MEE ELECTRICAL MACHINES – Experiment #6

LABORATORY CONTENT: Power amplifiers

EQUIPMENT REQUIRED: (students should bring electronic components)

Qty	Description
1	Voltage supply (will be ready at lab.)
1	DC motor (5-6V or 12V, 1A nominal current at max)
1	2N2222
1	2N2907
2	LM741
2	1k resistor
1	10k potentiometer
-	Wiring equipments (jumper cables, crocodiles, etc.)

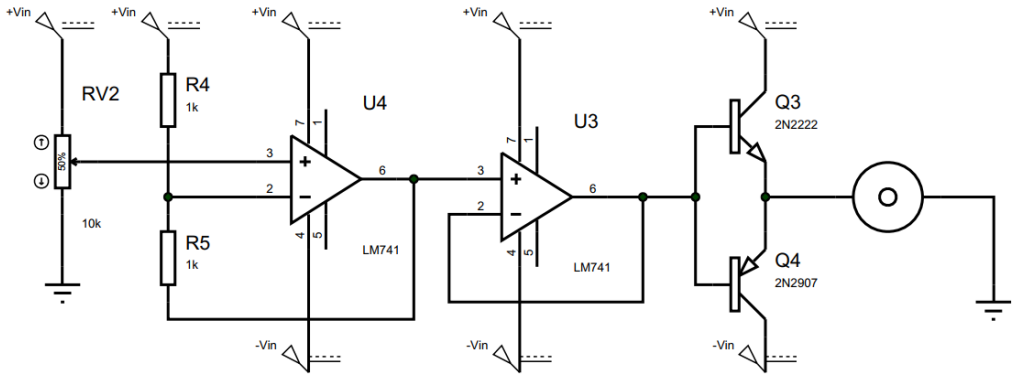
PRELIMINARY QUESTIONS:

1) Search about the power amplifier classes (A, B, AB, C and D). Draw the circuits basically. Briefly describe the field of application, advantages and disadvantages (two sentences and matters at max. for each).

2) Simulate a B class and an AB class amplifier. Print the results of input and output voltage for input voltage 5 V_{p-p} at 50Hz, 100Hz and 500Hz. Comment about the crossover distortions.

EXERCISE STEPS:

1) Apply the B class amplifier circuit below. Change the potentiometer to have two-directional motion with the DC motor.



POSTLIMINARY QUESTIONS:

1) Compare this work with the one in 5th experiment and tell the advantages/disadvantages with the field of applications.

2) For a fundamental npn-type transistor circuit (consisting of one transistor, a resistive load, supply voltage, control signal and a base-pin resistor), find the formula of heat loss with the transistor. Show it with a simple example (numerical).

IMPORTANT NOTE: For the next experiment, you need to build up some contents. So, the ones who are not prepared for the experiment will not be allowed to participate.

MEE210 ELECTRICAL MACHINES – Experiment #7

LABORATORY CONTENT: Driving with H-bridge
EQUIPMENT REQUIRED: (students should bring electronic components)

Qty	Description
1	Voltage supply (will be ready at lab.)
1	Oscilloscope (will be ready at lab.)
1	DC motor
2	*IR2101 MOSFET driver
4	*IRFZ24 n-type MOSFET
2	*1N5819 Schottky diode
4	10R resistor
2	500R resistor
2	1µF capacitor
1	LM555 timer
1	100k potentiometer
2	2k resistor
1	*1N4004 diode
1	0.1µF capacitor
-	Wiring equipments (jumper cables, crocodiles, etc.)

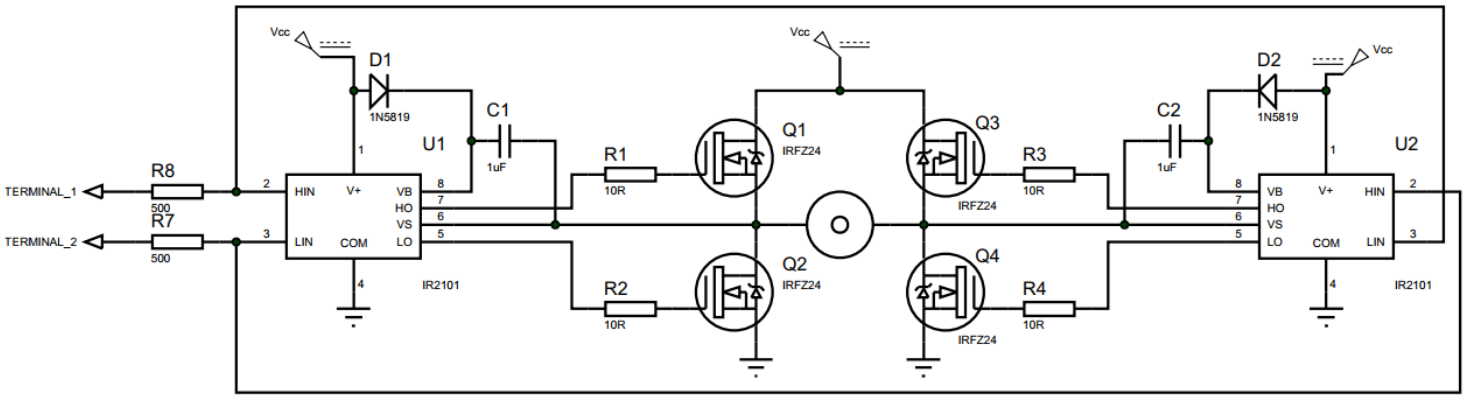
**** You may use equivalent components as well, just look up the datasheet for the component specifications***

