

pHRI Oral Exam HS2021

- The duration of the oral exam is 25 minutes
- The location of the exam will be announced shortly
- You are expected to prepare all topics listed below for the exam
- At the exam, you will be randomly assigned 3 of the topics

1	Discuss important design criteria for the development of an active hip orthosis for walk assistance in the elderly
2	Discuss important design criteria for the development of the haptic interface of a teleoperated surgical robot
3	Discuss the design process of a safe and efficient human-interactive robotic system
4	Compare serial and parallel kinematics
5	Discuss the effect of position discretization and quantization on position and velocity estimation (sensors, acquisition, processing). How can we address these issues?
6	Measurement techniques (direct vs differential, Wheatstone bridge)
7	Sensor types and optimal placement (position and force)
8	Sensor characteristics and noise (transfer function, sensitivity, accuracy vs precision, etc.)
9	Strain gauge-based force sensing (working principle, measurement system, placement considerations)
10	Compare DC motors with two other actuator types for a prosthetic knee
11	DC motors: dynamic equations, speed-torque curve and efficiency
12	Motor control (conceptual): linear vs PWM amplifiers; velocity, position and torque controllers
13	Power transmission: equations of motion of a gear pair
14	Kinematic equations of a planar 2-DOF manipulator
15	Jacobian transformation
16	System dynamics: Tetrahedron of state
17	System dynamics of a motor-driven rotating mass: sourcing, storing, and sinking energy
18	System model of a human on a unicycle (assumptions, parameters, schematics)
19	Purpose of control / feedforward and feedback
20	PID basics (schematic, contribution of each term, tuning; example of step response)
21	Advanced PID (set point weighting, integral windup, noise amplification)
22	Static friction model (stiction-coulomb-viscous friction)
23	Karnopp friction model
24	Static friction model – parameter identification (stiction & viscous friction)
25	Impedance control (open-loop, feedforward, force feedback) – schematics and concept
26	Admittance control (with position feedback) – schematics and concepts
27	Passivity inequality
28	Performance metrics (KB plot, Z-width, output impedance, how to determine?)
29	Purpose and process of obtaining ethics approval
30	Error analysis methods (FMEA)
31	Possibilities to reduce risks in a pHRI setup