ROBOTICS (05/09/2016)

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The exam will be graded IFF the following recommendations have been taken into account:
- Write clearly so that the teacher can easily understand your answers
- Write your name, surname, and student id on each sheet you deliver for evaluation
- For each exercise/question report clearly the number and sub-number (if present)
- You are not allowed to use any programmable device (e.g., smartphone, calculator, etc.)
- You can use pen or pencil, paper will be provided, you cannot use notes or books

Exercise 1 (Algorithm)
Let's consider Simultaneous Localization and Mapping, in particular:
a) Describe the Simultaneous Localization and Mapping problem
b) Describe the difference between online SLAM and full SLAM
c) Describe what a particle filter is and how it can be used for SLAM or localization
d) Describe the FastSLAM algorithm for full SLAM

Exercise 2 (Numerical Exercise)
Let's consider the group of gears in the picture where Gear A spins at 100 revolutions per minute driven by a 100W motor (recall 1W = 1N x 1m / 1s).
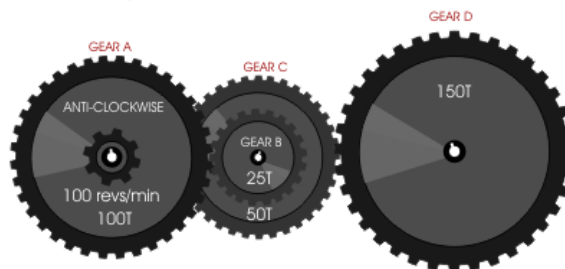
a) What are the output torque and speed on Gear D assuming no loss due to friction?
b) Assume we are using a 24V motor with 0.8 efficiency, how much current is it driving?

Exercise 3 (Theory)
Describe the following kinematics and provide an example for each of them:
a) Differential drive
b) Synchronous drive
c) Trycicle kinematics
d) Ackerman steering

Exercise 4 (ROS)
What are nodes and messages in ROS and how are they used to develop a robot? Make an example of a simple robot and its possible ROS architecture.

Exercise 5 (Other)
Describe the Beam Sensor Model, its components, and the rationale behind each of them.