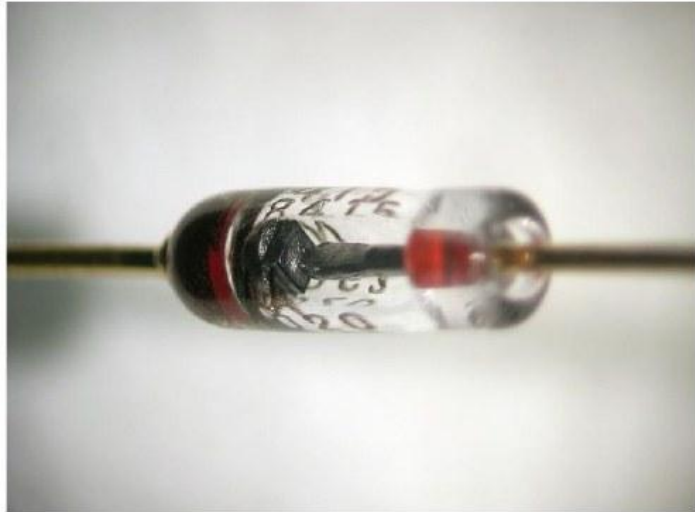


Signal Acquisition

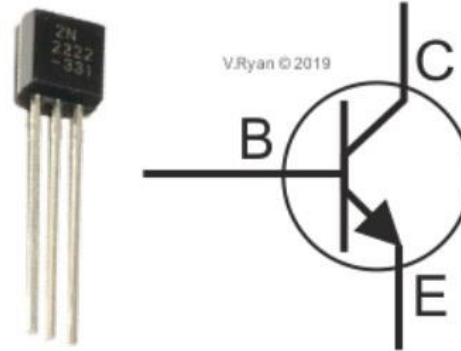
<https://youtu.be/KfOoxitcplc>



Active Electric components



BJT
(bipolar junction transistor)



FET
(Field-Effect Transistors)

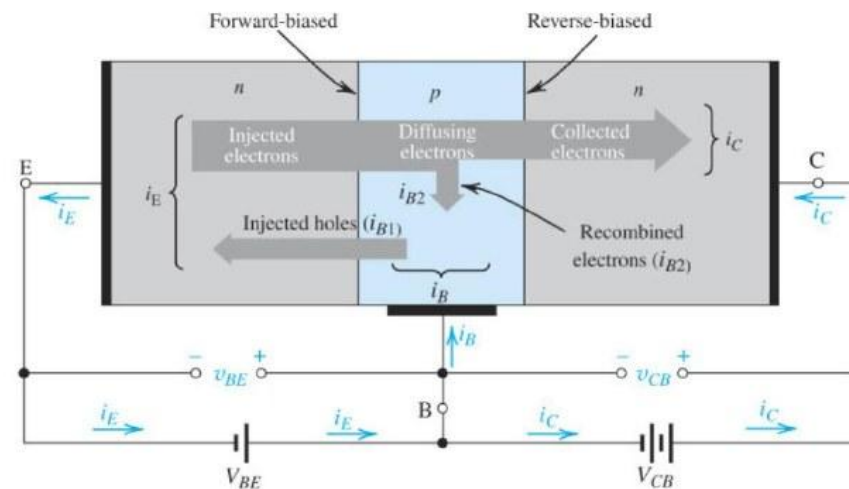
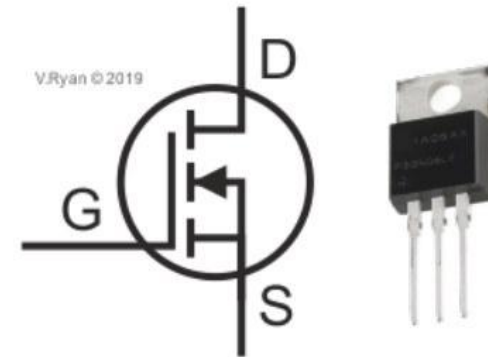
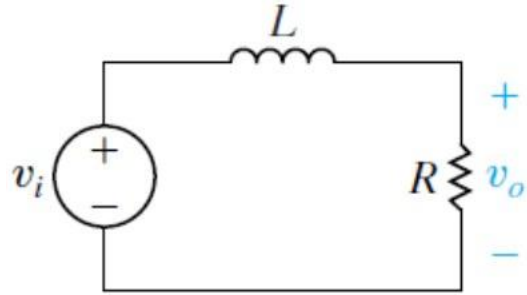
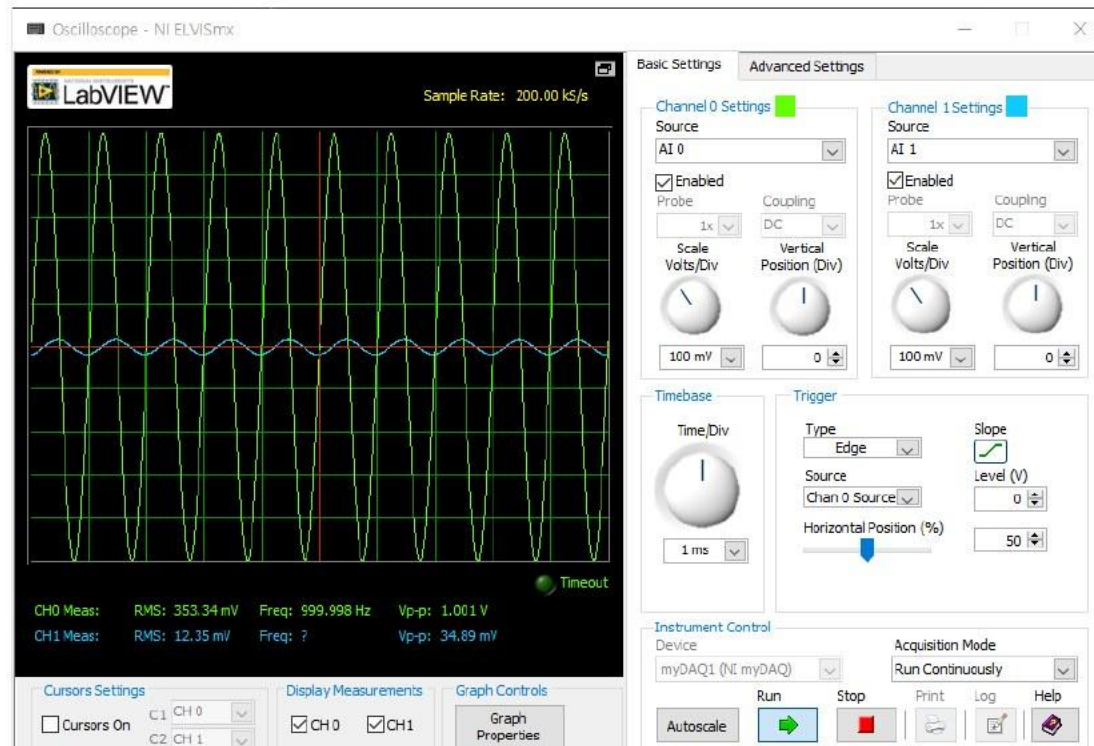


Figure 6.3 Simplified current flow in an npn transistor biased to operate in the active mode.

