THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY
Department of Electronic and Computer Engineering
ELEC 1100

Laboratory 2: DC Regulation and Pulse Generation (4%)

A) Objectives:

- To construct a regulator to transform DC voltages.
- To generate pulses from a constant supply.

B) Equipment:

- Zener Diode (IN4734), Voltage Regulator (LM7805)
- NE555 Timer, 74HC14 Schmitt Trigger, Resistors, Capacitors

C) Prelab (solution included)

- Q1 What is the difference between a Zener diode and a diode?

  Zener diode allows current to flow when reverse voltage is larger than a certain value.

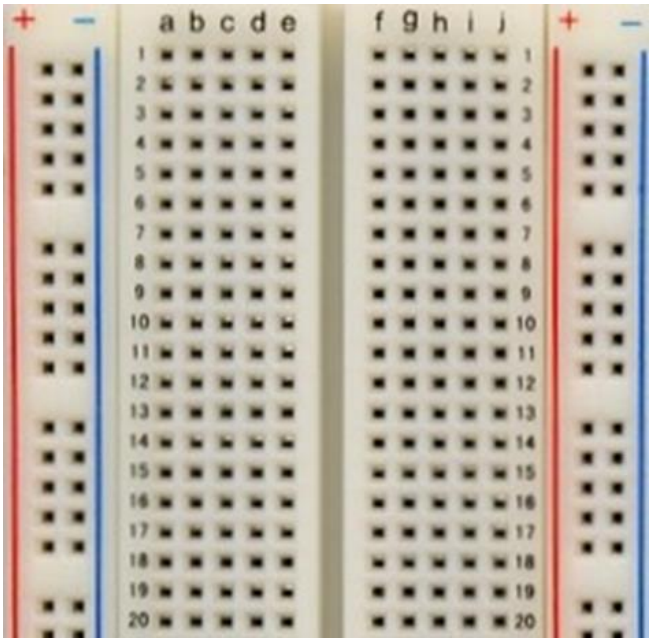
- Q2 For the NE555 IC picture below, circle pin #2. (Hint: Next to big dot is pin 1)

- Q3 In Experiment 3, what should be the frequency and duty cycle of the wave generated?

  Frequency = 1/[0.7*(30k+2*10k)*0.1µ] = 286Hz
  Duty Cycle = (30k+10k) / (30k+2*10k) = 0.8

- Q4 Draw the breadboard connection of Experiment 2, 3 & 4.

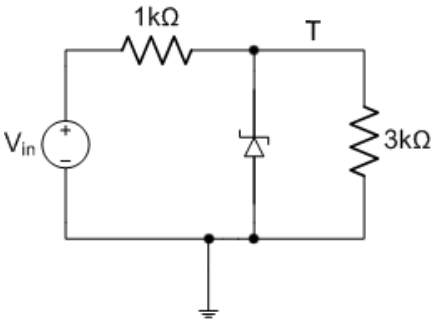
  Check with your partner or refer to the tutorial slides



D) Experiment Procedures:

Experiment 1: Zener diode regulator (~30 mins)

Step 1: With the new breadboard in your project box, connect the voltage regulator as shown in the figure on the right. The 1N4734 component is the Zener diode. Note its polarity.



Step 2: Use the digital multimeter to measure the voltage at joint T *with respect to ground*.

Step 3: Set the power supply (V_{in}) to 0V and turn it on. The multimeter should show 0V.

Step 4: Slowly increase the power supply voltage to 1V. Record the reading of the multimeter.

Step 5: Repeat step 4 by increasing V_{in} with 1V per step until 16V (i.e. 2V, 3V, etc. until 16V).

Q1: Fill in the table in the summary sheet.

