

Full Name _____

Question 1. Explain the working principle of a load cell and how strain gauges may be used to support the measurement.

Question 2. Displacement sensors (e.g., potentiometers or ultrasound sensors) can be used as building blocks of more complex sensors. Provide 3 examples of such sensors, what they measure, and how displacement sensors may be used in those cases.

Note: the reported sensors may or may not have been presented during the course; you can provide suitable use-cases for displacement sensors.

Question 3. Design a finite state machine, which implements the controller of a washing machine.

Inputs are:

- the on/off button
- the water temperature sensor
- a water level sensor
- a timer

Outputs control the following actuators:

- a pump that can make the water flows in and out
- a drive that rotates the bowl
- a resistor that can warm the water

The FSM has to implement a single working cycle, composed by:

- a filling phase, during which the tank is filled with cold water (assume the soap is loaded automatically together with water in this phase)
- a heating phase, during which the water is heated
- a washing phase, during which the laundry is washed with hot water
- a rinse phase, during which the laundry is rinsed by clean cold water
- a spin-drying phase

Make adequate assumptions where needed.

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Question 4. Consider a task set composed by 3 periodic tasks. Tasks are described by the tuple (T, C) , being the period and the computation time, respectively. The values of timing parameters are: $T1 = (7, 2)$, $T2 = (8, 3)$ e $T3 = (9, 3)$. Perform the following actions:

- check the schedulability of the task set applying the tests for RM and EDF;
- draw the schedule generated by RM and EDF up to time $t = 45$ or to the first deadline miss.

Suppose to use the EDF algorithm to schedule the periodic tasks, and to substitute the T2 task with a Constant Bandwidth Server having same period and budget equal to T2's computation time.

Redraw the schedule where the CBS is used to accomodate two aperiodic tasks J1 and J2 together with the periodic task set. The two aperiodic tasks have parameters equal to $J1 = (6, 2)$ and $J2 = (9, 4)$, where the first value is the release time while the second is the computation time.

Question 5. Considering the worst case, show the path generated by the Bug 1 and Bug 2 algorithms in the following configuration space (the calculation of the path length is not required).

