



Linnæus University
Sweden

Assignment 2

Real-time Hardware Project

Embedded system



| Author: your surname, your name
| Examiner: Mehdi Saman Azari
| Semester: 24HT
| Course code: 1DT903



Deadline:

The deadline to submit the assignment is **10 Oct 2024**.

Assignment structure:

This assignment will teach you how to perform multithreading using dual-core programming on Raspberry Pi Pico

Rules:

- 1) You have to submit a report for assignment, with the LNU template.
- 2) You have to submit a file, either in *.docx* or *.pdf* format.
- 3) You are allowed to use this file to make you report, or you can use a new one. In the case you use a new file, make sure to refer to the exercises you are answering. In the case of a new file, you still have to use the LNU template.
- 4) The file you submit **must be renamed** as follows: <1DT903_surname_name_assignment2>.
- 5) Deadline is **10 Oct 2024**. Each day of delay over the submission deadline will cause a penalization of 5 points on the global score of this assignment.
- 6) In the case photos are inserted into the report, if the **scans/photos** relative to an exercise **are not readable, no points will be given to that exercise**.

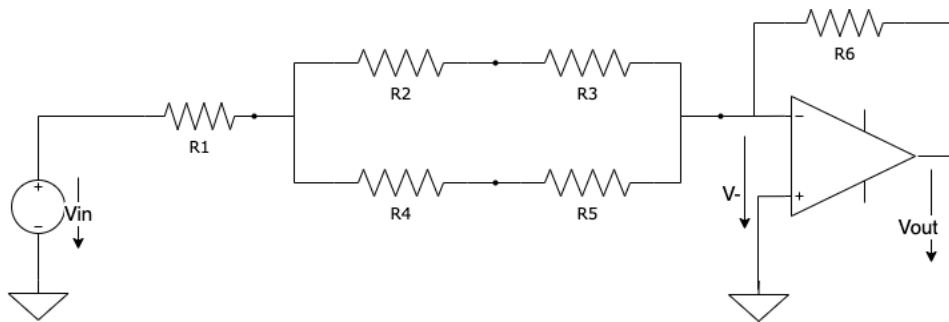


Exercise 1 (10 pts)

The circuit shown in below is an amplifier, amplifying input voltage

$$V_{in}: V_{out} = g_{closed} * V_{in}$$

Compute the gain g_{closed} for the below circuit, as a function of R_1, R_2, R_3, R_4, R_5 and R_6 !



Exercise 2 (10 pts)

Develop the schematic of a 3-bit DAC! The conversion should be done for a 3-bit vector x encoding positive numbers. Prove that the output voltage is proportional to the value represented by the input vector x .



Exercise 3 (30 pts)

Real-time Hardware Project

In this assignment, you will develop a real-time hardware project that demonstrates the necessity of using an RTOS, as MicroPython alone cannot meet the real-time requirements. Your project must include a sensor, a button, an LED or buzzer, wireless communication with a remote device, and real-time constraints that require the use of an RTOS on the Raspberry Pi Pico. You will show the limitations of MicroPython/CircuitPython by implementing the project using a basic program that fails to meet the real-time requirements.

Steps:

- Use RPi Pico 2040 as the microcontroller.
- Implement a real-time hardware project with at least one sensor, one button, wireless communication with a remote device and an LED or buzzer
- Implement a wireless communication protocol (such as WiFi) to transmit the processed data to a simple user interface (such as a web page) to display the processed data.
- Perform the test by the MicroPython/CircuitPython implementation
- Perform the test with the RTOS-based implementation and the Compare the results to demonstrate the necessity of using an RTOS to fulfill the real-time requirements of the project (optional)

Report

- Describe the project, including the hardware components and their functions.
- Explain the real-time requirements and why an RTOS is necessary.
- Detail the implementation process for MicroPython/CircuitPython versions of the project

Evaluation Criteria

- Project complexity and creativity.
- Fulfillment of real-time requirements.
- Quality of the test protocol and its ability to demonstrate the necessity of an RTOS.
- Thoroughness of the report, including clear explanations and supporting evidence.

Notes

- This assignment is designed for group work (max 2 person).