RMIT University

School of Engineering

Advanced Mechatronics System Design – MANU2451

Student Name:

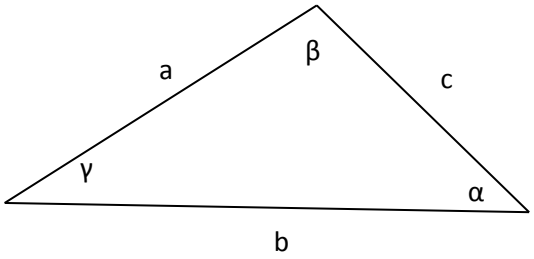
Student Number:

You have 60 minutes to finish this test and return this page at the end of the test period. If this page is not returned, you will not receive any mark for this assessment. After you finished testing your code, put all your files in a zip-folder, and then submit the zipped folder through Blackboard → Assignments → Programming Assessment.

If you have any questions, please raise your hand. This is an open book assessment and you can use all available materials. **However, this is an individual assignment and no form of communication with any other person (except your lecturer) is allowed during this test.**

Task 1: Please save and submit as "YourStudentNumber_Task1" (4 Points)

In a triangle, when we are given the length of three sides (a, b, c), we can calculate the angles using the cosine rule.



Write a program which allows you to:

a. Key in the length of three sides (on front panel) – 1 Point

b. Calculate the angle α (on the block diagram) – 2 Points

c. Show the angle α (on front panel) – 0.5 Point

The program has to run continuously until you press stop – 0.5 Point.

Task 2: Please save and submit as "YourStudentNumber_Task2" (6 Points)

In this task, you will create a counter which can be reset by pressing a reset-button.

a. Create a counter using Shift Register which will count 0, 1, 2, 3… at each iteration – 1.5 Point.

b. Each iteration needs to be 0.1s long – 0.5 Point

c. Use another Shift Register to detect change in a front-panel push button, i.e. if the state now is different from the previous state, give a Boolean TRUE – 2 Points.

d. When a change in front-panel push button is detected (as in part c of this question), reset the counter to start from 0. – 2 Points.

Task 3: Please save and submit as "YourStudentNumber_Task3" (4 Points)

Note for 2018 students: You won't be tested on this because we did not cover matrix in class.

Matrix algebra:

a. Write a program to obtain the result of: (1 Point)

$$\begin{bmatrix} 1 & 3 & 6 \\ 5 & 2 & 7 \\ 4 & 3 & 3 \end{bmatrix} \begin{bmatrix} 2 \\ 9 \\ 3 \end{bmatrix}$$

Note: If you have used a "control" to define the matrices, please right click on it, and select "change to constant" before submitting your answer.

b. Write a program to obtain the values of (a, b, c) from the following equation. Hint: you may use matrix inverse for solving this problem. (3 Points)

$$\begin{aligned} 3a + 4b + 6c &= 2 \\ 5a + 2b + 3c &= 7 \\ 6a + 5b + 9c &= 8 \end{aligned}$$

Note: If you have used a "control" to define the matrices, please right click on it, and select "change to constant" before submitting your answer.

Task 4: Please save and submit as "YourStudentNumber_Task4" (6 Points)

In this task, you will plot sine and cosine waves in graphs, and save the values in a file.

a. Create controls on the front panel which allows you to key in the amplitude, frequency and phase of a sine wave (A_1, ω_1, φ_1 respectively), and also another amplitude, frequency and phase of a cosine wave (A_2, ω_2, φ_2 respectively). (1 point)

b. Write codes to calculate continuously (2.5 Points):

$$y_1 = A_1 \sin(\omega_1 t + \varphi_1)$$
$$y_2 = A_2 \cos(\omega_2 t + \varphi_2)$$

c. The update rate of the "t" above should be every 100ms. (0.5 Point)

d. Plot both waves in a single Waveform Chart (1 Point)

e. Save the waveform y2 in an excel file (1 Point)