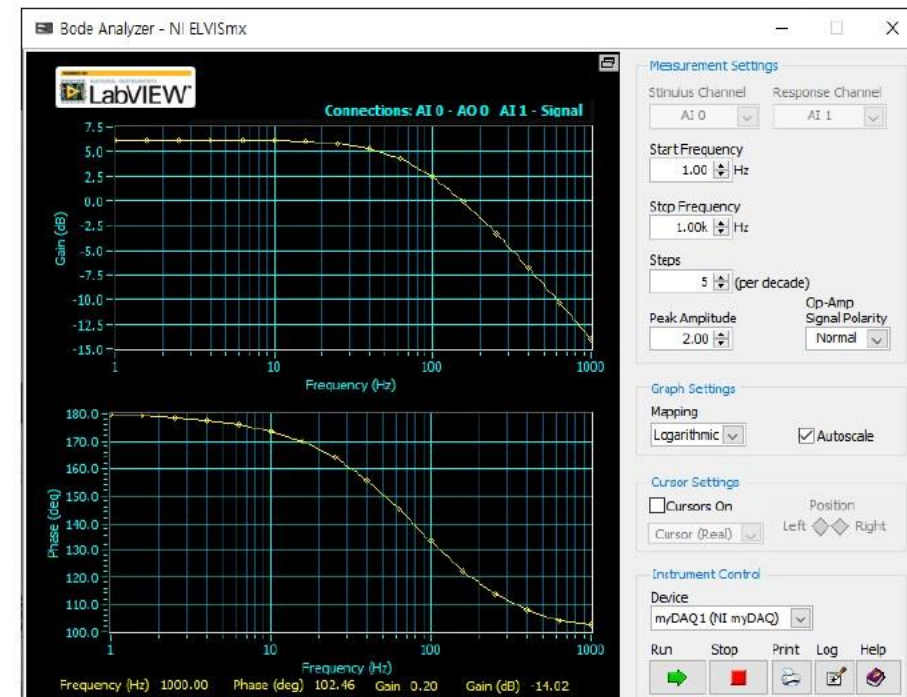
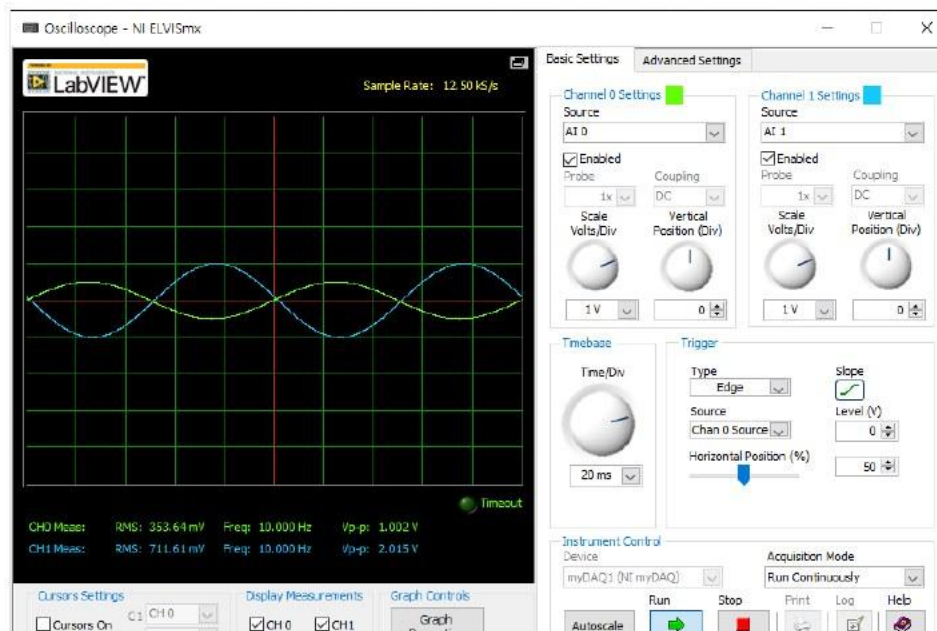
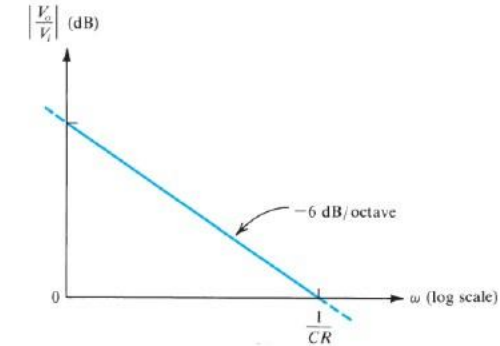
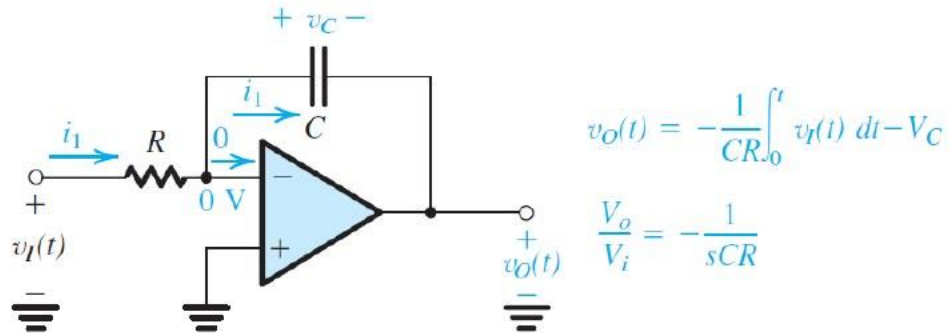
Passive Filter



$$H(s) = \frac{V_o}{V_i} = \frac{1}{s(L/R) + 1} = \frac{\omega_c}{s + \omega_c}$$



