

Your Name _____ CWID _____

ECEN3213 Homework 4

Spring 2022

Due Date: 11:59pm Sunday, April 17th, 2022 through Canvas
(Total 36 Points)

1. Memory (16 points)

- a) You are going to design an embedded system which has to save a small amount (less than 100 bytes) of data when the power to the embedded system begins to drop.

When the power is back, the saved data should be retrieved. There are the following options for your memory selection. Please decide which type you want to use and justify it. (4 points)

~~ROM~~, ~~OTP-ROM~~, ~~EPROM~~, ~~EEPROM~~, ~~SRAM~~, ~~DRAM~~, FLASH

Flash will hold bits for years and is non-volatile
While the others are Volatile

- b) A certain type of RAM has $65,536 \times 32$ bits. What is the width of the data bus? And what is the width of the address bus? (4 points)

- c) Consider a Level 1 cache with a 0.15 μ s access time and Level 2 memory with a

1.2 μ s access time, at a hit rate of 80%, what is the average memory access time? (4 points)

$$(.80)(.15\mu s) + (.20)(.1 + 1.2) = 0.38\mu s$$

$$(.20)(.15\mu s) + (.80)(.1 + 1.2) = 1.07\mu s$$

$$0.38 + 1.07 M_0 = 1.45 M_0$$

$$1.45 M_0 / 2 = 0.725 M_0$$

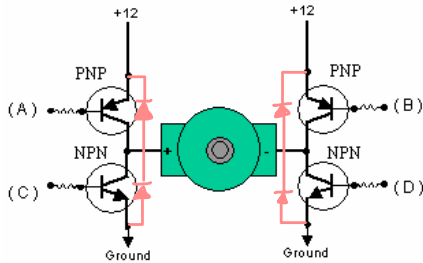
d) Why is SRAM faster than DRAM? (4 points)

SRAM uses 6 Transistors and Flip-Flops where DRAM uses 1 transistor and Capacitor

2. Motors and Control (20 points)

making the access time 10x SRAMs

a) The following figure is an H-bridge for DC motor control. Answer the following questions: (10 points)



i. How to make the DC motor run forward at full speed? (2 points)

A B C D
1 0 0 1

ii. How to make the DC motor run backward at full speed? (2 points)

A B C D
0 1 1 0

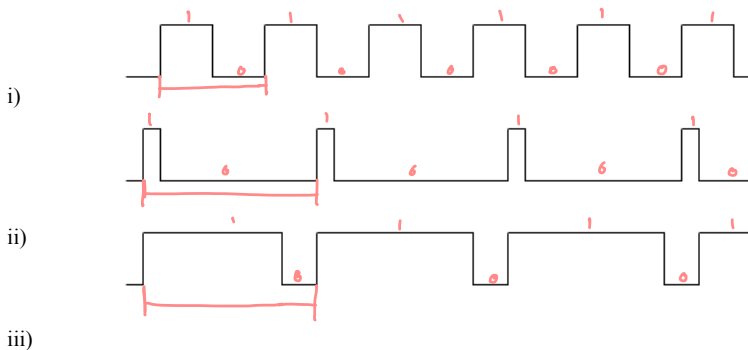
iii. How to make the DC motor run forward at half speed? (2 points)

A B C D
1 1 0 1

- iv. What is the potential problem of the above H-bridge circuit design? Can you improve it to avoid this potential problem? You can add your changes on the above figure. (4 points)

if you do A+C or B+D you would do what is called a *base test*. by adding some *Shunting Diodes* it would protect the circuit

- b) The following figure shows three PWM signals with different duty cycles. Estimate the duty cycle for each case. Please round your answer to the nearest tenth. Hint: you need measure the actual on and off times on the figure. (6 points)



Case i): 50% Duty Cycle

Case ii): 25% Duty Cycle

Case iii): 75% Duty Cycle

c) A stepper motor has 32 phases on the stator and the number of permanent magnetic poles on the rotor is 4. What is the step angle of this stepper motor? (4 points)

$$32_P \times 4_T = 128_{SPR}$$

$$\text{Step Angle} = \frac{360^\circ}{128} = 2.813^\circ$$