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

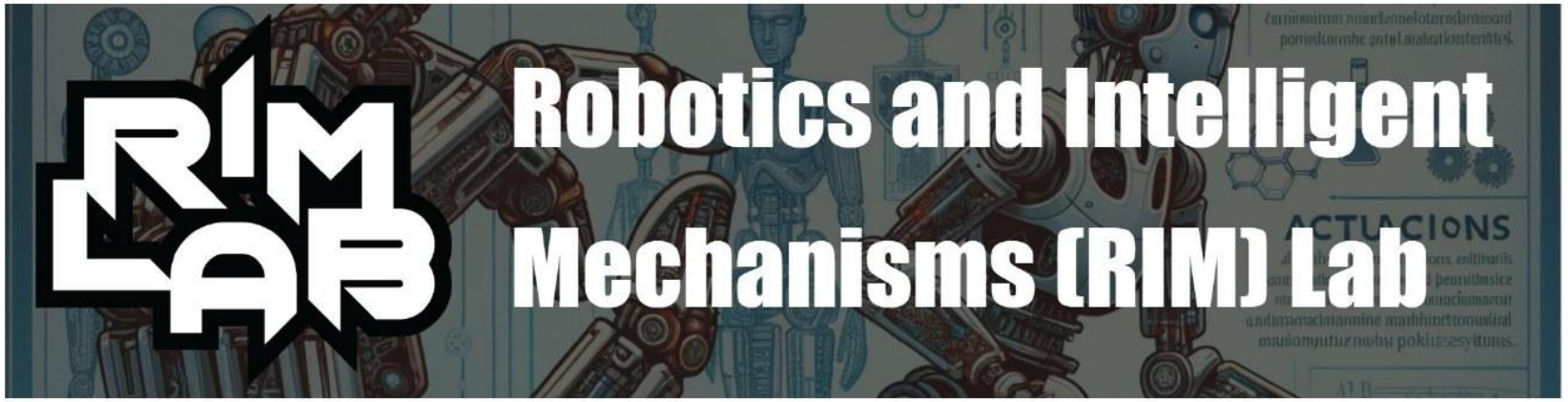
Name : Jeong, Seokhwan

Position : Assistant Professor, Mechanical Engineering Dept. Sogang University

Office Hour:

- K236
- appointment by email

- Website: https://rim.sogang.ac.kr/



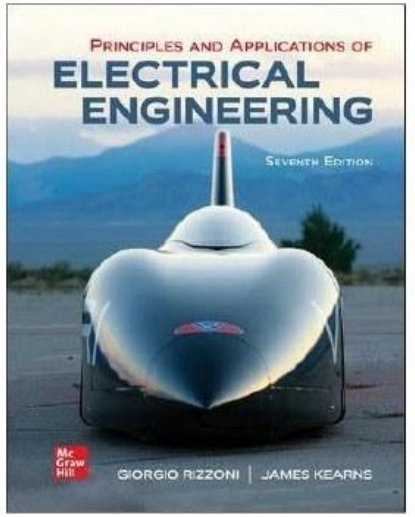
Course introduction

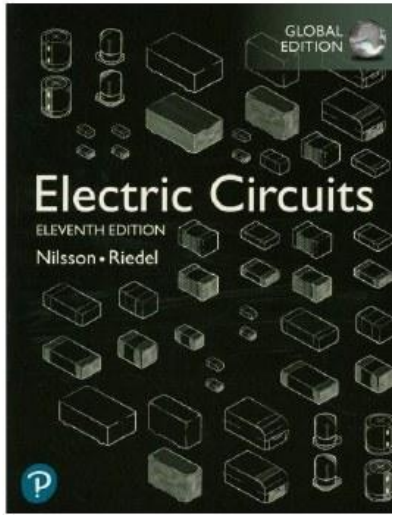
Main Textbook

- ✓ **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

- ✓ Choi, Junho
- ✓ Contact info: https://rim.sogang.ac.kr → Team → Email
- ✓ RA313

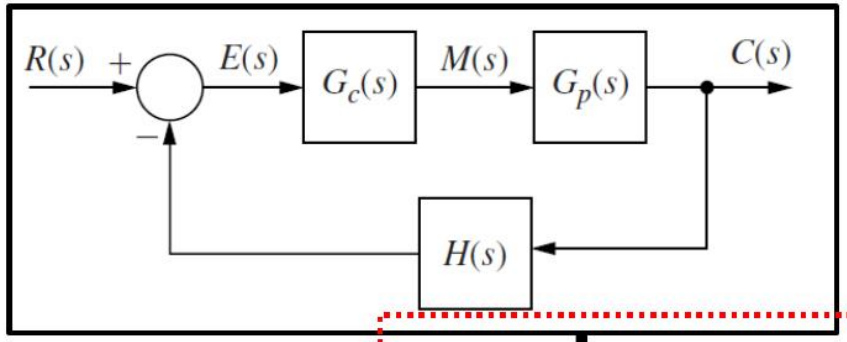
Attendance and grade of exams/reports related inquiry

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



Implementation

Programming - Digital

```
#include <stdio.h>

int main()
{

printf("Hello world! \n");
return 0;

}
```