Active Filter



C programming in Mechanical Engineering

- Embedded Systems (Microcontroller/Microprocessor)

Ex) Arduino integrated development environment (IDE)



```
test | Arduino 1.8.12
File Edit Sketch Tools Help

test $

#include <Due_HRPWM.h>
#include <DigitalRW_Direct.h>

int Driver_Enable = 21;    //Motor Driv
int Encoder_1_A = 50;
int Encoder_1_B = 51;
int Encoder_2_A = 52;
int Encoder_2_B = 53;

int HA[2],HB[2],HC[2];
int HSP[2];
int HSPp[2];

int Dir[2];
long Enc_RAM[2] = {0,};
long Enc[2] = {0,};
```

Microcontrollers



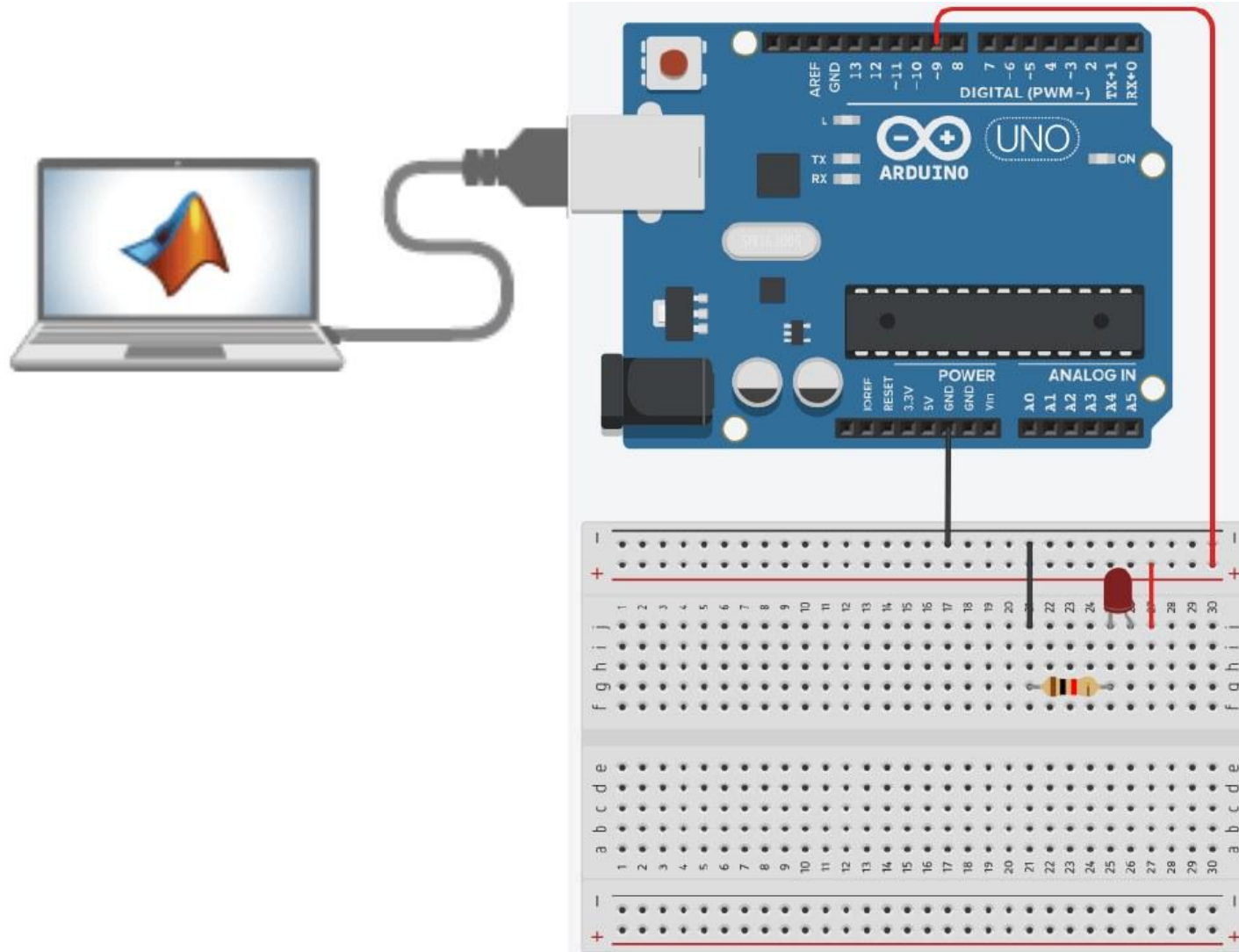
Arduino Series

Source: <https://www.arduino.cc/>



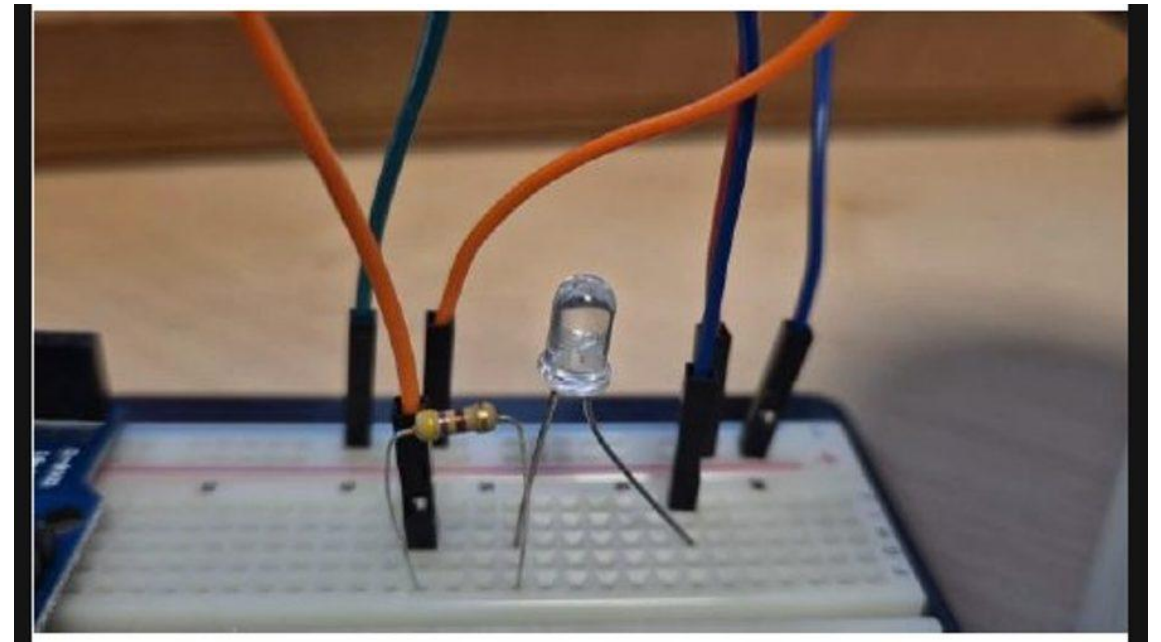
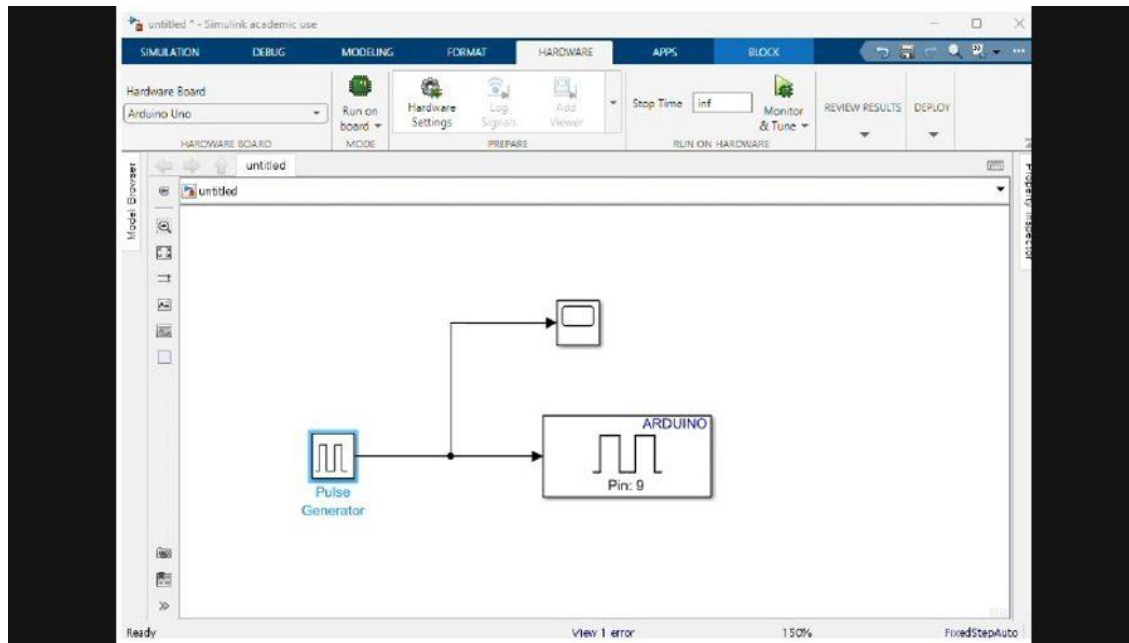