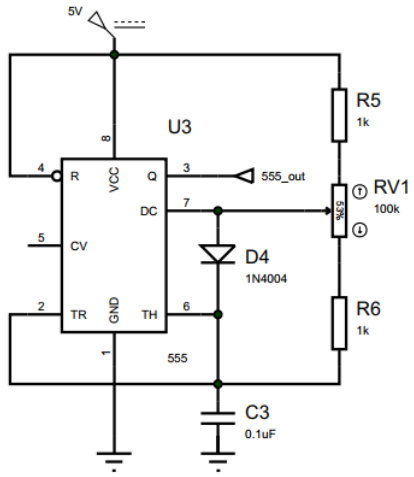
PRELIMINARY QUESTIONS:

1) Build up a H-bridge circuit for driving a DC motor. H-bridge circuit should be built with MOSFETs. You may use MOSFET drivers. The motor should be controlled with an adjustable PWM signal input (not by a function generator, but with your circuit). Both circuits are given below. You may use them (do not bring L298N-like ready-to-use H-bridge circuit, you should build your own driver).

EXERCISE STEPS:

1) Apply the circuits below. Show rotary motion in both directions and change the motor speed by changing PWM duty cycle. If you are using the circuit below, for one direction motion you should apply *555_out* to *TERMINAL_1* and *GND* to *TERMINAL_2*, and for the other direction, vice versa.





POSTLIMINARY QUESTIONS:

1) Research about Power MOSFETs (P-MOSFET).
2) Compare MOSFETs with transistors in H-bridge circuits.

IMPORTANT NOTE: For the next experiment, you need to build up some contents. So, the ones who are not prepared for the experiment will not be allowed to participate.

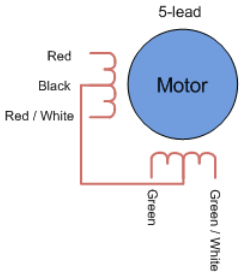
MEE210 ELECTRICAL MACHINES – Experiment #8

LABORATORY CONTENT: Stepper motor

EQUIPMENT REQUIRED: (students should bring electronic components)

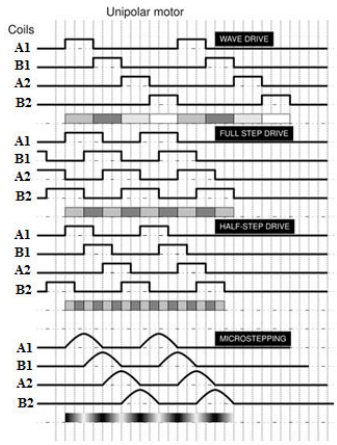
Qty	Description
1	Voltage supply (will be ready at lab.)
1	Computer (Arduino IDE program should be installed)
1	5-lead unipolar stepper motor
1	Arduino card (with operation voltage 5 V like Arduino Uno, Mega, etc.)
1	Multimeter
1	Breadboard
4	2N2222 transistor
4	1N4001 diode
4	150 ohm resistor
-	Wiring equipment (jumper cables, crocodiles, etc.)

INTRODUCTION:



Stepper motors are preferred for being cheap for the applications where a precise positioning is required. The most common stepper motor types are unipolar and bipolar stepper motors. Although unipolar stepper motors have different cabling variations (you can search for other variations on the internet), a 5-lead unipolar stepper motor cabling is figured on the right side. The cable colors may not be identically equal for each motor in practice (ex. even if your motor has 5 leads, the colors may not be the same as in the figure), so the most basic method for this is to measure the resistance between each terminal pins where the center tap pin divides the resistance by two (still, to reveal each of them, the rest still depends on the experimental tests). These sequence is important due to driving methodology which is applied in this exercise.

The driving method can be categorized depending on the resolution of the motion and the torque provided to the rotor. A1 and A2 represents the first coil, B1 and B2 represents the second coil.

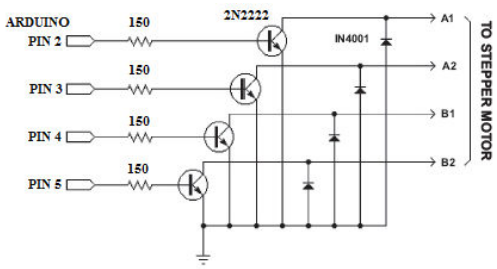


PRELIMINARY QUESTIONS:

1) Determine the motor pins by measuring the resistance between the terminals and write down the colors.
2) Download Arduino code given below.
3) Set up the circuit given on the right-side figure where COMMON terminals of the motor are connected to Vcc (power supply for the motor).
4) Try out the driving modes by changing the code. Change “mytime” variable to observe the limits of the motor.
2) Modify Arduino code given below for just one direction as the motor will turn in both directions as demanded. The modification will be made just for full step drive function. Add an input to the function as it will indicate the rotation direction.

EXERCISE STEPS:

1) Have motion with the Arduino code given in lecture website.



POSTLIMINARY QUESTIONS:

1) Search about hybrid stepper motor
2) Compare stepper motor with servo motors (power, torque, speed, etc.)