Microcontrollers

Arduino Series

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

Ti MCU series

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

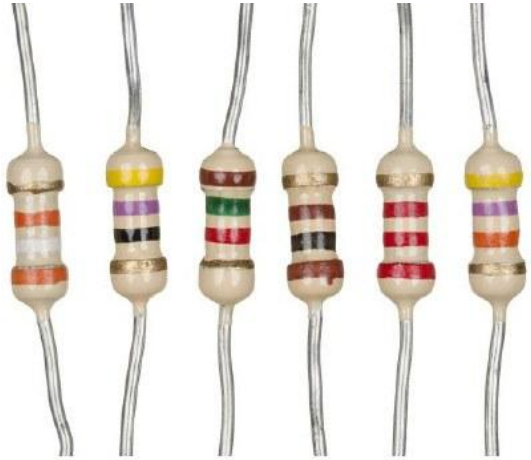
Sensors

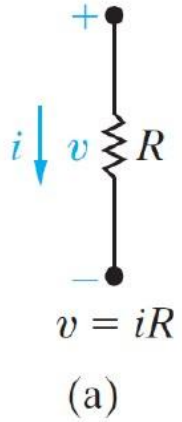
Actuators

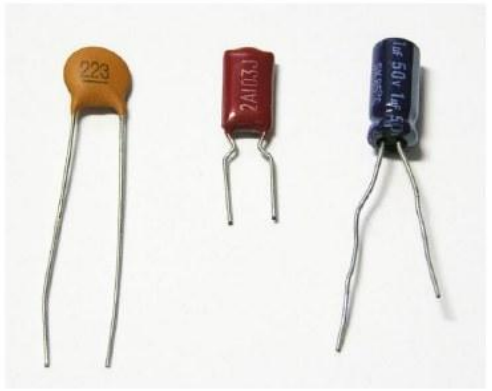
Source: https://www.bostondynamics.com/

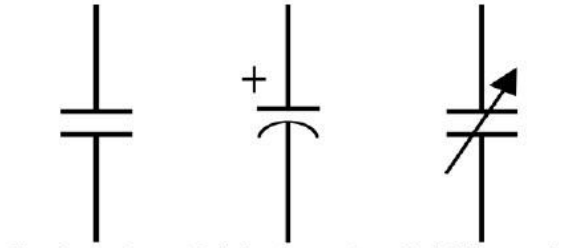
Actuation

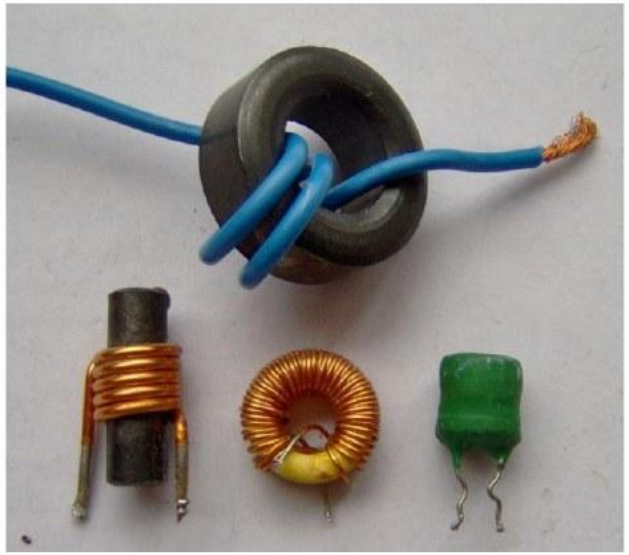
Passive Electric components

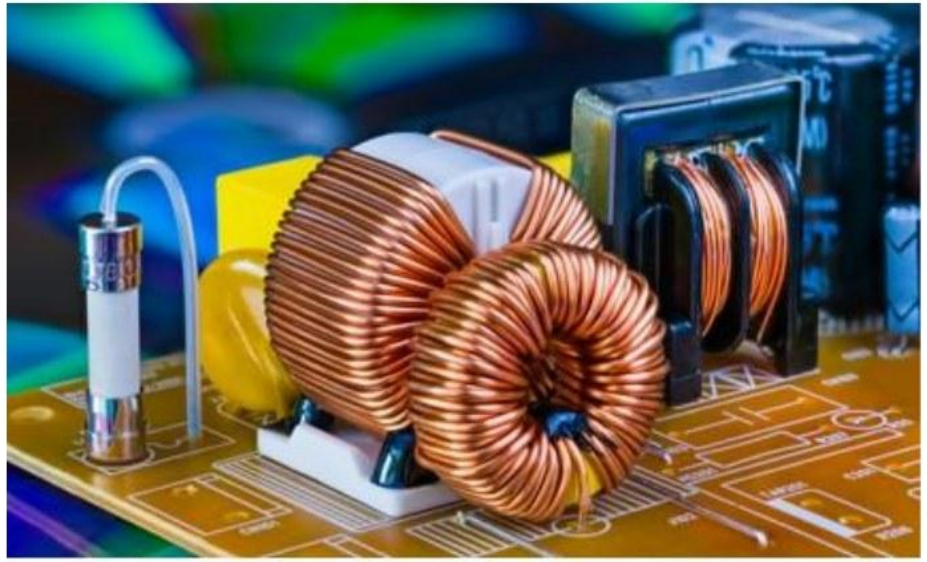




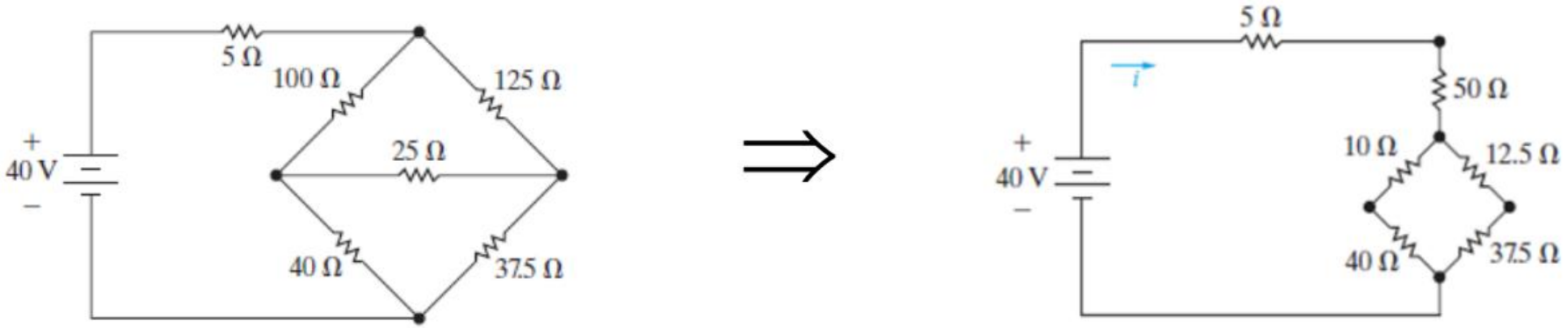


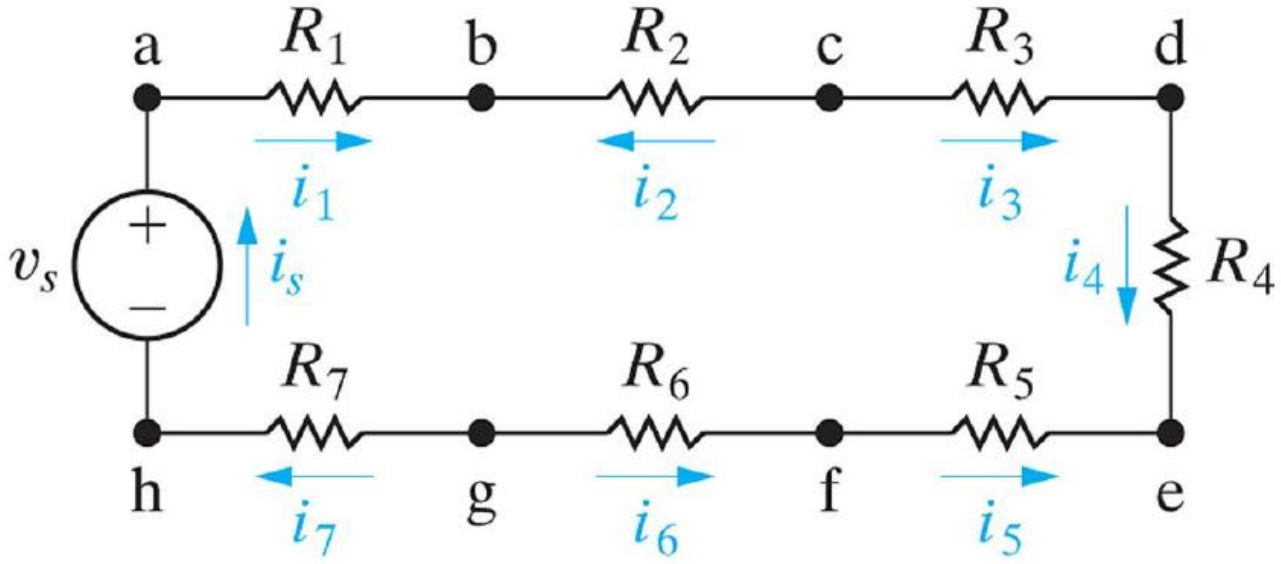




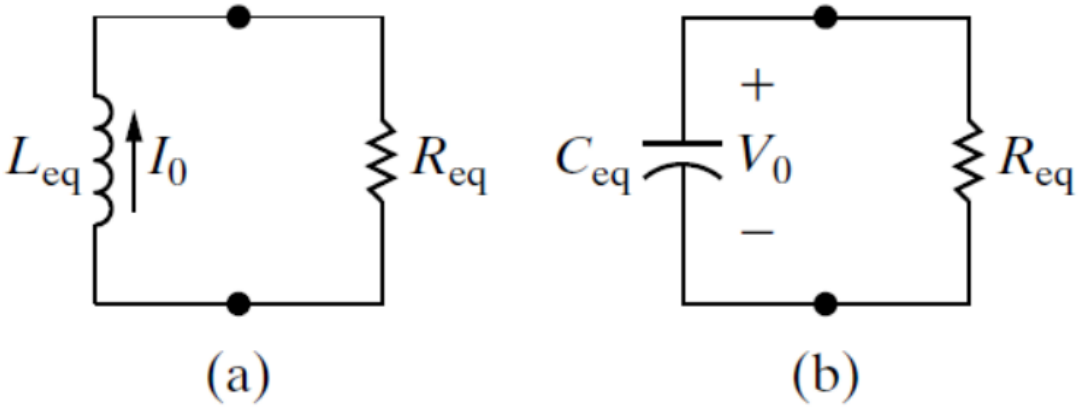


Passive Electric components





Circuits



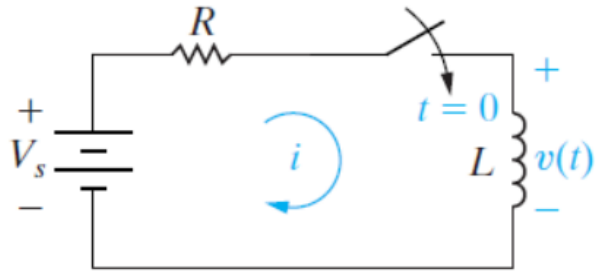


Figure 7.16 ▲ A circuit used to illustrate the step response of a first-order *RL* circuit.