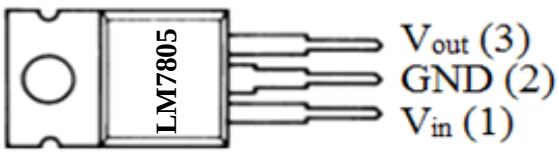
Q2: Sketch the result of Q1 on the graph provided in the summary sheet. (T against V_{in})

Q3: According to the graph you got in Q2, what is the breakdown voltage of the Zener diode?

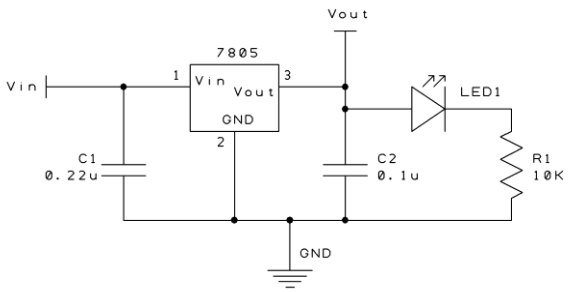
Note: Zener diode circuit is NOT part of your project. You can remove it from the breadboard when you finish Experiment 1.

Experiment 2: LM7805 Voltage Regulator (~30 mins)

Step 1: Take a LM7805 Voltage Regulator. Note its pin diagram shown below.



(the number side is facing up)



Step 2: Construct the circuit in the figure above (you may refer to the tutorial notes for the breadboard arrangement).

Step 3: Set the power supply to 0V (connect to V_{in}). Connect the digital multimeter to measure the output voltage (V_{out}) *with respect to ground*.

Step 4: Turn on the power supply, slowly increase the voltage to about 8V, the multimeter reading would stay at about 5V. If it keeps increasing, there is something wrong with the connection. Turn off the power supply. Check your circuit and repeat Step 4.

Caution: Do NOT touch the regulator LM7805 as its temperature may increase. However, if bad smell comes out, turn off the power supply immediately and ask TAs for help.

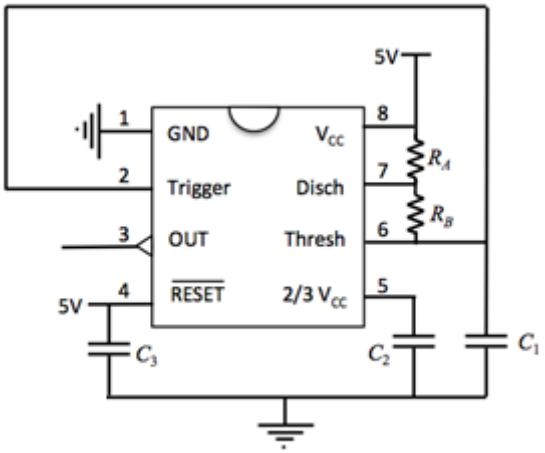
Step 5: Increase the input voltage (V_{in}) to 12V and check if the output (V_{out}) is still 5V. Show your TA that you have finished the circuit and obtained 5V output from 12V and get his/her signature.

DO NOT remove the regulator circuit.

Experiment 3: Constructing a pulse generator with NE555 Timer (~30 mins)

Step 1: Take a timer IC (NE555) and construct the circuit shown on the right with the component values below.

R_A = 30kΩ R_B = 10kΩ
$C_1 = C_2 = C_3$ = 0.1μF



[The number on the capacitor is read as:
- Digits 1, 2: Significant bits
- Digit 3: Multiplier, i.e. 10^n
- Basic unit: pF (p = 10^{-12})

E.g. "104" = 10×10^4 pF = 0.1μF]

Put this timer circuit below the LM7805 regulator circuit on the breadboard, such that it occupies less space (but keep it tidy), saving space for future labs.

Step 2: Use the 5V from the regulator you obtained in Experiment 2 to be the power supply (you may refer to the tutorial notes for the breadboard arrangement).

Step 3: Measure the voltage on Pin 3 of the IC *with respect to ground* with the oscilloscope.

