University of Wollongong:

School of Mechanical, Materials, Mechatronics Engineering

ROBOTICS GROUP PROJECT

You need to comply with the following rules:

(i) **Forming a group:** A group consists of 4-6 members. You are free to join with any other students to form a group. Each group elects a group coordinator who is responsible to organise the group meetings and coordinate the operation of the group. Each group need to pick a group name.

(ii) **Report:** Your group must submit **one written report**. The report should include:

- The cover sheet as attached.
- The assumptions you have made in the design of your robot.
- The design of your robot in the form of response to the questions asked in the project.
- The fair contribution sheet completed as described in the class.

(iii) **Presentation:** The groups will give a presentation on their work. They can nominate 3-6 members of the group to give the presentation. The presentations will primarily consist of the configuration of the designed robot using Matlab and related theory or background. The length of the presentation will be about 15 minutes.

(iv) **Matlab script:** You must upload to the system before presentation, the Matlab script you have developed at different stages of your project and in animation of the Assembly process. The script should be in working condition as it will be run during the assessment of your project to confirm your result.

(v) **The Project Mark:** The project mark will consist of 15 marks for the report and 15 marks for the presentation, which will be based on the presentation of the group representatives. The group mark will be scaled by fair contribution rate. The assessment criteria used are as follows:

Presentation:

Technical Correctness	Presentation Clarity	Presentation structure	Presentation Quality	Effort
1/5	1/5	1/5	1/5	1/5

Report:

Design	Modelling of the Robot	Report Quality
6/15	6/15	3/15

Group Project

Automatic Assembly of a Mobile robot

The mobile robot shown in Figure 1 should be automatically assembled using a robotic system. The assembly process is illustrated in Figure 2. Your task is to **<u>design a robotic system</u>** to carry out the assembly. The Assembly work cell is shown in Figure 3. You can place your robotic arm anywhere in the work cell provided.

You need to consider the following data for the robot parts:

- The upper and lower panels are the same size of 260(width) × 500 (length) mm.
- The motors driving the wheels are already installed on the lower panel when they arrive for assembly.
- The wheels are simply pushed to clamp of the shafts of the motors.
- The L3 spacer is 30 mm.

Figure 1- Mobile robot

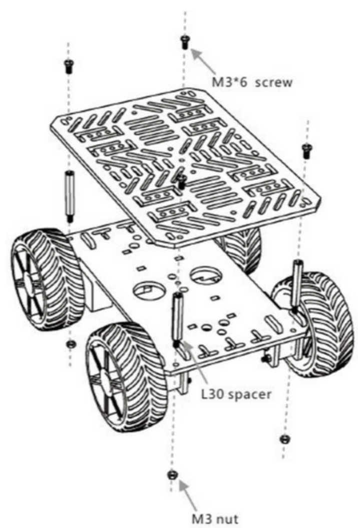

Figure 2- The assembly process

Consider the following assumptions in your design:

- You should choose an industrial robot from any robotics companies, such as Kuka, ABB, Kawasaki, Yaskawa, Epson, Mitsubishi, Omron, Staubli, Siasun, Nachi, IGM etc. No more than 2 groups can choose the robots from the same manufacturer. The system should consist of one robot with maximum 6 DoFs. After your selection of robot, confirm with lecturer before proceed with calculation and simulation. You can position your robot anywhere in the workcell
- You should choose a proper gripper and its powering mechanism required for each component and justify your choice. You don't need to consider the gripper action during the simulation (assuming the end effector is always equipped with the right gripper to

perform a task).

- The robotic system approaches each component from the above or front along the normal to its plane.
- Your robot should include the joint required to screw the nut and M3 screw.
- You can make assumption about any dimension not provided in the diagram.
- The fingers of the robot gripper (tool) have a length of 50 mm.