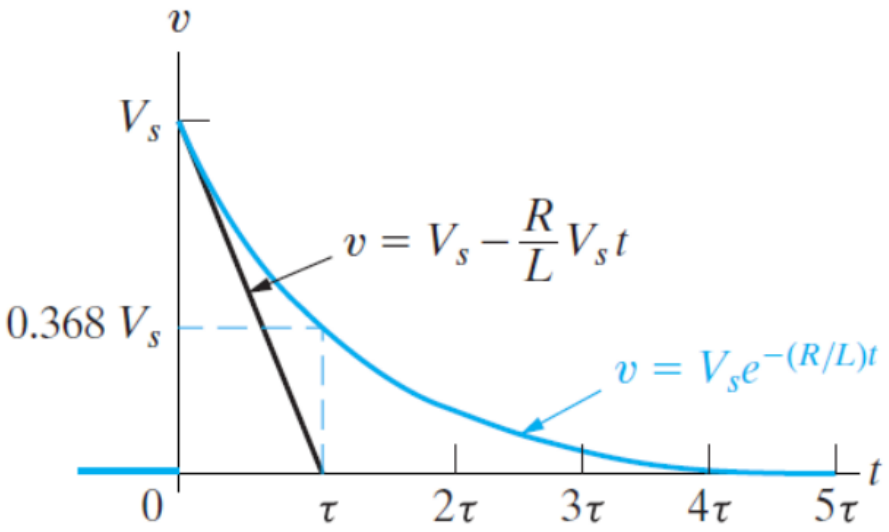
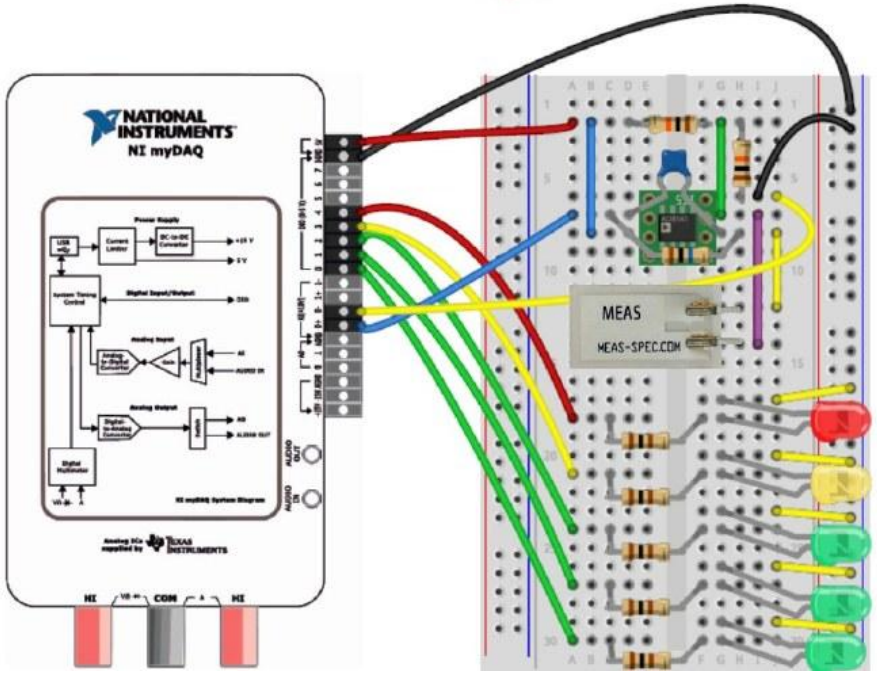
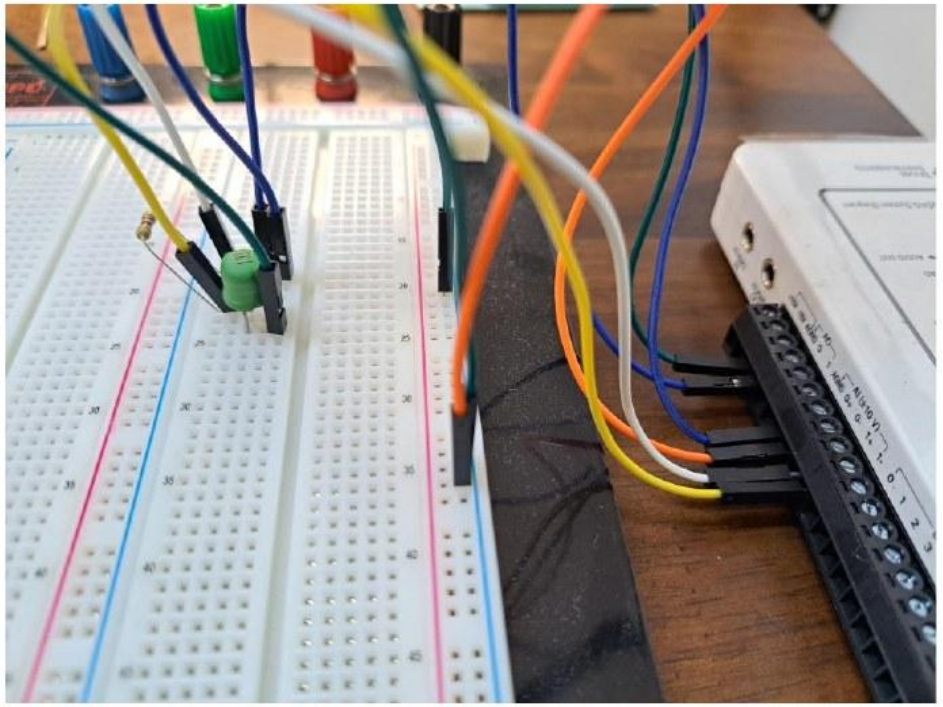


Figure 7.18 ▲ Inductor voltage versus time.

Signal Acquisition

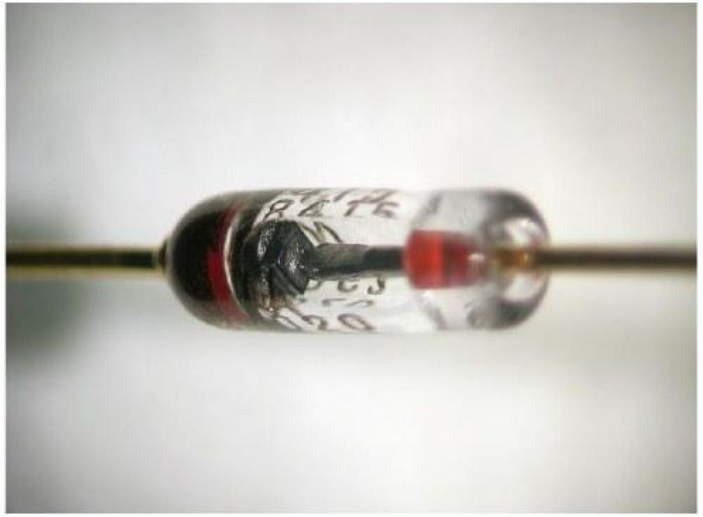




Signal Acquisition

https://youtu.be/KfOoxitcplc

Active Electric components



BJT
(bipolar junction transistor)

FET
(Field-Effect Transistors)

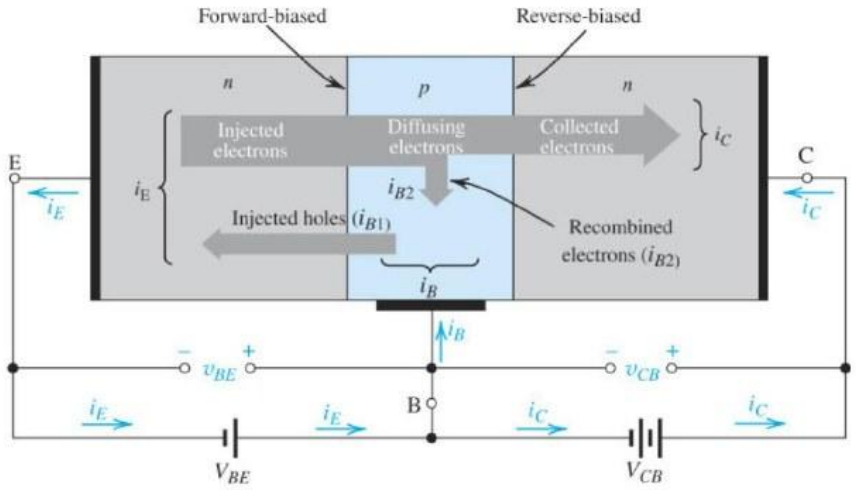
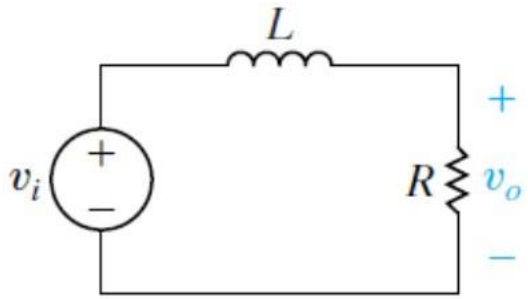
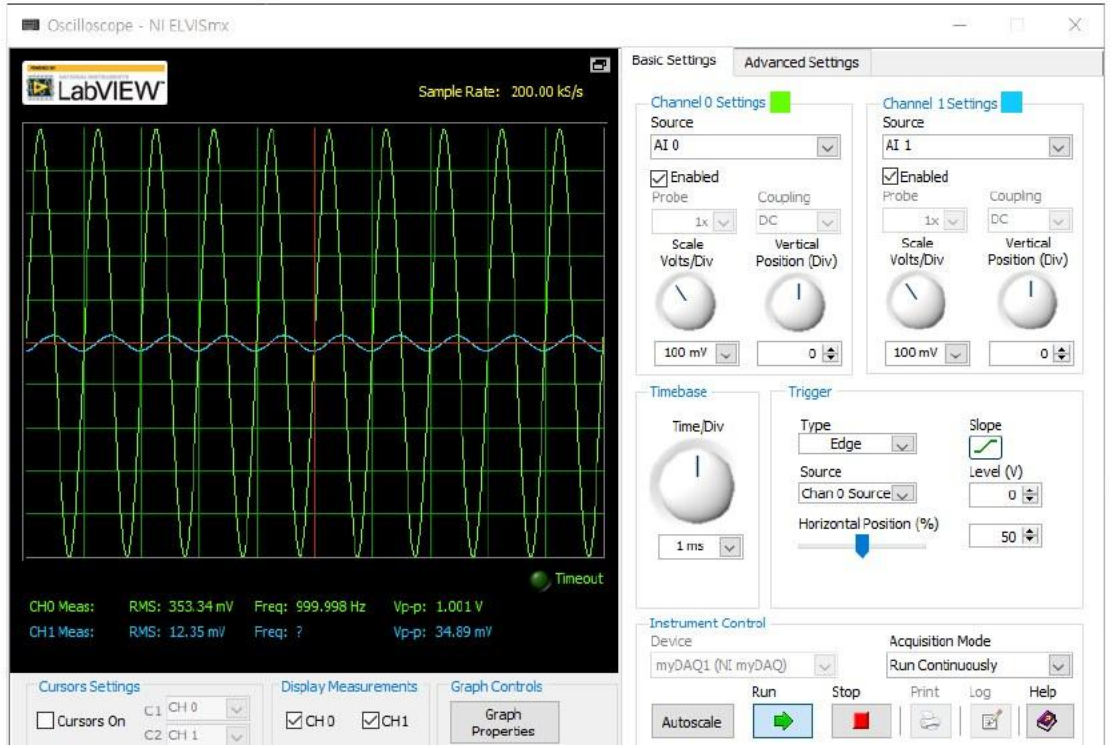