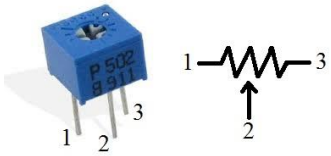
Q4: Sketch the waveform you see on the DSO (including the scales).

Q5: What is the frequency of the waveform displayed on the screen?

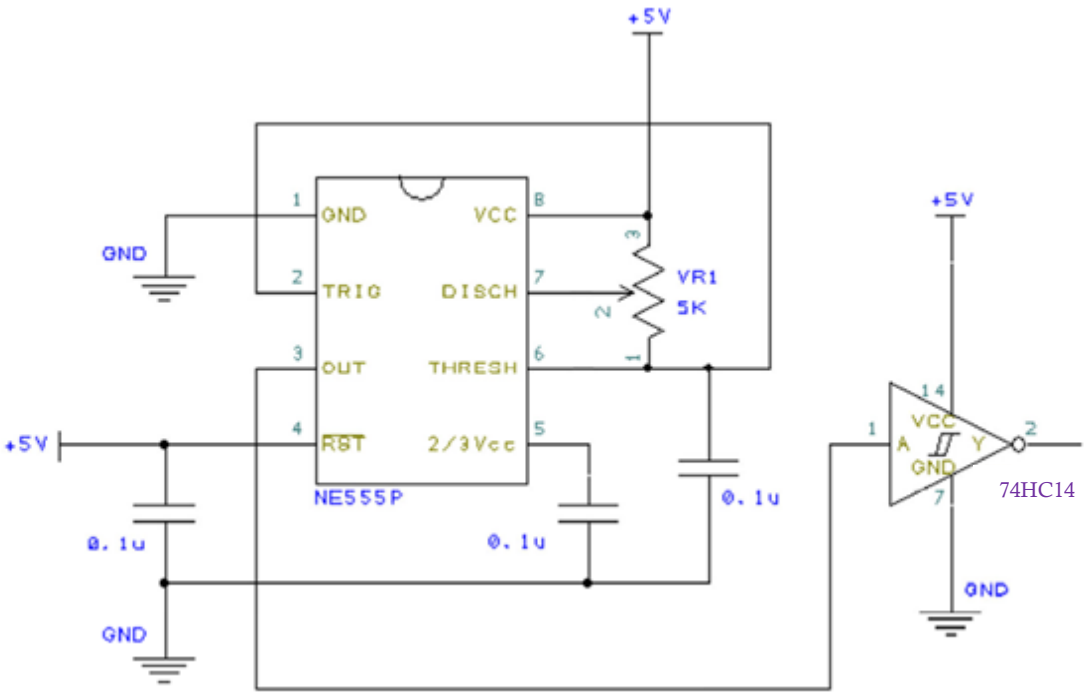
Demo to your TA and obtain his/her signature.

Experiment 4: Pulse generator for your project (~20 mins)

Step 1: Take a variable resistor. It looks like this. Note how it connects.



Step 2: Replace the resistors R_A and R_B in Experiment 3 with the variable resistor, as shown in the circuit diagram below.



Step 3: Connect a Schmitt Trigger (74HC14) to the output (Pin 3) of the timer.

Step 4: Connect CH1 of the oscilloscope to pin 3 of the timer, and CH2 to pin 2 of the Schmitt Trigger. Press "Auto-Set" to display both waveforms, CH1 at the top and CH2 at the bottom. Reminder: Set the CRO probes to 1x if necessary.

Step 5: Using the screwdriver in the project box, adjust the variable resistor until a square wave of frequency 2kHz is obtained. Demo to your TA and obtain his/her signature.

Q6: Sketch the waveforms you see on the DSO (both CH1 and CH2, including the scales).

Q7: What is the difference between the waveforms in CH1 and CH2?

Keep the circuits you finished on the breadboard for the future.

Remember to clean up your bench! A messy table will cost 3 points!

