MEC4126F: Integrated Embedded Systems

Prac 7
08 May 2025

Total marks: 51

Instructions to students

1. This template file contains space for the answers to the written questions of Prac 7.
2. Ensure that you copy-paste your answers inside the space allocated for each question.
3. Provide your numerical answers to **TWO (2)** significant decimal points, unless stated otherwise.

PeopleSoft ID: 1906643

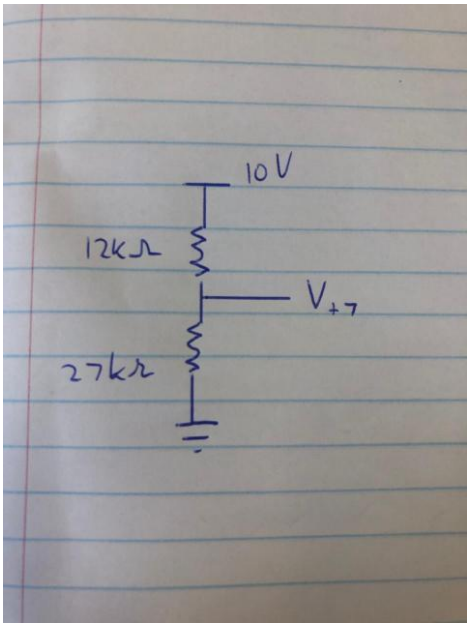
Question 1

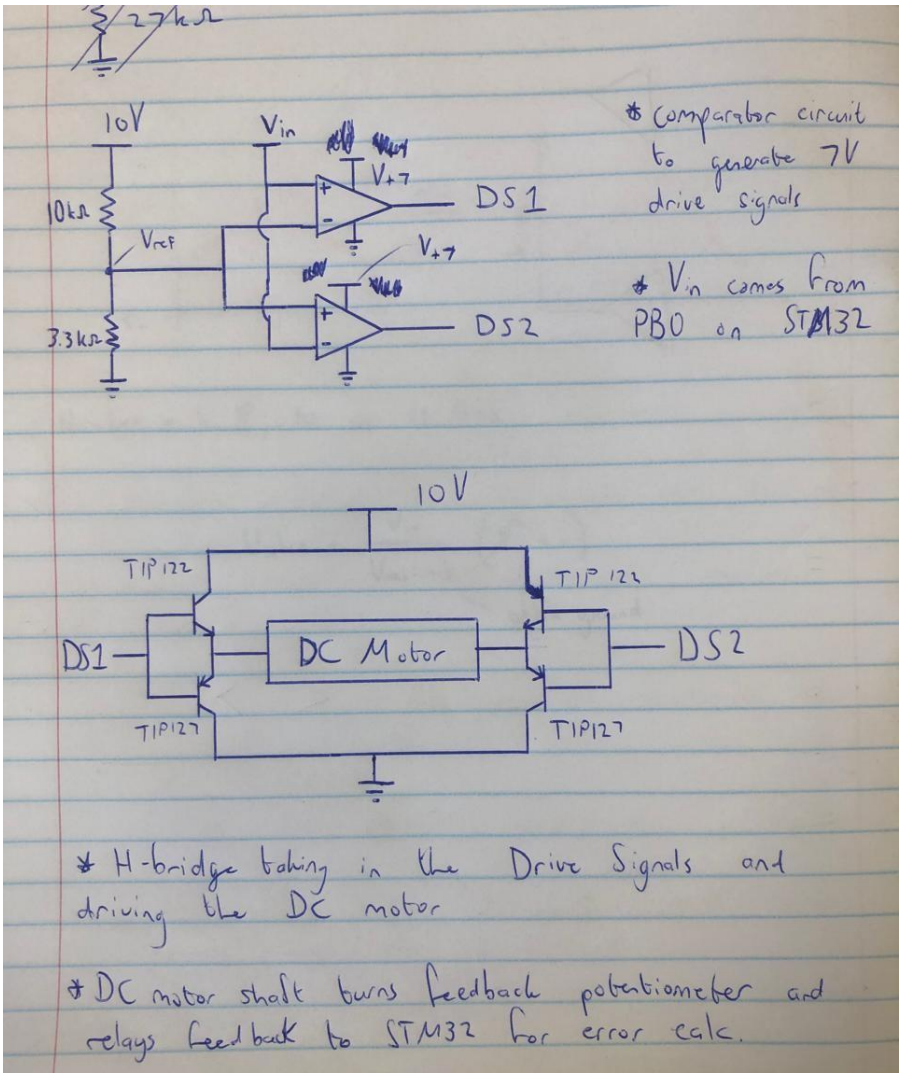
By demonstrating and submitting this practical I agree that:

- I know that plagiarism is a serious form of academic dishonesty.
- I have read the document about avoiding plagiarism, am familiar with its contents and have avoided all forms of plagiarism mentioned there.
- Where I have used the words of others, I have indicated this by the use of quotation marks.
- I have referenced all quotations and other ideas borrowed from others.
- I have not and shall not allow others to plagiarise my work.
- I have not used an AI language model to generate the code or answers submitted here.