Figure 6.3 Simplified current flow in an *npn* transistor biased to operate in the active mode.

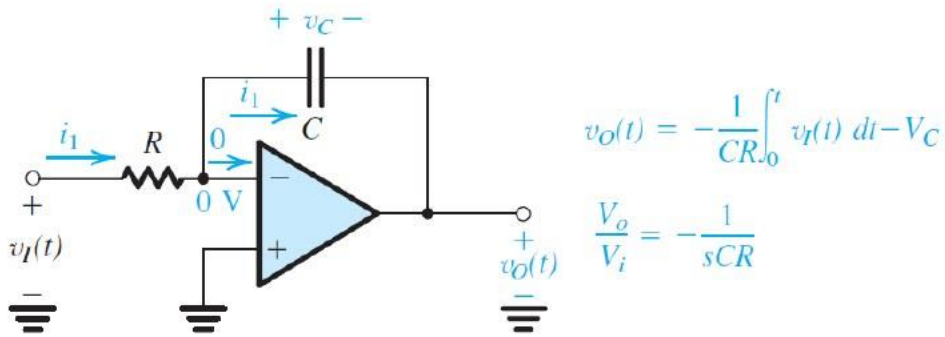
Passive Filter



$$H(s) = \frac{V_0}{V_i} = \frac{1}{s(L/R)+1} = \frac{w_c}{s+w_c}$$

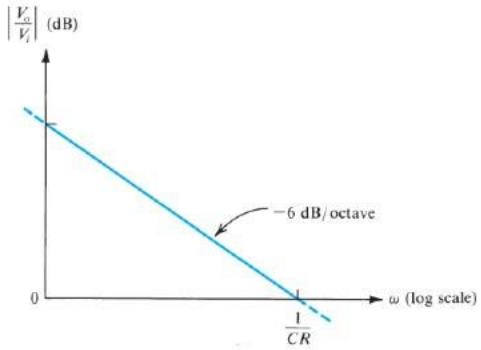


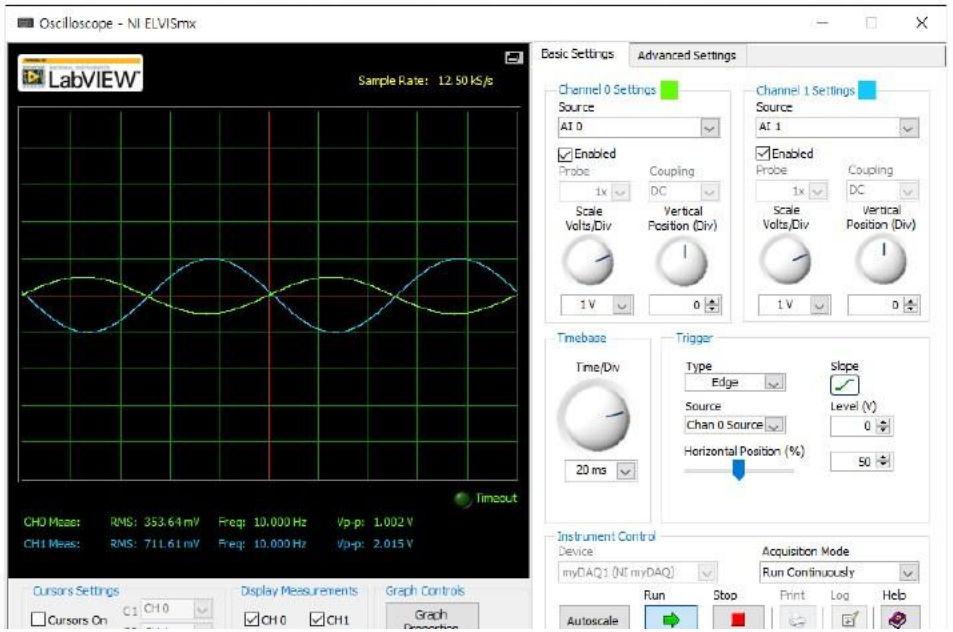
Active Filter



$$v_O(t) = -\frac{1}{CR}\int_0^t v_I(t)\,dt - V_C$$

$$\frac{V_o}{V_i} = -\frac{1}{sCR}$$

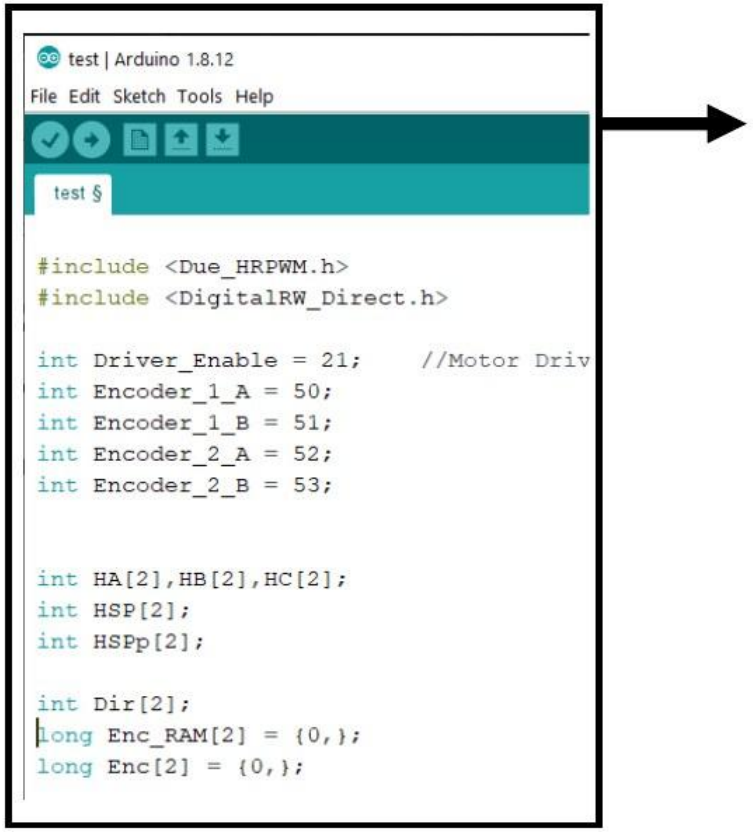




C programming in Mechanical Engineering

- Embedded Systems (Microcontroller/Microprocessor)

Ex) Arduino integrated development environment (IDE)



