**Entry Exam Questions**
**for international students**
applying for
**Intelligent Technologies in Robotics**
(Tracks on Biomechatronics and Mechatronic Systems and Technologies)

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## *1. Control and Systems Theory*

1.1. State-space and transfer function models.

1.2. Methods for linearizing dynamics models.

1.3. Bode plots in analyzing LTI system properties in a frequency domain.

1.4. Controllability and observability properties and criteria to check it.

1.5. System stability: definition, stability types, and stability criteria.

1.6. Lyapunov function and its application for system stability analysis.

1.7. Pole-placement approach for controllers design.

1.8. PID controllers and Ziegler-Nichols method for tuning its parameters.

1.9. Discrete-time models. discretization and relation between poles of continuous and discrete-time system representation. Nyquist–Shannon sampling theorem

1.10. Full-order and reduced-order state observers.

1.11. Quality criteria for control systems design.

## *2. Electrical and Mechanical Engineering*

2.1. Links, joints, and kinematic pairs: definitions and types.

2.2. Rotation and homogeneous transformation matrices: definition and properties.

2.3. Direct and inverse kinematics tasks.

2.4. Motion equation in configuration space and meaning of its components.

2.5. Direct and inverse dynamics tasks.

2.6. Electric, pneumatic, and hydraulic drive types for robotic systems: classification and main properties.

2.7. Harmonic drives, planetary, and differential gears types for robotic systems: classification and main properties.

2.8. Main principles of controlling DC drives rotation speed.

2.9. Working principles and main properties for capacitive, resistive, and inductive sensors.

2.10. Computer vision systems for robotics: working principles and main properties (LIDAR, ultra-sound, infrared, ToF).

2.11. Embedded controllers types for robotic systems: classification and main properties (AVR, ARM, FPGA).