Robotics   09/09/2015

Full Name _____

Question 1.   In a manufacturing facility there is a conveyor belt that is used to move some objects.
A proximity sensor is placed to detect if an object is crossing a given point on the conveyor belt. The proximity
sensor is sampled by a periodic real-time task.
Find the minimum period of the real-time task that guarantees that no objects are missed, i.e., an object does not
pass over the detection poit without being detected.
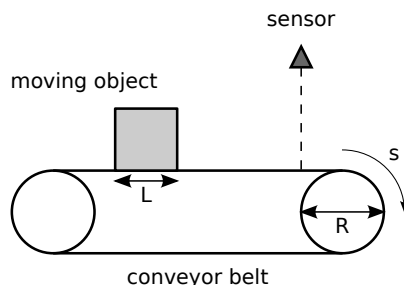
The physical system parameters are:

- minimum size of the object: $L = 10$ cm
- radious of the conveyor belt: $R = 50$ cm
- rotation speed of the conveyor belt: $s = 10$ deg/sec

Also consider that:

- the sampling of the sensor is done in no time (the instruction to read the sensor value is short enough to
  neglect its duration).
- the sampling real-time task is scheduled using the Earliest Deadline First algorithm, together with many other
  tasks.
- the task set including the samplig task is always schedulable.

Make any additional assumption that may apply, if any.

Question 2.   Explain the key features, working priciple, pros and cons of the Network Time Protocol.
What is the role played by the communication delay in the protocol behavior?

Question 3.   Show the state diagram of a Finite State Machine which accepts as input a sequence of up to
100 characters ('A', 'B', 'C', ...) and returns 1 as soon as the string (sequence of characters) ROBOT is found.
Otherwise it returns 0.
You can select between a Meely or Moore formulation.

Question 4.   Shortly explain the working priciple of the Priority Inheritance protocol to manage shared
resources in a real-time computing system.
Show an example of priority inversion that can arise when no protocol is used to manage the concurrent access to
a given resource by different tasks.

Question 5. Plot *the longest* possible path generated by the Bug 1 and Bug 2 algorithms in the following two cases:

Bug 1

Bug 2