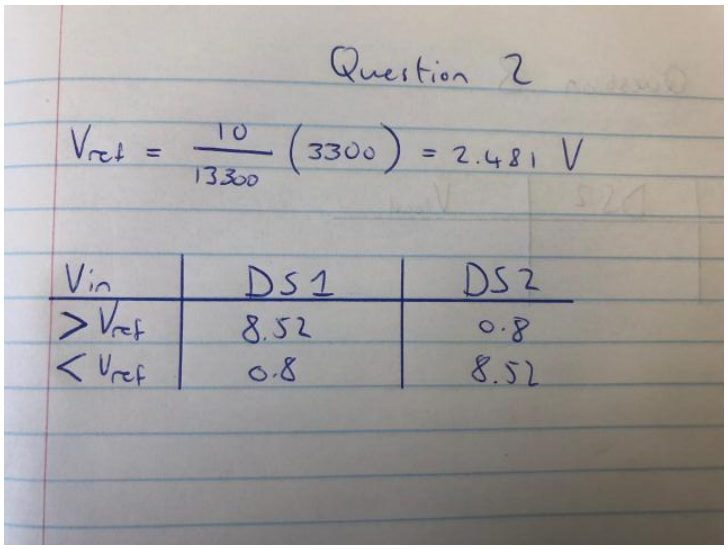
Name: Luke Bruchhausen Signature: Luke Michael Bruchhausen

Question 1


10V
12kΩ
V_{+7}
27kΩ

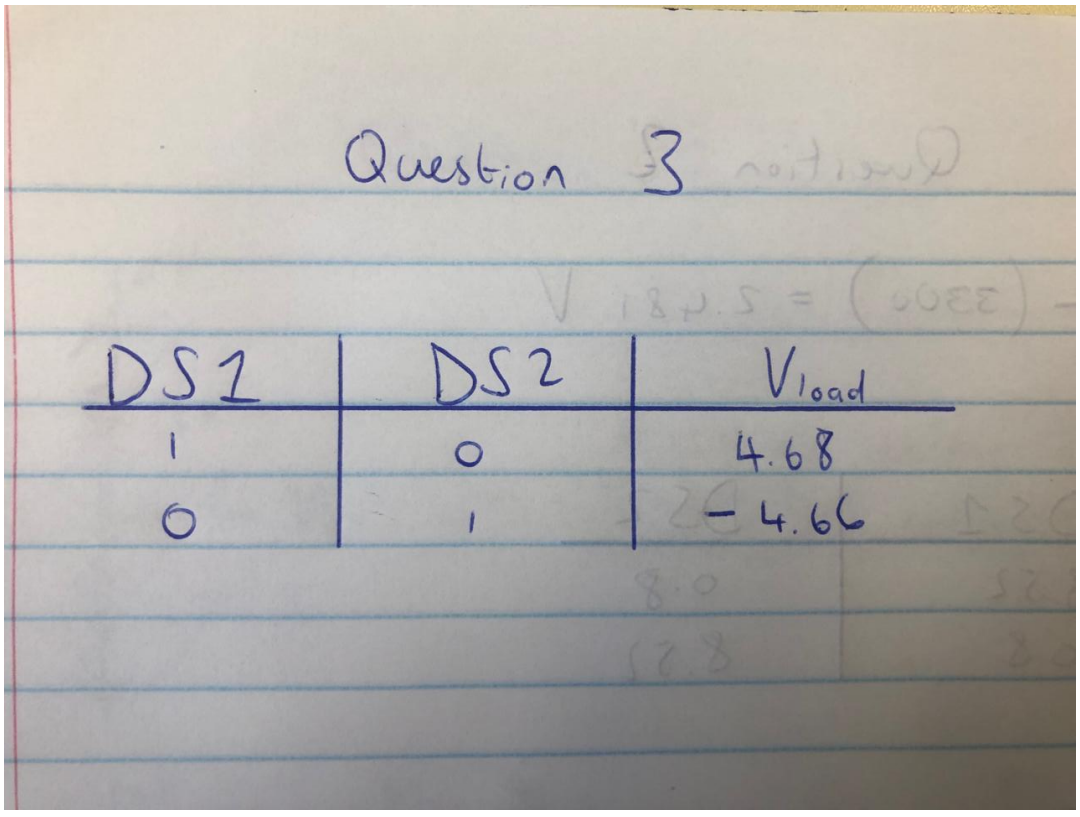

27kΩ
10V
V_{in}
V_{+7}
10kΩ
V_{ref}
DS1
V_{+7}
3.3kΩ
DS2
* Comparator circuit to generate 7V drive signals
* V_{in} comes from PB0 on STM32
10V
TIP122
TIP122
DS1
DC Motor
DS2
TIP127
TIP127
* H-bridge taking in the Drive Signals and driving the DC motor
* DC motor shaft turns feedback potentiometer and relays feedback to STM32 for error calc.