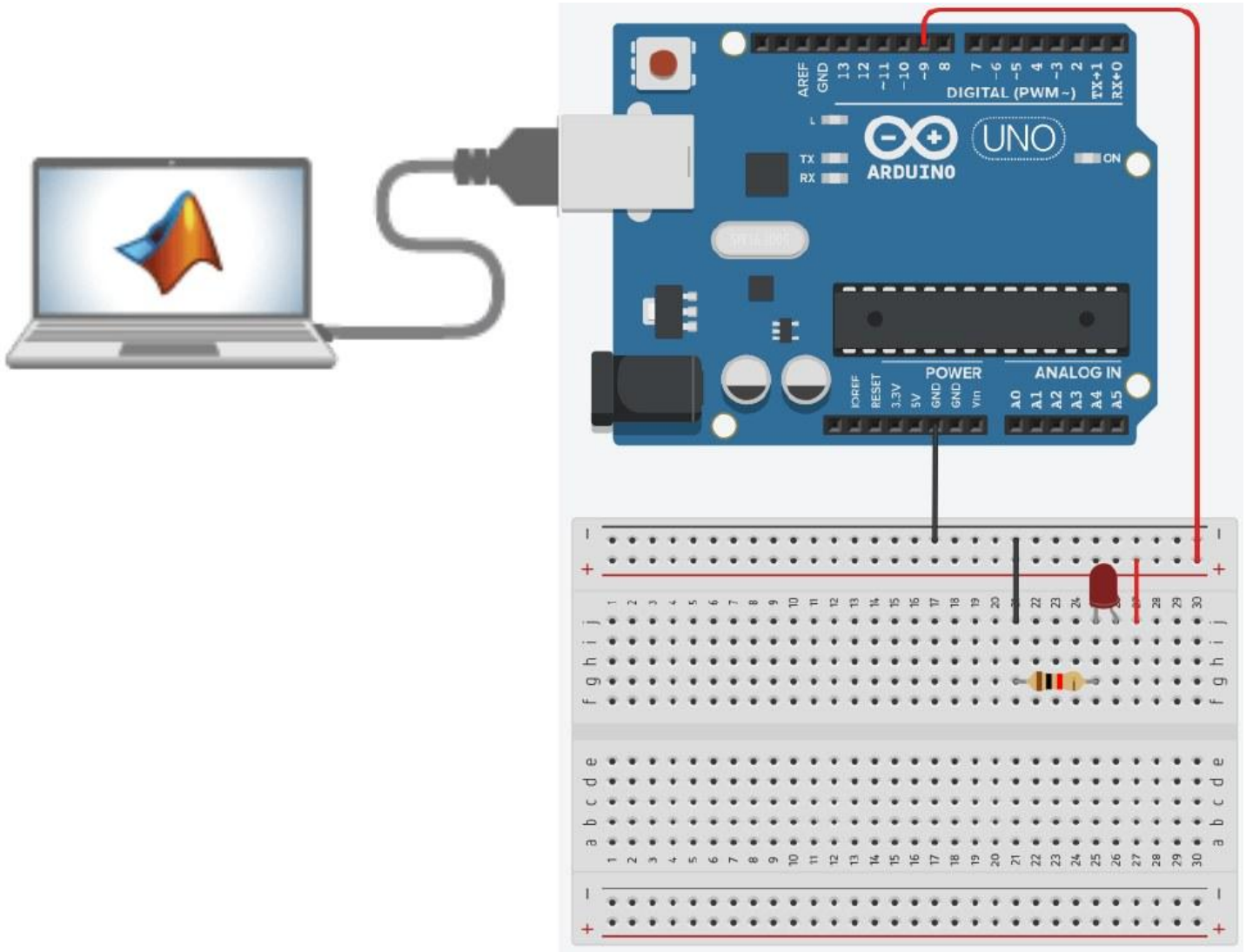
Microcontrollers

Arduino Series

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

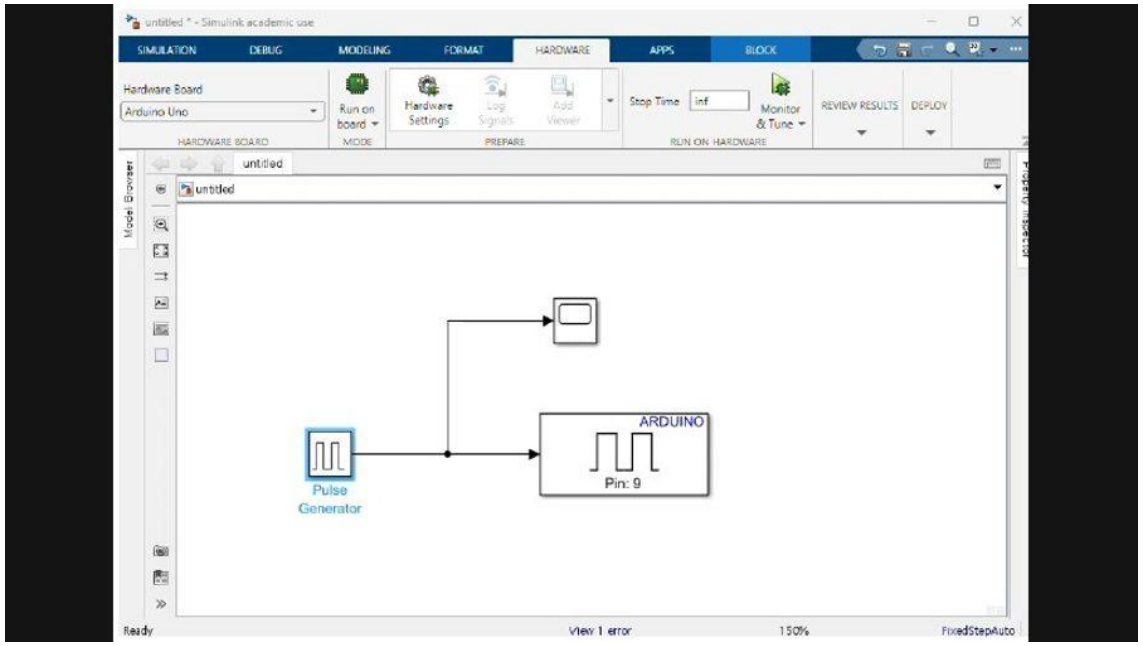
Ti MCU series

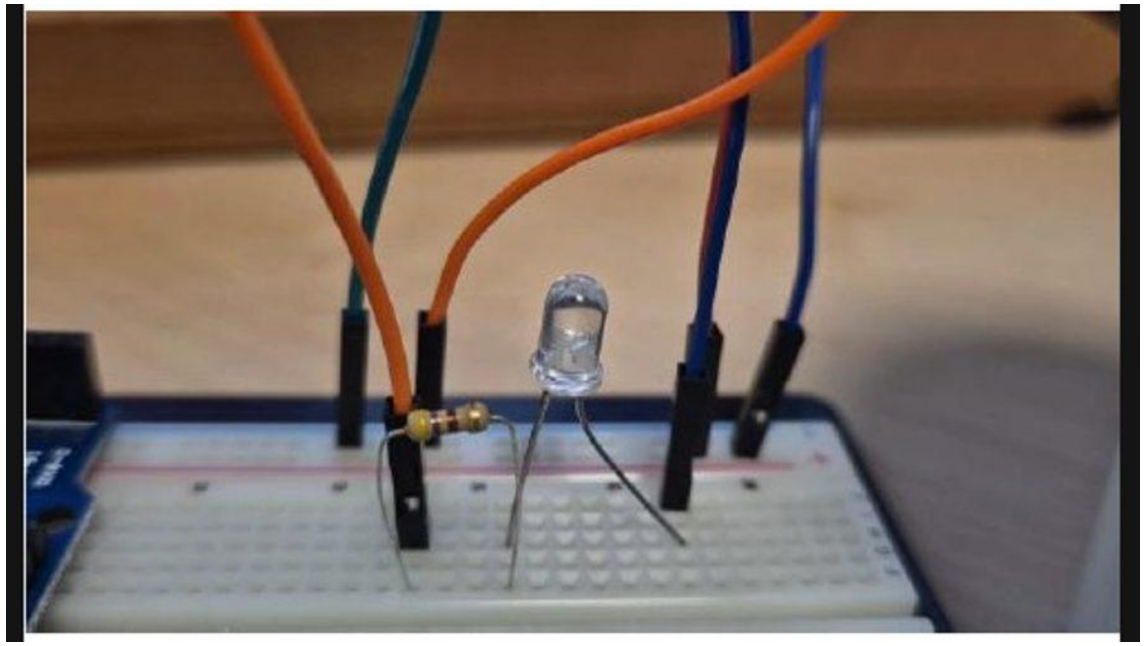
Arduino Support from MATLAB and Simulink



Arduino Support from MATLAB and Simulink

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

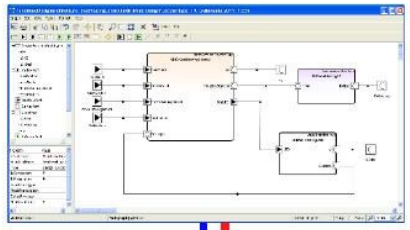




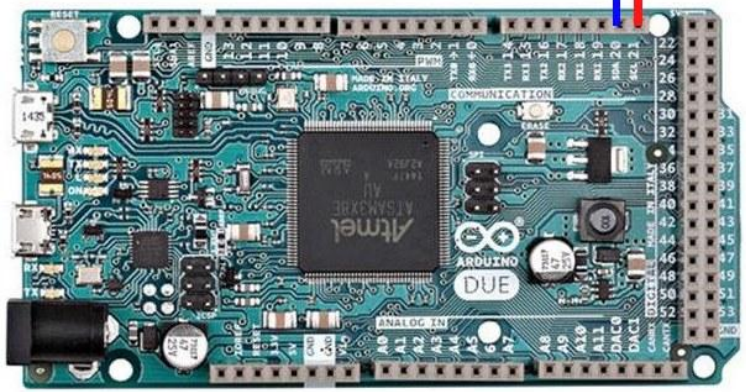
Microcontrollers — Arduino Due / TI LaunchPad