Ti MCU series

Arduino Support from MATLAB and Simulink

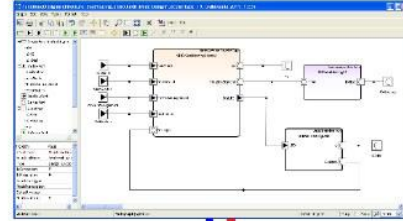


Arduino Support from MATLAB and Simulink

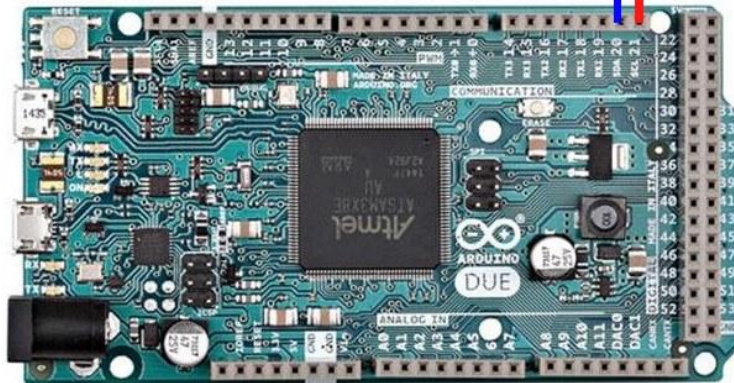
<https://youtu.be/ewaPMOjs9vE> <https://youtu.be/DrkNCGbYyW0>



Microcontrollers — Arduino Due / TI LaunchPad

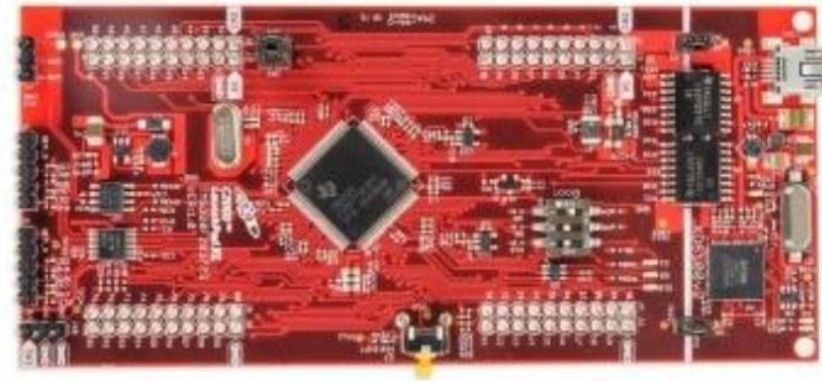


Arduino Due



- ARM Cortex-M3
- 84MHz
- Digital I/O pin 54 (PWM 12)
- Analog input 12
- Analog output 2
- Flash Memory 512 KB
- SRAM 96 KB

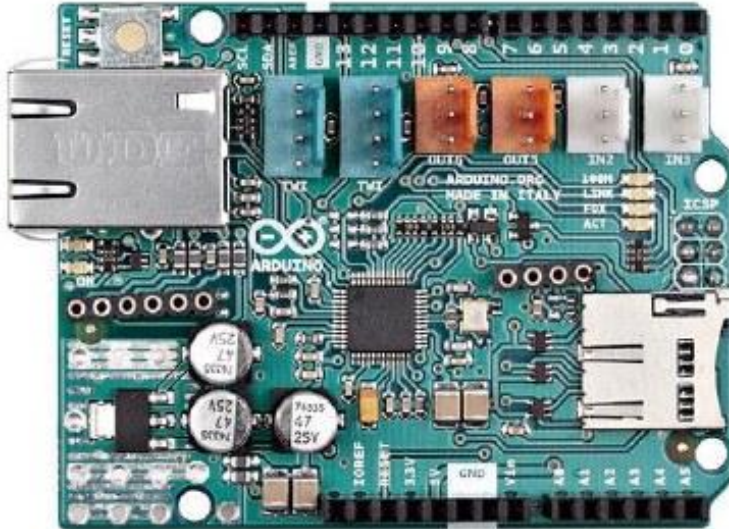
TI TMS320F28377S LaunchPad



- TI C2000 Delfino MCU
- 200MHz
- Digital I/O pin 46 (PWM 14)
- Analog input 16
- Analog output 4
- Flash Memory 1024 KB
- SRAM 164 KB

