AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
MECHATRONICS ENGINEERING DEPARTMENT

Fall Semester, 2024

MCT411: Hybrid Control

Major Task

Project (A): Furuta Pendulum

Project Description:

You are required to make a **Furuta Pendulum (Rotary Pendulum)** **as shown below in Figure 1.**

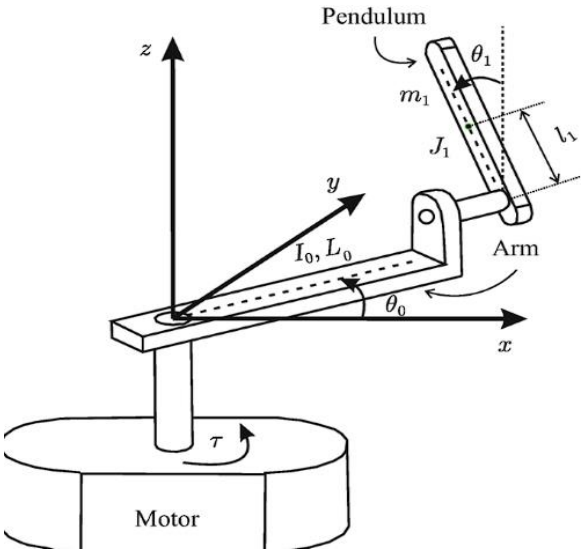
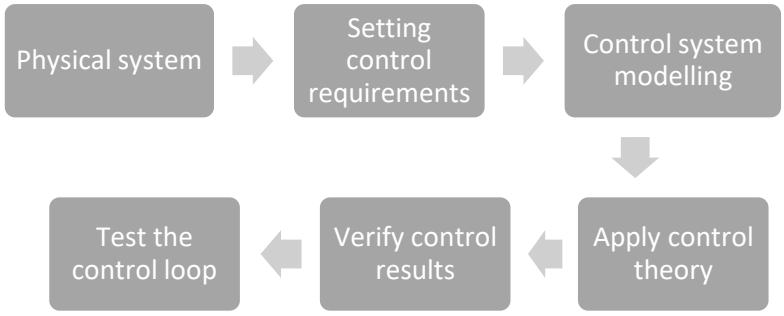


Figure 1 Furuta Pendulum

You are required to:

1- Use the pole placement technique to control the pendulum.
2- Control the angle *theta1* to be zero. So, the pendulum stands in the upright position.
3- Overcome any disturbances that may affect the pendulum. So, the pendulum should maintain its upright position and don't fall.
4- Follow the standard procedure for performing a control task to design a controller to regulate the system's output according to the set control requirements.

- ***Standard procedure for performing a control task:***



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Project (A): Furuta Pendulum

Quick bullets you need to care for:

- You need one motor equipped with an encoder to control *theta0* and one encoder (at least 360 pulses/revolution) for *theta1*.
- Wires should be hidden as much as you can, and All components must be fixed well.
- You can choose any platform that can be connected to the MATLAB from the below list in **Figure 2.**
- You **must** build and control your model on MATLAB/SIMULINK.
- You must implement HIL (Hardware in the loop) using SIMULINK.

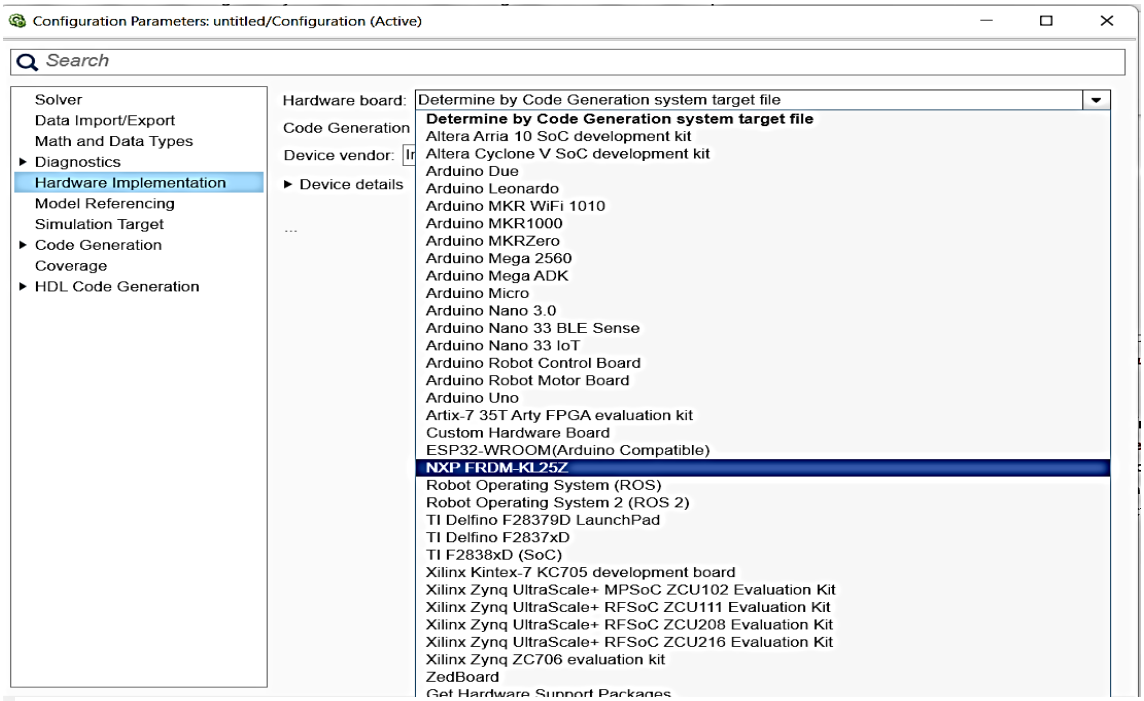

Figure 2 A sample of the supported platforms by MATLAB

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Project (A): Furuta Pendulum