MATLAB SIMULINK

Real-time Window

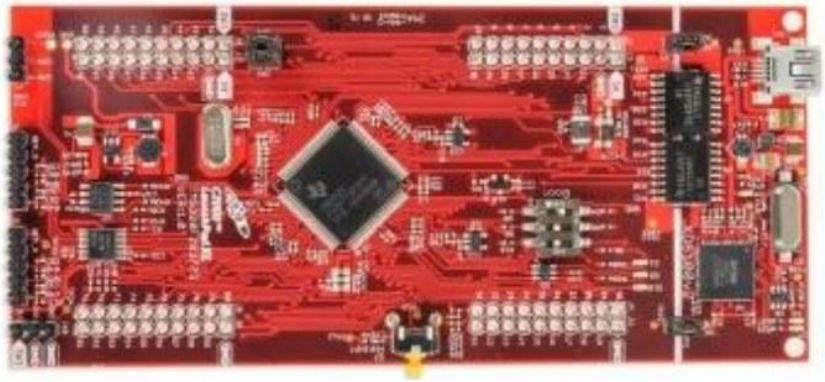


Arduino Due



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

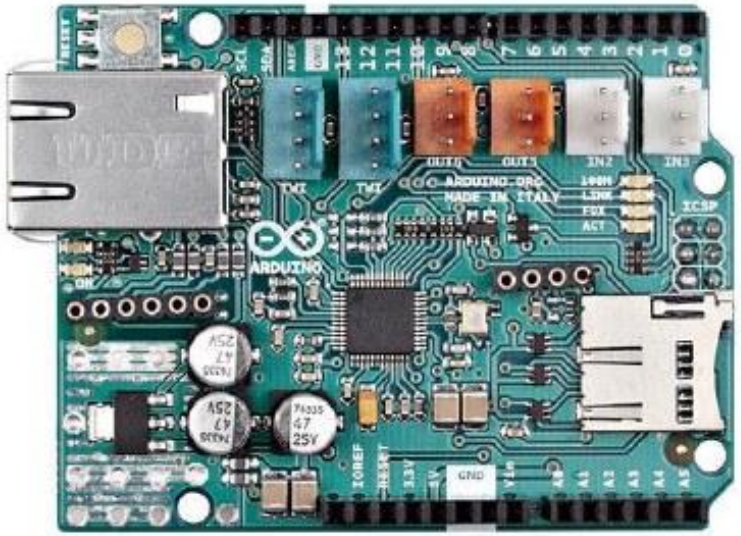
TI TMS320F28377S LaunchPad



- 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

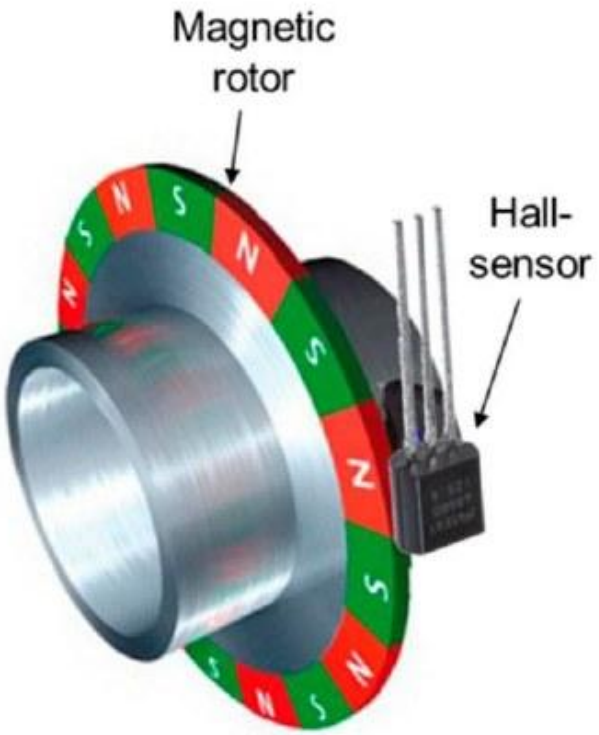


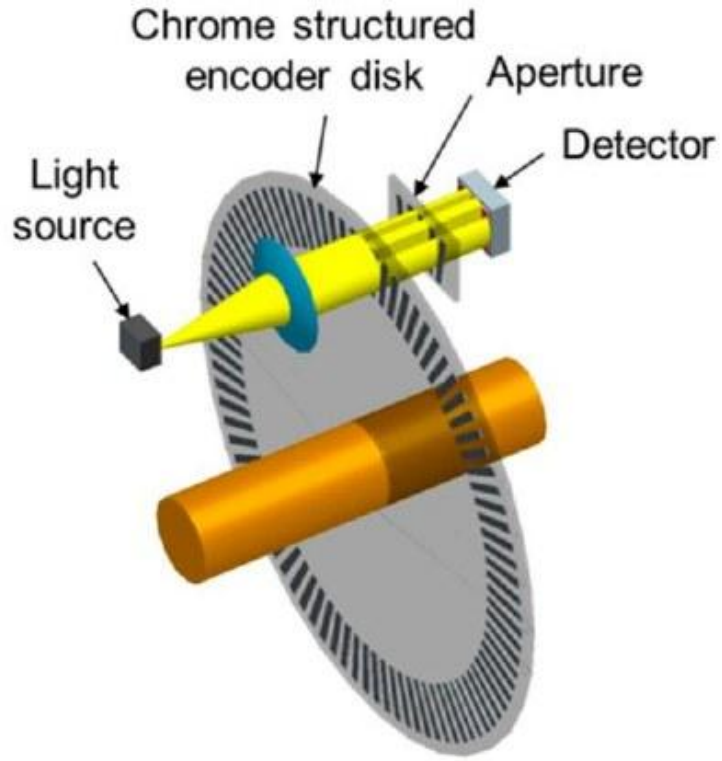
- WIZnet W5500
- Micro-SD
- Ethernet (TCP/IP, UDP)
- SPI