Arduino Ethernet Shield 2 / MAXON EPOS Module

Arduino Ethernet Shield 2



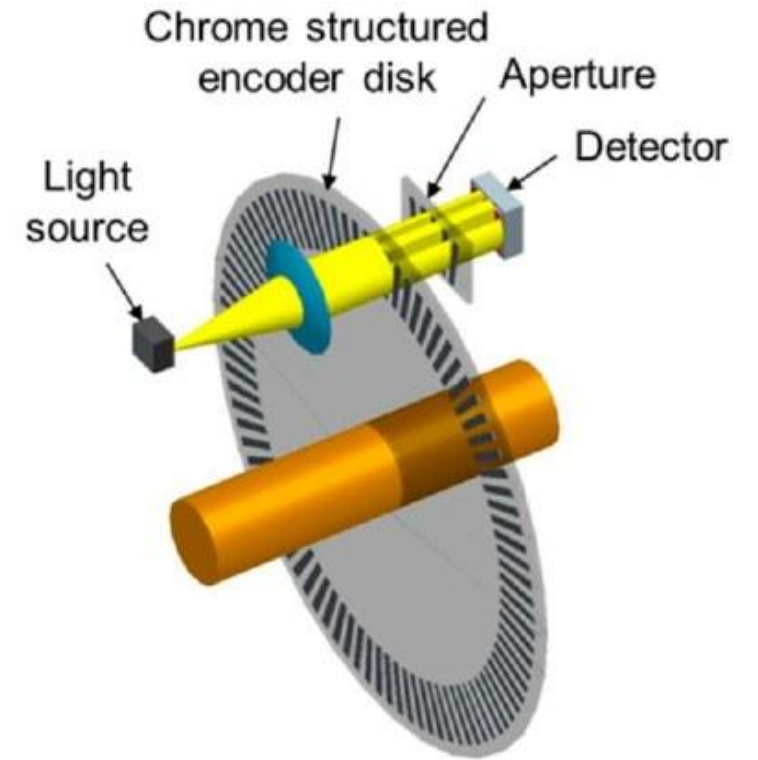
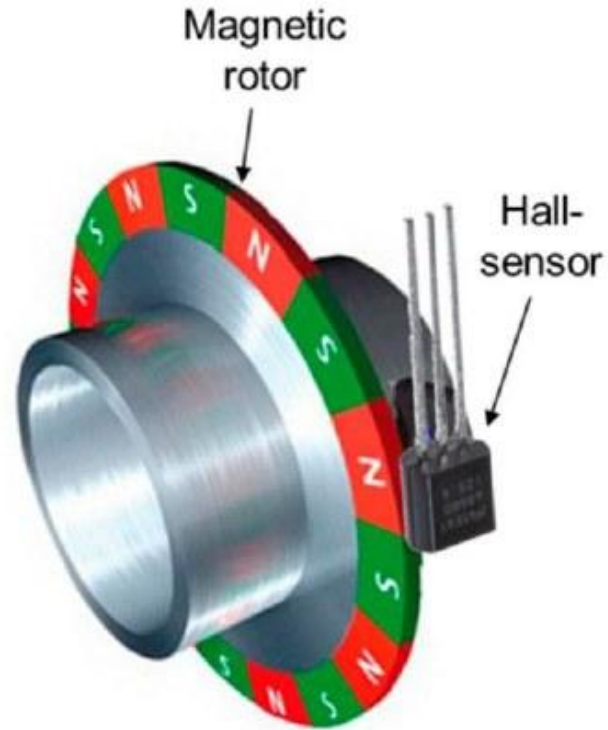
- WIZnet W5500
- Micro-SD
- Ethernet (TCP/IP, UDP)
- SPI

MAXON EPOS Module



- DC/BLDC
- Current/Speed controller
- Current 2A (Maximum 6A)

