ME1004 COMPUTER PROGRAMMING

QUIZ 1 (A)

1) Performance Analysis of Robotic Arm Joints

Scenario:
A mechanical engineering firm analyses angular positions, torques, and performance data from a robotic arm used for repetitive tasks. Your objective is to perform a thorough analysis using MATLAB matrix operations to help engineers assess and optimize the robot's performance.

Step-by-Step Tasks:

1. The robotic arm's joints move through angles from 0 to 180 degrees. Create an array named joint_angles containing 10 equally spaced angle positions.

2. Create a matrix named `torque_data` representing measured torques (Nm) on three robotic joints at each of the 10 angular positions. Each torque measurement should be a random value between 0 and 50 Nm.

3. The sensor data at the 5th angle position on the 2nd joint was found to be incorrect. Modify this specific element to represent a corrected torque value of exactly 25 Nm.

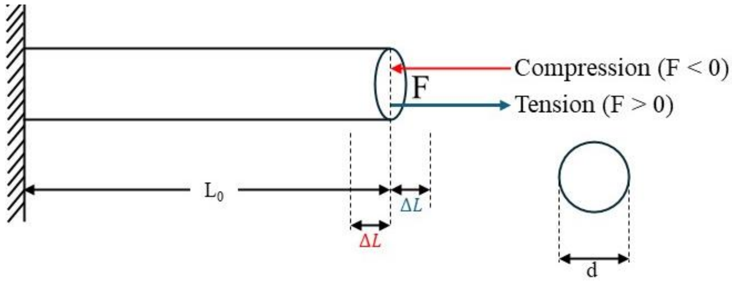
4. Engineering analysis determined the 3rd joint data is unnecessary. Remove the entire row corresponding to the 3rd joint from your `torque_data` matrix.

5. Combine the angular positions with the modified torque data to form a single comprehensive matrix named `analysis_matrix`. The first row of this matrix should contain the angle values, followed by torque data rows for the remaining joints.

6. Calculate the average torque at each angular position across the joints provided and add this as an additional row at the bottom of your `analysis_matrix`.

7. Clearly display the completed `analysis_matrix` with your calculated results. Ensure it is well-organized for easy interpretation by the engineering team.

2) Simple Bar Under Axial Load



A cylindrical bar subjected to an axial load F. The bar can be either in tension $(F > 0)$ or compression $(F < 0)$.

Tasks:

1. Prompt the user for:

a. The load F (in Newtons).
b. The diameter d of the cylindrical bar (in meters).
c. The Young's modulus E of the bar's material (in Pascals).
d. The yield strength σ_y of the material (in Pascals).

2. Classify the load using an if-else structure:

- If $F > 0$, the bar is in tension.
- If $F < 0$, the bar is in compression.
- If $F = 0$, display a message that there is no loading and do nothing.

3. Compute the stress in the bar using

$$\sigma = \frac{|F|}{A}$$

where

$$A = \frac{\pi d^2}{4}$$

and display the calculated σ with its unit (Pa).

- Note that σ should always be positive (use the absolute value of F) to represent magnitude.

4. Provide a switch-case menu for the user to select one of three calculations once the load is known to be nonzero:

1) Compute the strain ε using

$$\varepsilon = \frac{\sigma}{E}$$

2) Compute a safety factor (SF) using

$$\mathrm{SF} = \frac{\sigma_y}{\sigma}$$

3) Compute the bar's approximate elongation ΔL over a gauge length L_0.

    - Prompt the user for L_0 (in meters), then use

$$\Delta L = \varepsilon L_0$$

- If the user chooses anything other than 1, 2, or 3, display an "Invalid choice" message.

IMPORTANT: Display the computed quantities (strain, safety factor, or elongation) with clear units and a short description. If there is no load (i.e., $F = 0$), the code should skip all calculations.

Briefly Tasks:

- Write a MATLAB script that implements the above logic.
- Use an if-else to distinguish tension, compression, or zero load.
- Use a switch-case for selecting which quantity to compute.
- Prompt for all necessary inputs and display meaningful outputs.