Question 2 (3 marks)

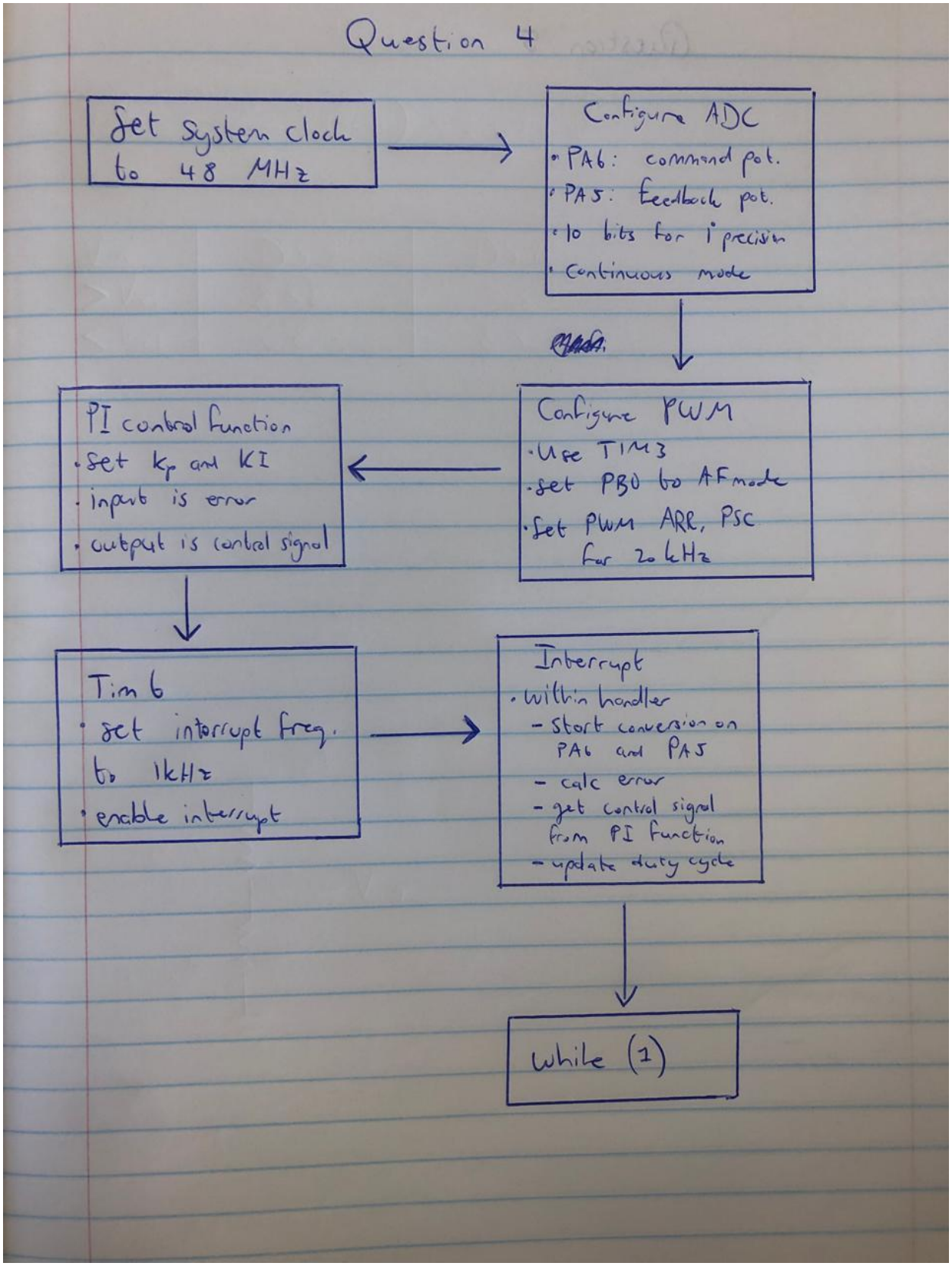


The rails had to be set to 10V instead of using the 7V output of the voltage divider due to the circuit not working as expected when including the divider.

Question 3 (3 marks)



Question 4 (14 marks)



Question 5 (6 marks)

Increasing the proportional gain of the system raises the overall loop gain. This improves the response speed and decreases steady state error. It can lead to increased overshoot and decrease stability. It causes the system to respond more strongly to error, making it faster but less damped. To high a proportional gain will lead to unwanted oscillations.
The integral term accumulates past error and drives the steady-state error to zero. Increasing the term eliminates offset but this integral action is slow and leads to phase lag. It also speeds up the elimination of the offset error but if increased too much, it will lead to overshoot.
In a discrete PI controller, the sampling interval effectively adds a delay of up to one sample period. A smaller sampling interval improves performance while a larger sampling interval slows the control response and introduces phase lag.

Question 6 (10 marks)