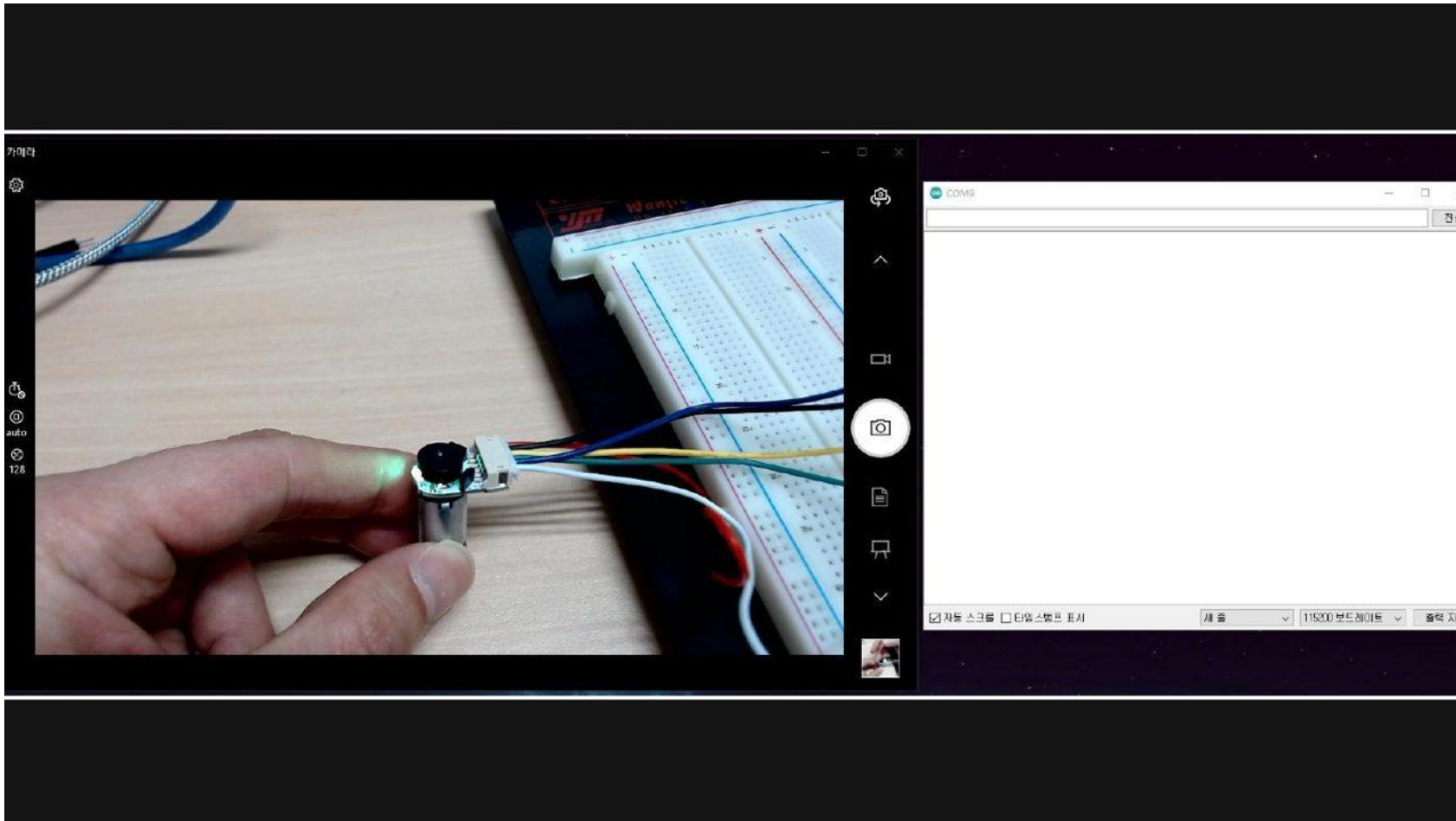
Sensors



Encoder

Sensors

<https://youtu.be/41Ser4ZQjy4>



Motor dynamics

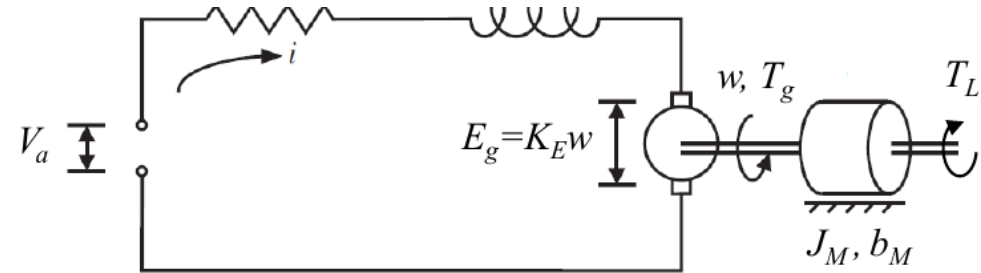