MAXON EPOS Module

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

Sensors

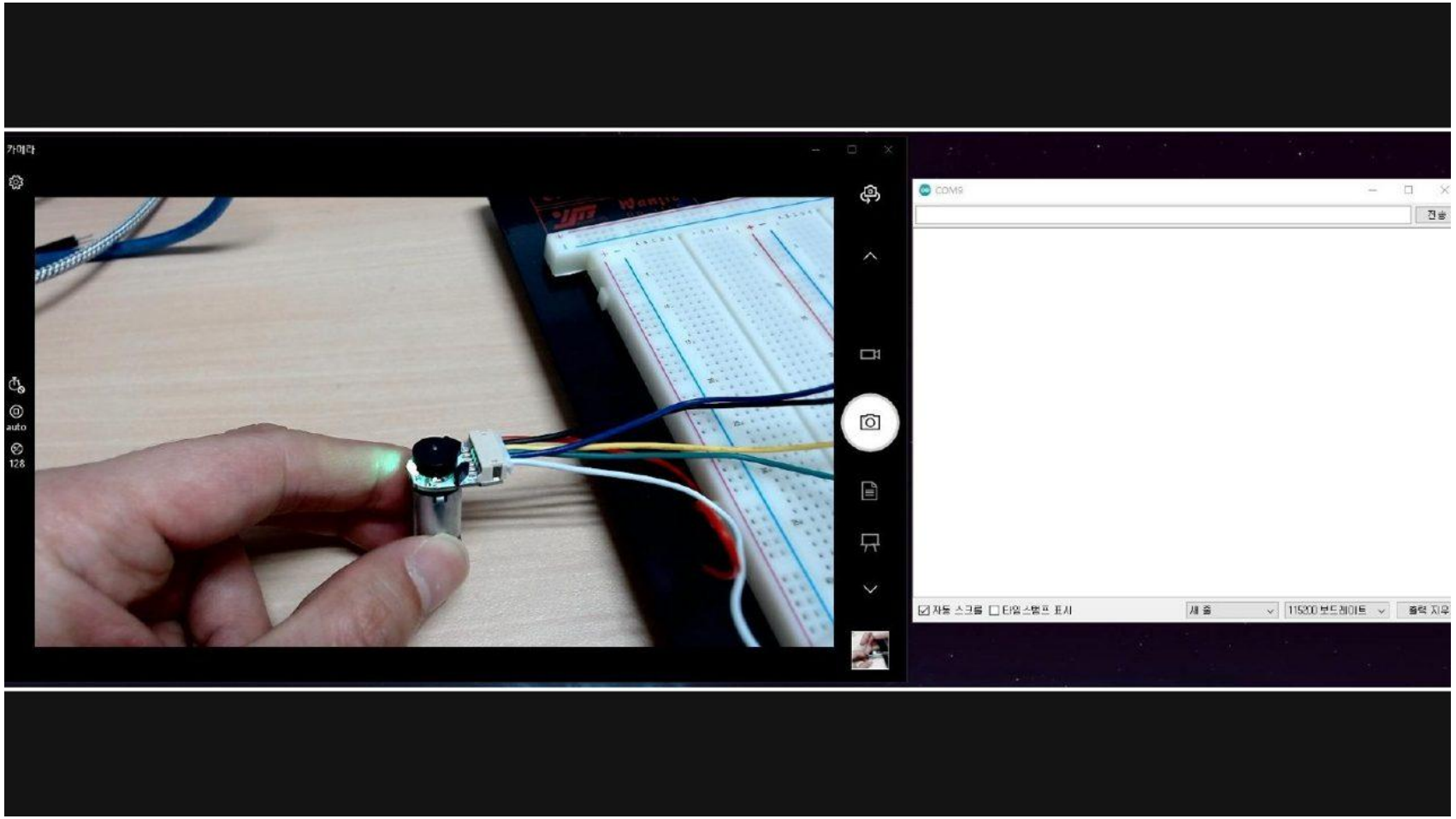




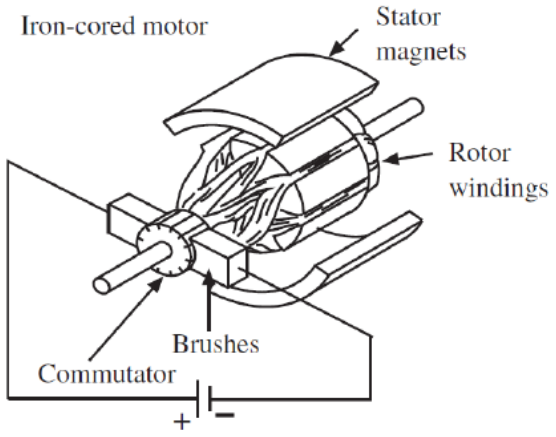
Encoder

Sensors

https://youtu.be/41Ser4ZQjy4



Motor dynamics



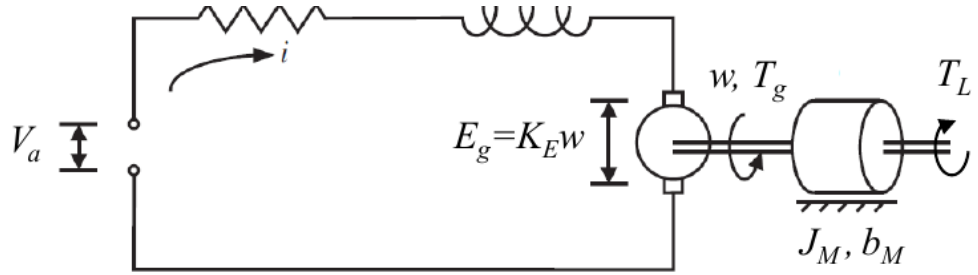
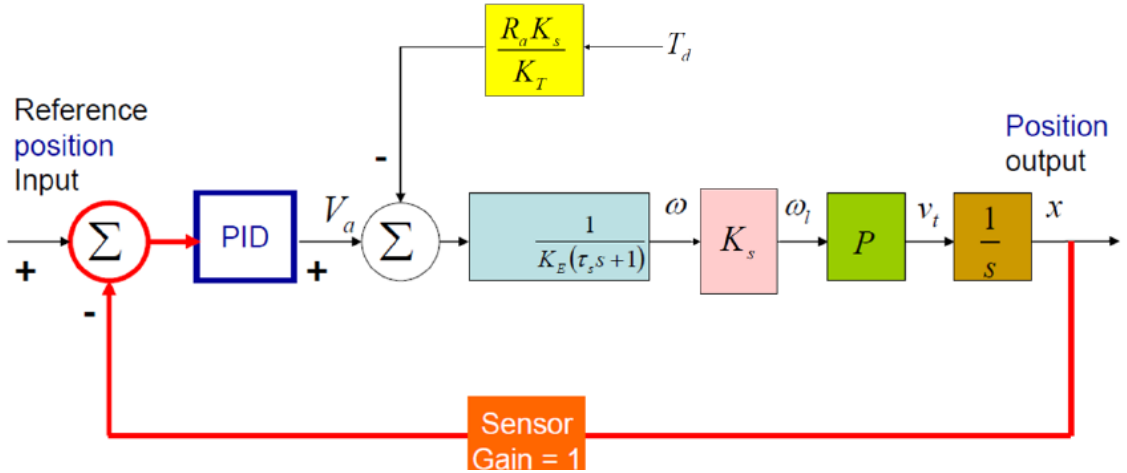
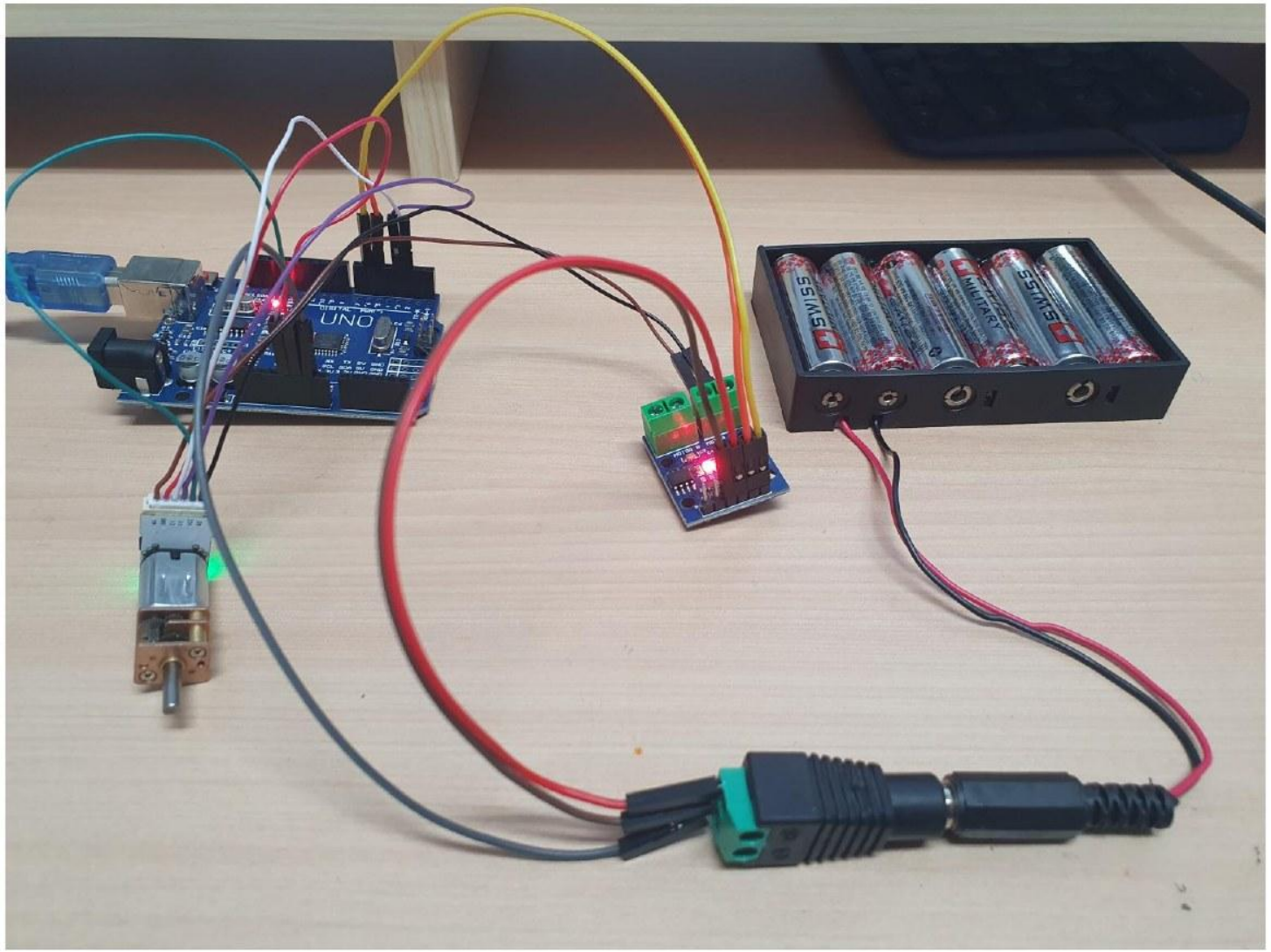


FIGURE 8.59: DC motor dynamic model.

