Part 1: Essay

1. Select one of the key industry 4.0 technology and write a literature review about how the selected key technology will contribute to the implementation of industry 4.0.
    a. Some of the key technologies for your consideration include the internet of things, advanced robotics, big data, cloud computing, artificial intelligence, augmented reality, additive manufacturing. This is not an exhaustive list and you can select other key technologies which may come across during the review.
    b. Some suggestions for the summary are an introduction about the technology, its contribution to the fourth industrial revolution, and any challenges associated with the implementation of the technology.
    c. Your summary should consist of between 600 and 700 words (without references).
    d. Use Harvard referencing style (You can find more information about the Harvard referencing style from University of Exeter library guide: https://libguides.exeter.ac.uk/c.php?g=693244&p=4971276#s-lg-box-wrapper-18441833)

Marking Criteria	**Marks (%)**
Knowledge and understanding about the selected key technology	30
Use of research-informed Literature (including referencing)	20
Cognitive/ Intellectual Skills (e.g. analysis and synthesis; logic and argument; analytical reflection; organisation and communication of ideas and evidence)	30
Presentation style (clarity of writing and overall readability of the report)	20
Total	**100**

Part 2: Robotics design challenge using Matlab/Simulink

The challenge is for you to design your own robot that uses the end effector to trace a specific shape. This mimics a welding action (for example the welding robot in Figure 1).

Figure 1: An example of a welding robot

The shape to be traced is a *rectangle* and has the following waypoints (in cartesian coordinate (x, y, z), with units in metres):

(0.5,-0.5,0.1), (0.5,-0.5,0.5), (0.5,0.5,0.5), (0.5,0.5,0.1), (0.5,-0.5,0.1).

Figure 2 shows the waypoints in 3 dimensions.

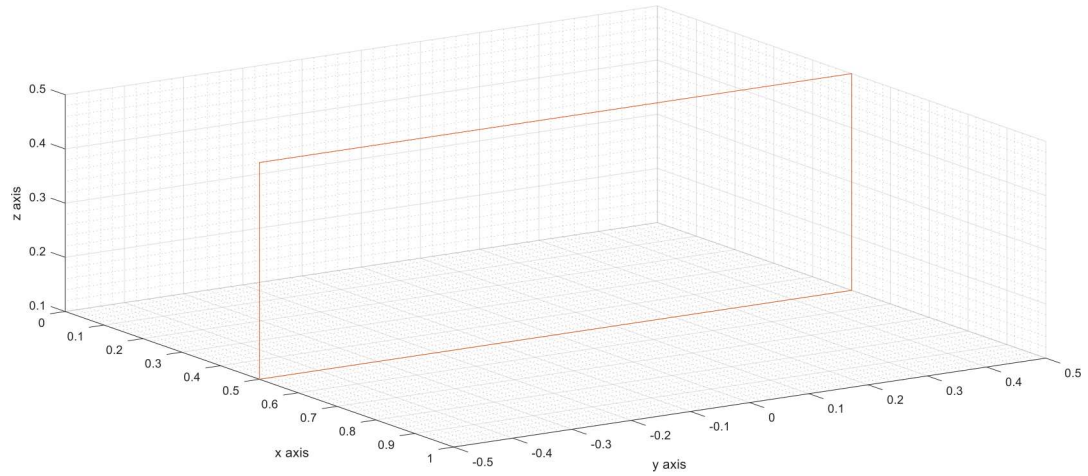

Figure 2: Waypoints

These waypoints should not be changed and must remain fixed. These waypoints provide the specific location the welding tip (end effector) should be located since the components to be welded has to be at this location.

Tasks

Based on your design, complete the following tasks for your robot.

1) Sketch the overall design of your robot. Clearly labels
    a. all the joints (revolute or prismatic),
    b. all the arms (and length).
    c. Also clearly indicate the limits of each joint (e.g. to avoid clash)

2) Draw the reachable workspace.

3) Draw the kinematic diagram using the Denevit-Hartenberg frame rules.

4) Using MATLAB/SIMULINK, create the robot simulation and animation to trace the required shape. Ensure that the robot passes through all the waypoints with no or minimal distortion.

    You need to design all the controllers needed (feedforward and feedback) to enable the end effector position control.

    Notes: *You can use workshops 4 and 5 as a starting point, but marks will be given based on the originality of your design.*

Marking criteria

This part of the report should be brief, concise and to the point.
The marking criteria are as follows:

Task	Criteria	Marks (%)
1	*How original and unique is the designed robot?* *Do the arms, joints and their limits have been specified properly?* *Is there a possibility that any of the joints might clash with its arms?*	25
2	*Does the reachable workspace have been drawn properly and represent the designed robot and its limits?*	5
3	*Does the kinematic diagram have been drawn properly?* *Does the diagram satisfy the Denevit-Hartenberg frame rules?*	5
4	*Has the Simulink model and animation have been implemented correctly?* *Does the end-effector position trace the rectangle and the waypoints with no (or small distortion)?* *Has the feed-forward and feed-back (PID) controllers been designed, implemented and tuned correctly?*	60
5	*Presentation - clarity of writing and overall readability of the report*	5
	Total	**100**

eBart Submission Instructions:

- **This coursework submission files have two parts:**
  a) **A report in PDF that contains answers for tasks in part 1 to part 4**
  b) **Simulation files that implement the simulation model for part 2*.**
     The simulation files should contain:
     i. **One m file and**
     ii. **one Simulink (slx) file**

- **ZIP all three files (PDF, m and slx) before submitting to eBart**.**
  Name your zip file eBartCandidateNumber.zip
-
- **File naming convention***:
  - **eBartCandidateNumber.pdf**
  - **eBartCandidateNumber_init.m**
  - **eBartCandidateNumber.slx**

REMARK:
*** The submitted simulation files should run task 4 for part 2.**
**** Make sure that files submitted are the correct file type. Incorrect file type may fail to open and thus preventing it from being marked.**
***** If you are not sure what your eBart candidate is, check the eBart submission page.**

The ZIP file for this coursework must be submitted to **e-BART** (https://bart.exeter.ac.uk - School: CEMPS, location: Harrison) by 12:00 noon on the date indicated on the front page of this document.

In the report, you should address all questions in all parts presented above, which should be **brief and to the point**. Furthermore, you should include the MATLAB commands or SIMULINK diagrams you used, and the text or image output produced. Finally, you should include the reasoning and motivation behind the choices made.

Matlab Version requirement:
The official version to be used for this coursework is Matlab 2021a
If you are using Matlab later than R2021a, please save your Simulink file to R2021a version – In Simulink, Menu>File>Export Model to>previous version>select R2021a models.
If you are using a Mac, make sure the file can be open in a windows PC.

Report (PDF) formatting requirement:
- The report should **not exceed ten A4 pages** (or approximately 4000 words - when excluding plots/figures/codes).
- Only **Arial or Calibri Light** font styles may be used and text should be **justified left**.
- You should use a **minimum font size of 11.**
- Margins must be at least 2cm in all directions.
- The document size should be standard **A4 size**, single column.
- All **pages must be numbered**.