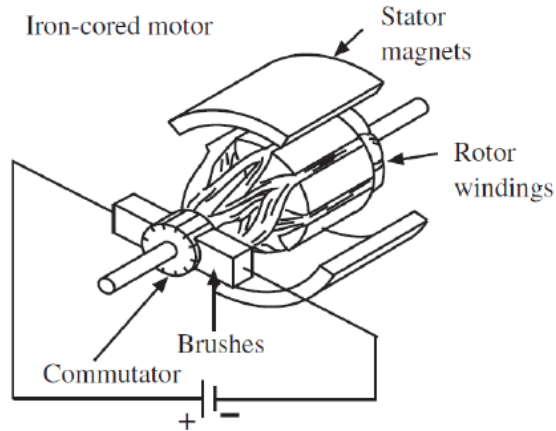
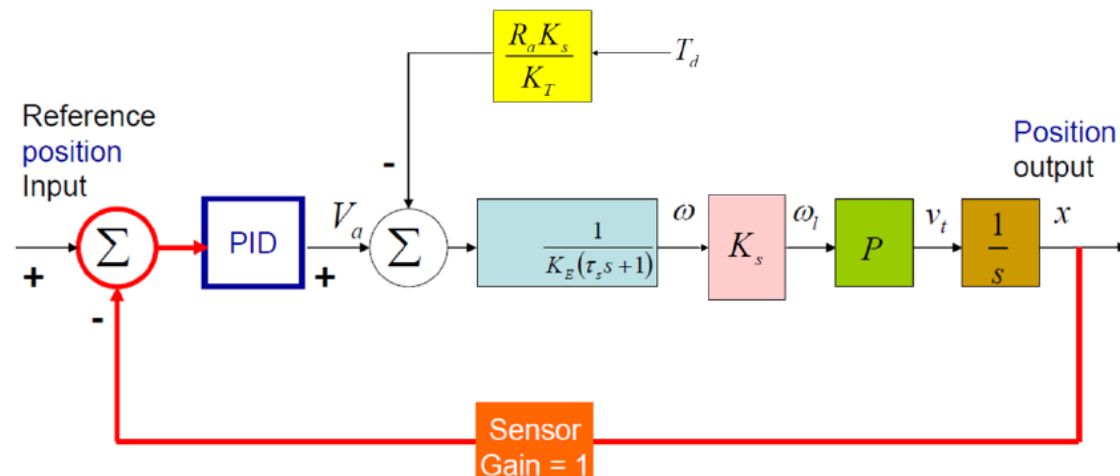
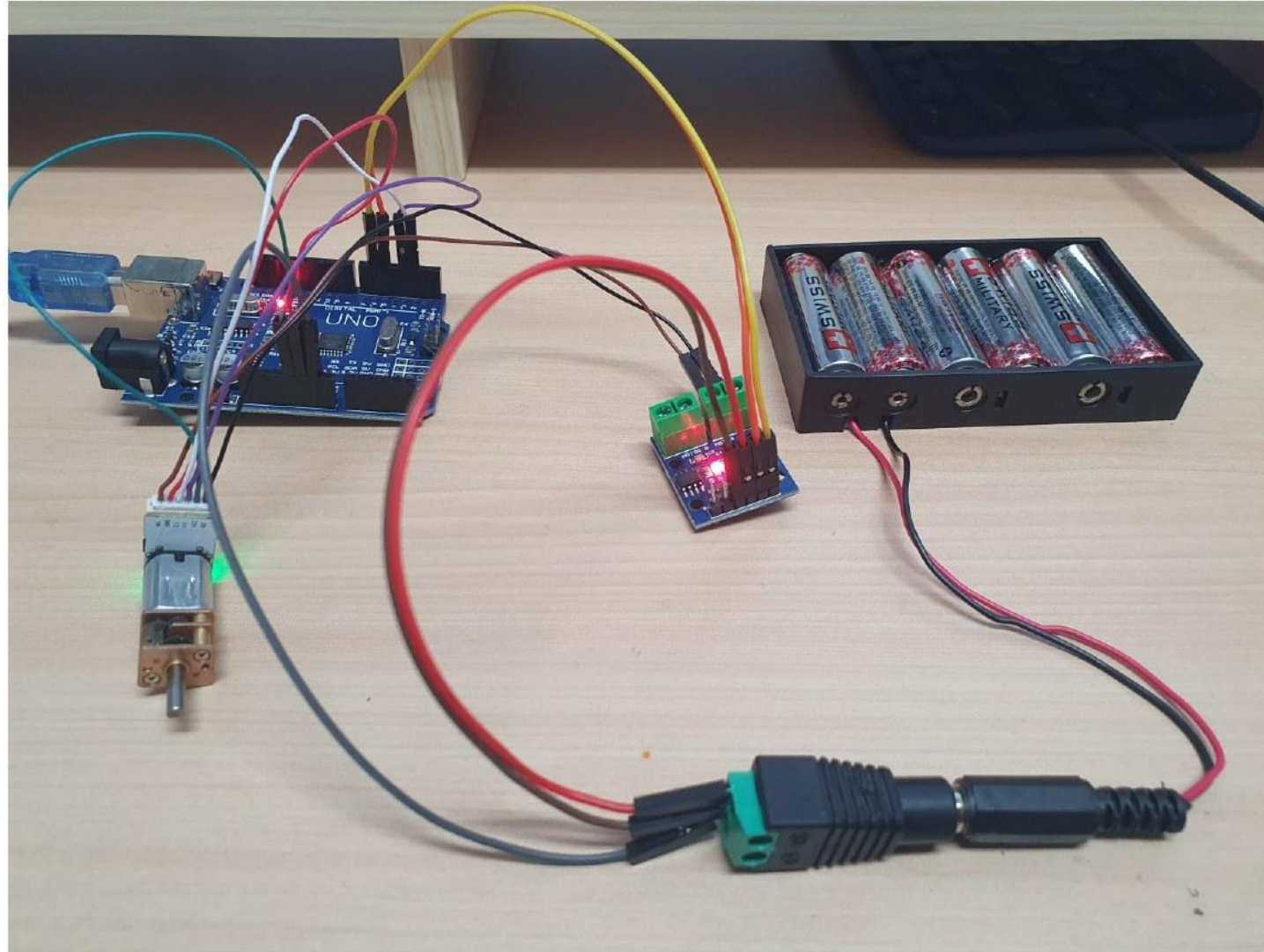