ELEC 1100 Laboratory 2: Summary Sheet

Group Number: _____

Name: _____ Lab Partner: _____

Student ID: | | | | | | | | | Student ID: | | | | | | | | |

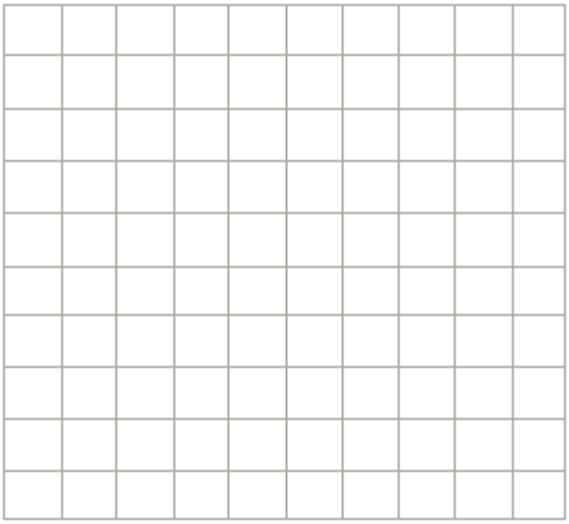
Experimental Part

Experiment 1: Zener diode regulator

Q1: Fill in the table in the answer sheet.

V_{in} (V)	1	2	3	4	5	6	7	8
T (V)								
V_{in} (V)	9	10	11	12	13	14	15	16
T (V)								

Q2: Sketch the result of Q1 on the graph provided. (T against V_{in})



Q3: According to the graph, what is the breakdown voltage of the Zener diode? _____

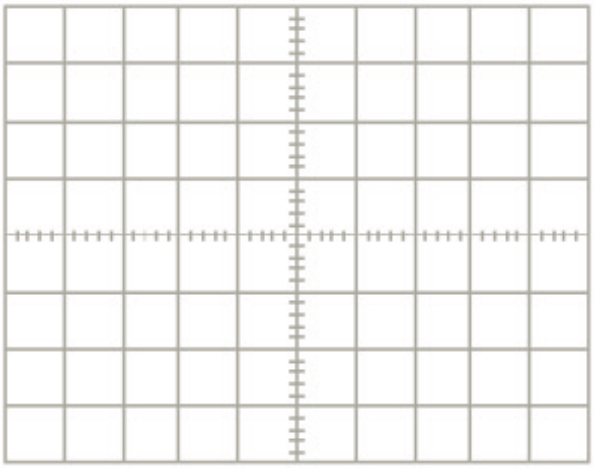
Experiment 2: LM7805 Voltage Regulator

TA's Signature: _____

Experiment 3: Constructing a pulse generator with NE555 Timer

TA's Signature: _____

Q4: Sketch the waveform you see on the DSO (including the scales).



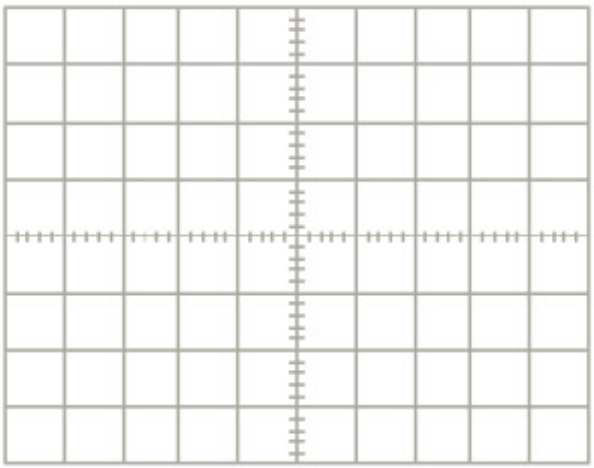
Q5: What is the frequency of the waveform displayed on the screen?

_____

Experiment 4: Pulse generator for your project

TA's Signature: _____

Q6: Sketch the waveforms you see on the DSO (both CH1 and CH2, including the scales).



Q7: What is the difference between the waveforms in CH1 and CH2?

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