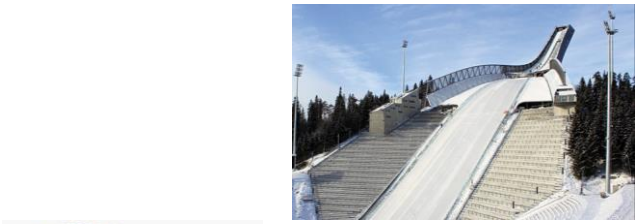
INDUSTRIAL ELECTRONICS – EXAM JANUARY 28th 2011

Candidate Name and Surname ……..

Registration N° ……



We want to adjust the pitch height H in a structure for ski jumping from the trampoline. To this purpose, an open loop control system is conceived, in which an object of the same weight as a typical athlete is subsequently launched from a height H, varying the inclination of the angle with which the skier detaches from the trampoline. The angle is modified by driving the final mobile part of the trampoline by means of a suitable motor. The goal is to give the athlete an exit speed V_0 that does not allow him/her to exceed, during flight time, a predetermined landing distance limit D_{max}.

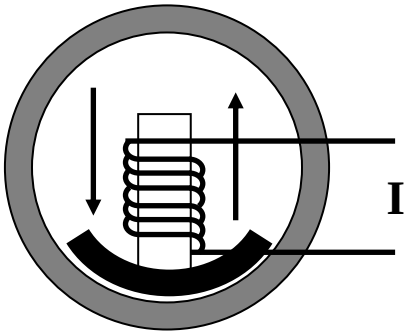
Suppose we know the values of L base of the trampoline and its inclination, Y_0 detachment height.
Suppose also known the horizontal speed V_0 with which the athlete detaches himself/herself from the trampoline. Neglect any form of delay and any air friction.

1. Show how it is possible, by adjusting the height H, to set the distance D on a suitable value. It is advisable in this regard to place a Cartesian reference system with origin at the starting point, X axis parallel to the slope of the trampoline and perpendicular Y axis.
2. Calculate the transfer function of the process highlighting what variables must be known.
3. Plot the Bode diagram of the loop function (process + actuator) discussing the eventual problems in terms of stability/instability. Show the numerical implementation of the regulator if it is necessary.
4. Design a circuit to power supply the motor and explain how it works.
5. Propose a system that measures the process variable in the most convenient way and connect it with a microprocessor.

INDUSTRIAL ELECTRONICS – EXAM JANUARY 28th 2011

Candidate Name and Surname ……..

Registration N° ……



A wheel of a train that rotates at angular speed ω is braked through special brake linings operated by an electromagnetic actuator.

We want to apply the braking action on the basis of the current I given to the actuator so as to slow down the rotation of the wheel but also to avoid to brake if not necessary.

The force that the actuator must exert in order to brake the wheel must take into account all the active and passive components that operate on the wheel of the wheel.

Suppose that there is a delay TD = 500 msec between the perception of the driver and the effective actuation of the brake and suppose to know the rest distance between the lining and the internal surface of the disc.

1. Draw the block scheme of the acquisition/regulation chain identifying the input and output variables in every block and in particular the process variable.
2. Calculate the transfer function of the process highlighting what variables must be known.
3. Plot the Bode diagram of the loop function (process + actuator) discussing the eventual problems in terms of stability/instability.
4. Describe what kind of regulators can be introduced to eliminate the sources of instability and their numerical implementation in particular assuming the controller clock is 200 MHz.
5. Describe how the electromagnetic actuator works. Should it be magnetized or not?
6. Illustrate the features of a power circuit for the regulation of the current provided to the actuator.
7. Describe a measurement system able to acquire the process variable.