FIGURE 8.59: DC motor dynamic model.

$$T_g = J_M \frac{d\omega}{dt} + T_L + b_M \omega$$

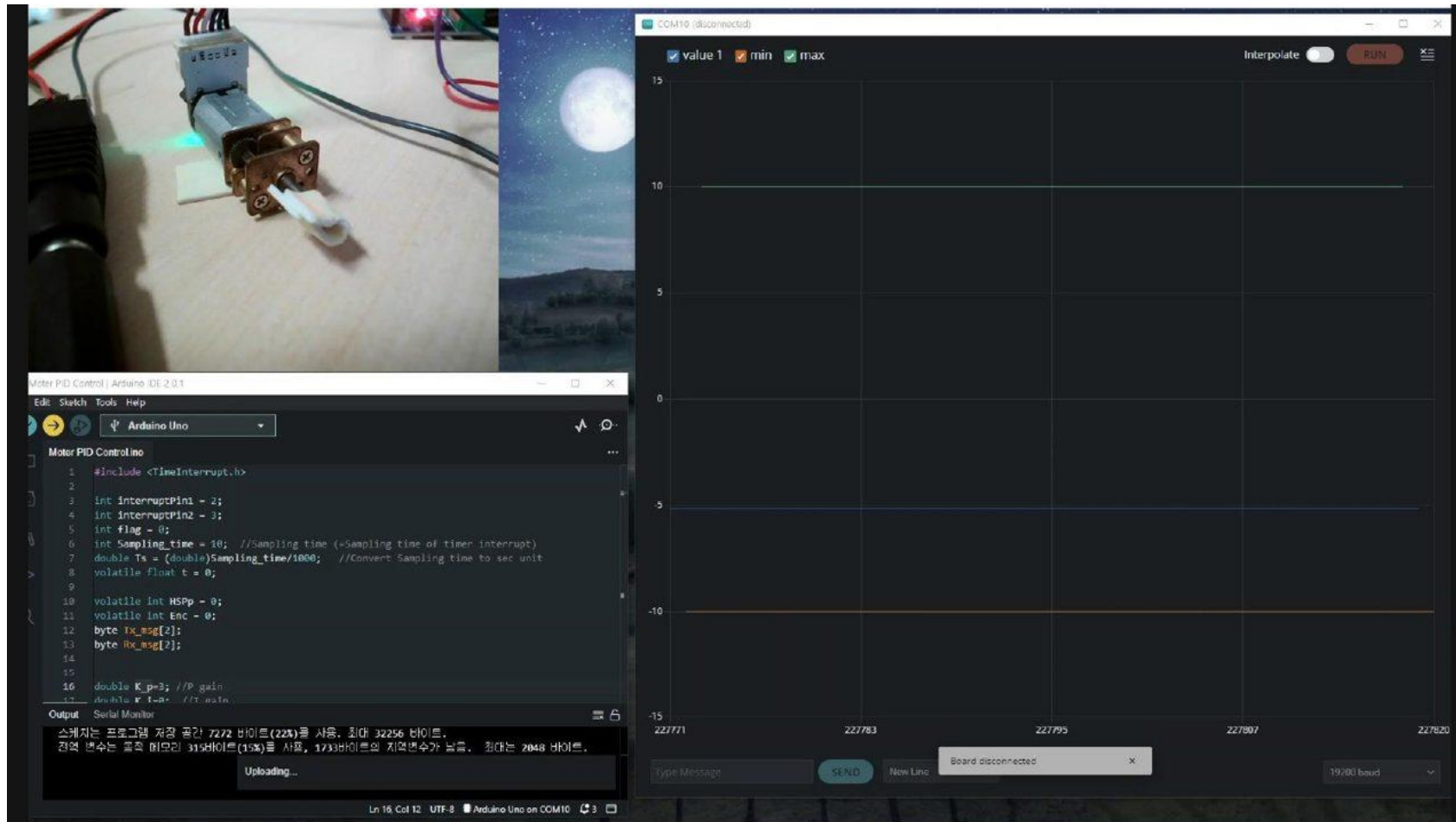


Final Goal of this lecture



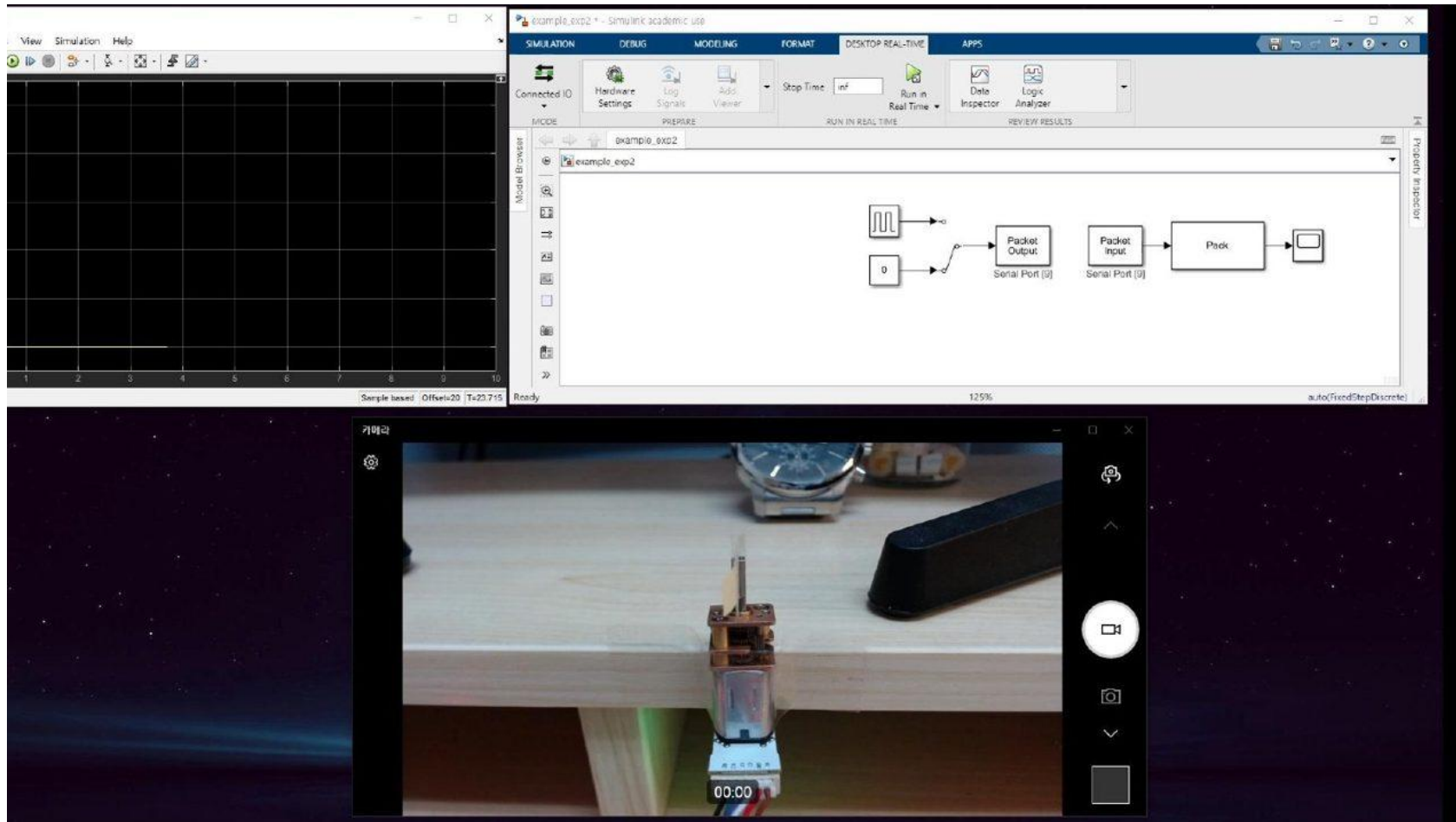
Final Goal of this lecture

<https://youtu.be/SChoWQsN2Uo>



Motor control

<https://youtu.be/ridV3BWROC4>



Project Kit & Components

Each student receives the following kit and components (used for Reports 1–7 and the Term Project).

Arduino Learning Kit × 1*

KitPlus KPK005 — intermediate kit (49 items)

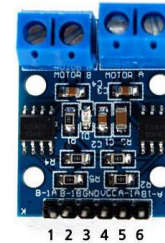


UNO R3 board + USB cable · 830-hole breadboard · jumper wires · resistor set · push buttons · LCD1602 · servo & stepper motor · ultrasonic, DHT11, light, tilt, sound sensors · 7-segment · 8×8 dot matrix · RGB LED · joystick · 4×4 keypad · buzzers · 9 V battery snap



DC Geared Motor × 1

DFRobot FIT0484, 6 V 105 RPM, encoder



Motor Driver × 1

L9110S dual H-bridge



JST-ZHR Cable × 1

6-pin, motor → breadboard



9 V Battery × 1

6F22, motor power



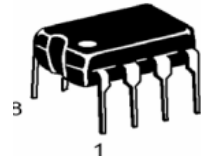
Inductor × 1

10 mH radial (Reports 1–2)



Capacitors × 3

0.1 μ F · 1 μ F film, 10 μ F elec.



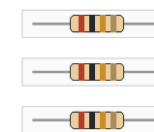
Dual Op-Amp × 2

LM2904N + DIP-8 socket × 2



10 k Ω Trimmer × 4

Tocos GF063P, filter tuning



Resistor Kit × 1

PP-K009, 30 values × 20 pcs

Loaned (return at end of semester): FLUKE-101 multimeter · NI myDAQ · DC barrel jack. * Students who already received the KPK005 kit in Mechanical Engineering Experiment are not given a second kit.

Included in the Learning Kit: breadboard, jumper wires, push buttons, 9 V battery snap, LEDs, and basic resistors — no separate purchase needed.



Term Project

- Video presentation: 12/9(Wed), 12/11(Fri)
- **Less than 3min Video**
- Submission due: 12/8, Upload it on Cybercampus by 23:59
- Subject:
 - Not limited
 - Needs to include the contents of this course