Project Submission

Working in the project should be **in groups up to Four**. You all should submit **a compressed file** containing the following deliverables:

1. (MATLAB/SIMULINK + CAD) Source code files. (Project folder)
2. You should prepare at least 5 mins video **with talking** for evaluation.
3. A report in one PDF file containing:
   - **a-** The contribution of each member of the group (What did each member do?).
   - **b-** Project description and features.
   - **c-** Controller Design methodology.
   - **d-** The list of components used and the circuits topology.
   - **e-** System mechanical construction.
   - **f-** Simulink model graphs screenshots.
   - **g-** Problems faced and how you managed to solve it.

Deadline: Week 13.

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MCT411: Hybrid Control

Project (B): Twin Rotors

Project Description:

You are required to make a **Twin rotor system** **as shown below in Fig.1**.

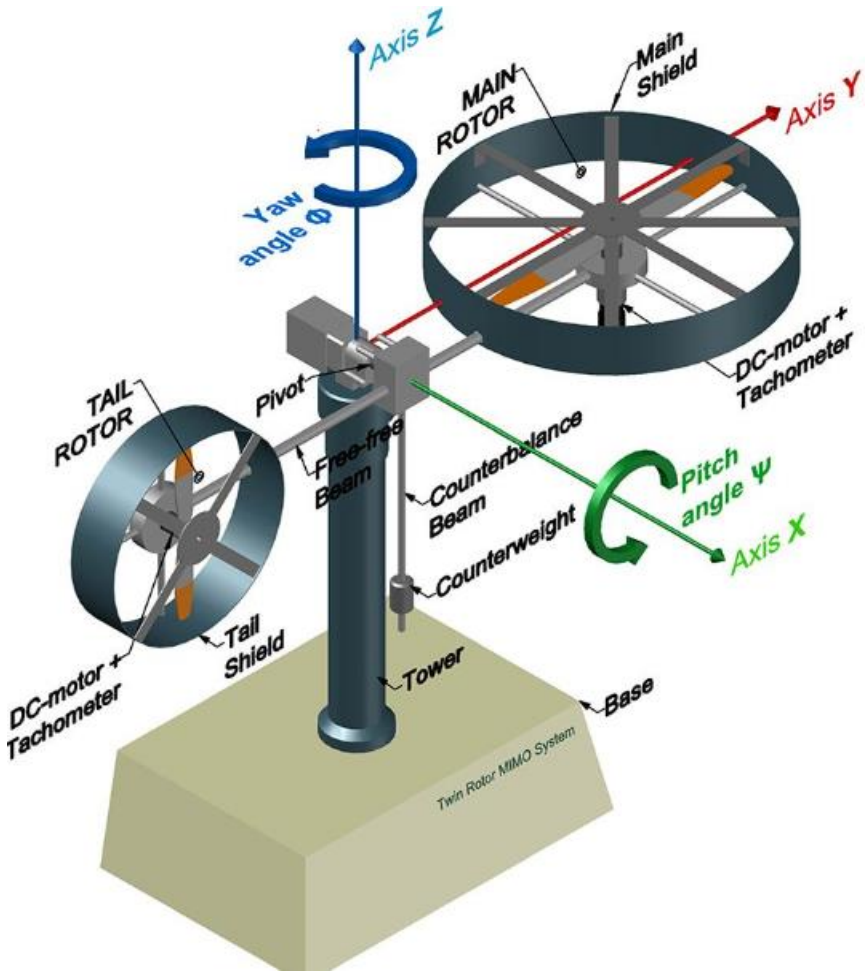

Fig.1 Twin Rotor MIMO System

- You are required to control the Pitch angle as a mandatory task and controlling the Yaw angle is bonus.

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MCT411: Hybrid Control

Project (B): Twin Rotors

Quick bullets:

- **To Control only the Pitch angle. It's enough to use one motor for the main rotor.**
- **Controlling the Yaw angle requires twin rotors.**
- **You don't have to fetch a sensor for the motor speed feedback. It's better to bring a DC motor equipped with a DC Motor**
- **You need a fast motor. Brushless motors are the best choice but normal DC motors with appropriate propeller will do for the job.**
- **Wires should be hidden as much as you can, and All components must be fixed well.**
- **You can measure the rotation angle using encoders or using an accelerometer with a gyro module.**
- **You can use any microcontroller as you want (Arduino is ok)**
- **you must build and control your model on MATLAB/SIMULINK.**
- **You must implement HIL (Hardware in the loop) using SIMULINK.**

Project Submission

Working in the project should be **in groups up to Five**. You all should submit **a compressed file** containing the following deliverables:

1. (MATLAB/SIMULINK + CAD) Source code files. (Project folder)
2. You should prepare at least 5 mins video **with talking** for evaluation.
3. A report in one PDF file containing:
   - **a-** The contribution of each member of the group (What did each member do?).
   - **b-** Project description and features.
   - **c-** Controller Design methodology.
   - **d-** The list of components used and the circuits topology.
   - **e-** System mechanical construction.
   - **f-** Simulink model graphs screenshots.
   - **g-** Problems faced and how you managed to solve it.

Deadline: Week 13.