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



Final Goal of this lecture



Final Goal of this lecture

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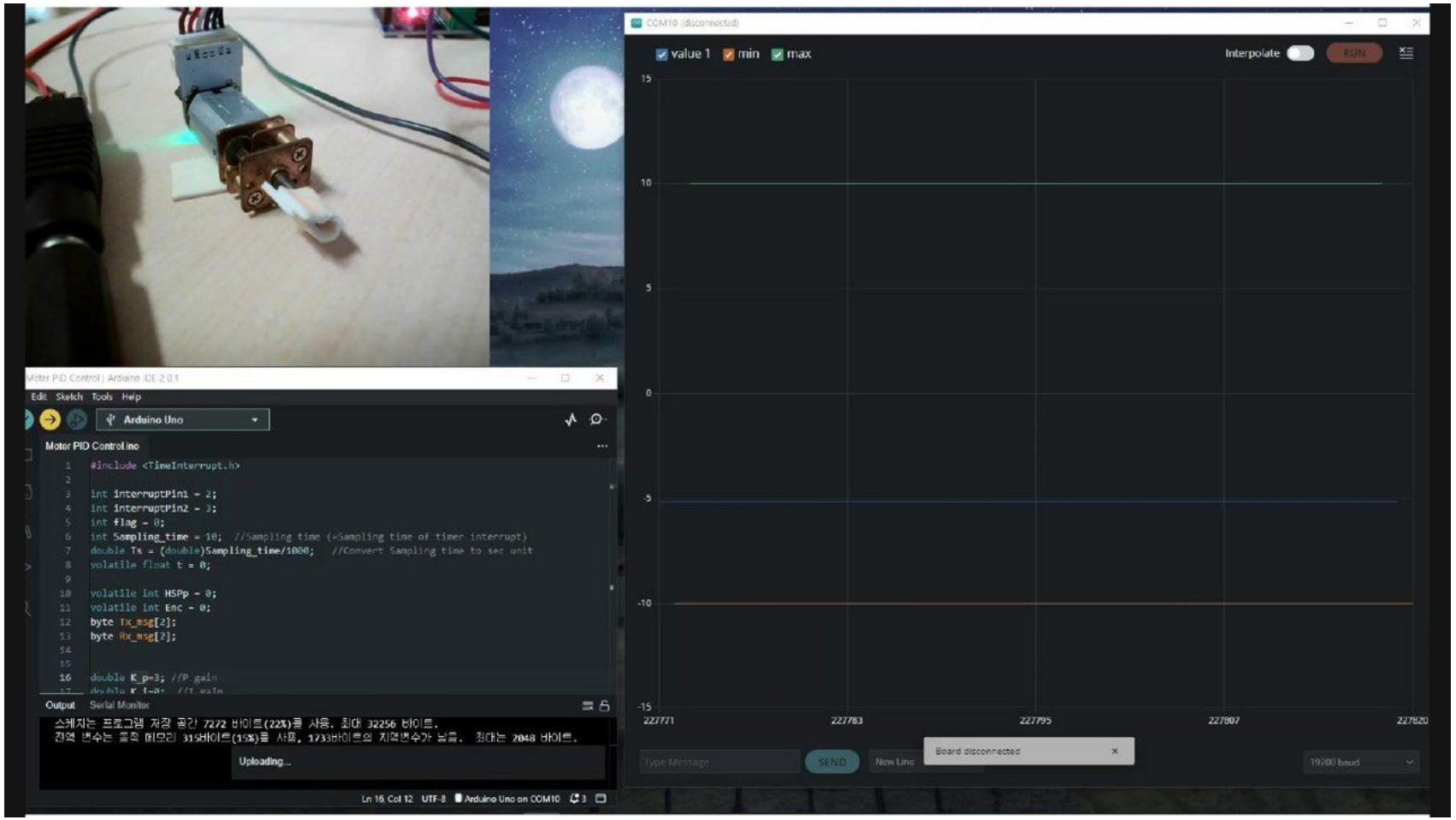
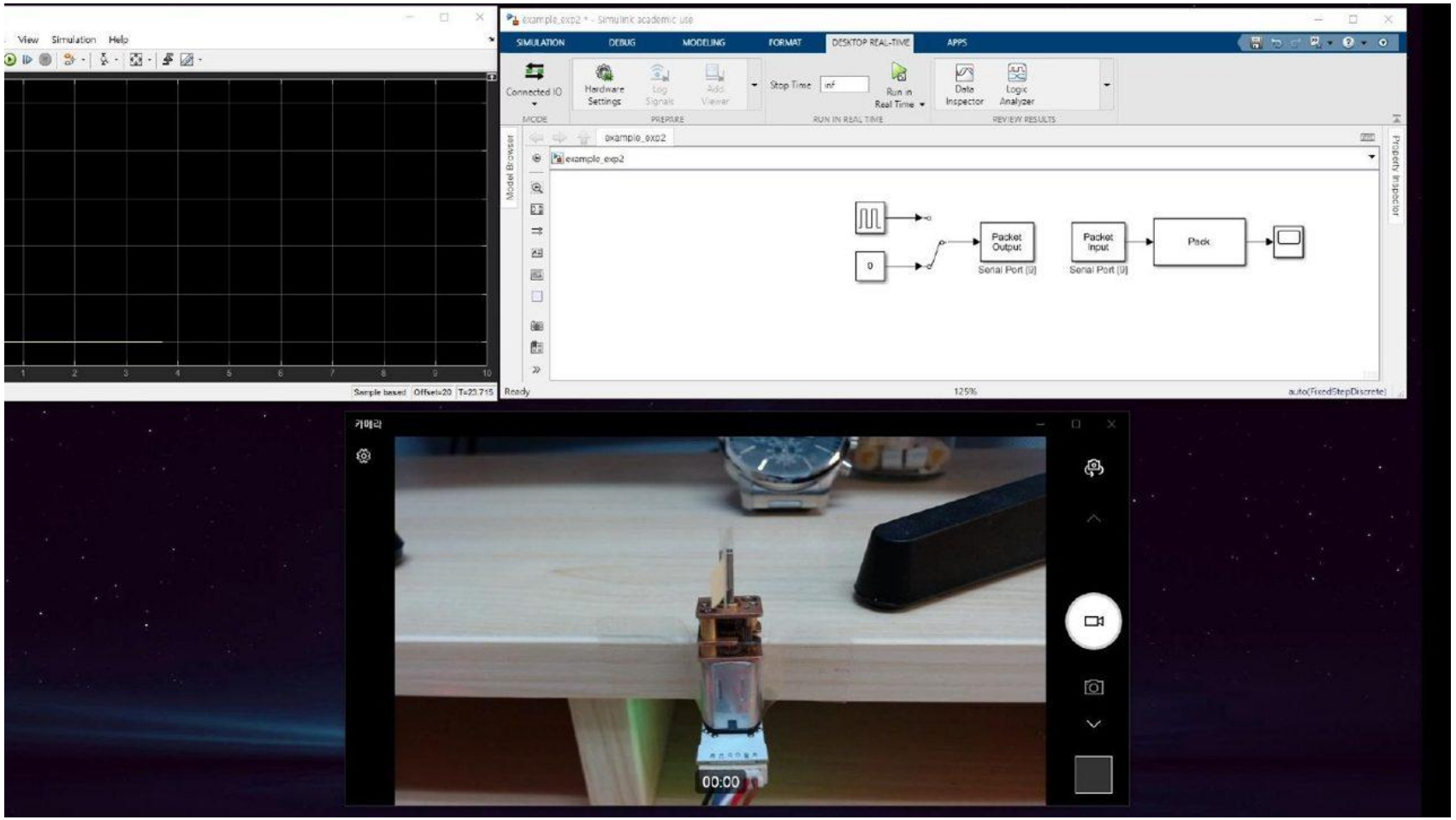


Motor control

https://youtu.be/ridV3BWROC4



Project Kit & Components

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

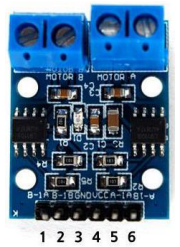
Arduino Learning Kit ×1*

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

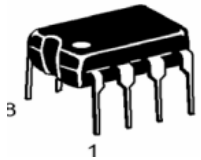
6F22, motor power

Inductor ×1

10 mH radial (Reports 1–2)

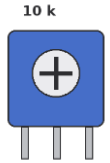
Capacitors ×3

0.1 µF · 1 µF film, 10 µF elec.



Dual Op-Amp ×2

LM2904N + DIP-8 socket ×2



10 kΩ 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