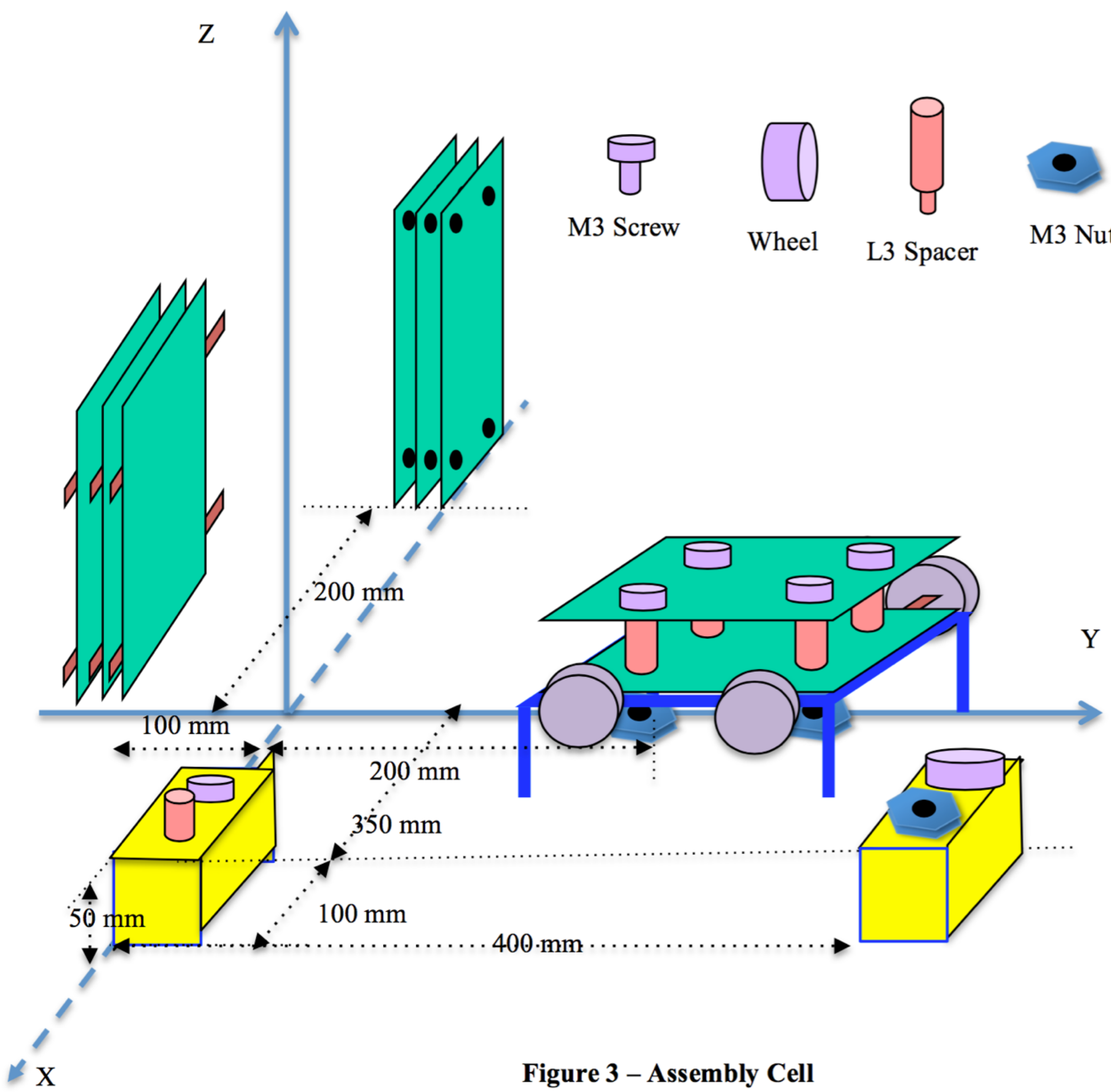

Figure 3 – Assembly Cell

Questions:

1) Design a robotic system that can perform the assembly task automatically. Determine:

a) The number of degrees of freedom (DOFs) of the robotic system.
b) The number and type of the joints of the robot.
c) The base position of the robot
d) The length of the links of the robot.
e) The horizontal and vertical reaches of the system.
f) The joint space work envelope required by the robotic system to perform the task.

2) Derive the orientation and location of the tool of the robot when picking a wheel and lower panel from the magazines in terms of normal, sliding and approach vectors.
3) Derive the kinematic model of the robot and determine
   a) The coordinate frames attached to the links of the robotic system.
   b) The kinematic parameters of the robotic system.
   c) The arm equations relating the coordinate frames of the robot tool to the coordinate frame of its base.
4) Using Matlab robotics toolbox to derive the kinematic model and confirm the results obtained in 3.
5) Using Matlab toolbox to determine the tool Jacobian matrix when the robot picks an M3 screw and depositing it.
6) Using smooth interpolation in Matlab toolbox, determine the smooth transition for the tooltip of the robot when picking an M3 screw and depositing on the first hole of the panel from left. Choose appropriate via points. Animate the transition using the function provided in the toolbox.
7) Calculate the velocity of the robot joint to produce the tool trajectory you have generated for picking an M3 screw and depositing on the first hole of the panel from left. Plot both the tool trajectory and joint velocities using Matlab.
8) Use Matlab to show different configurations that your robot and its tool assumes when performing the assembly process.

Zengxi (Stephen) Pan,

October, 2020

Group Project Cover sheet

Group number:

Group name:

	Student number	Student name	Contribution (100%)	Signature
1				
2				
3				
4				
5				
6				