

Examination Questions for the Final Exam  
„Industrial Robot Systems I, II”  
NAMRR2ENND “Ipari robot rendszerek I, II.” and  
NAMRR25NEC “Ipari robot rendszerek I, II.”  
(for January 2019)

1. The concept of „Group” and “Lie Group”;
2. Generators of Lie Groups, exponential series of constant generators, Lie algebra, the geometric interpretation of the Lie brackets (commutators), Jacobi identity;
3. Basis vectors in the tangent space at the identity element, structure coefficients, commutation relationships;
4. Homogeneous matrices as Lie groups: their generators and the physical interpretation of the generators;
5. Parametrization of Lie groups with special emphasis on the Orthogonal Group and the group of the Homogeneous Matrices;
6. Formulation of the forward and inverse kinematic task for the robots of open kinematic chain: redundancy, kinematic singularity;
7. Differential solution methods: optimization under constraints, the Lagrange multipliers and the reduced gradient method, the Moore–Penrose pseudoinverse.
8. The basics of Classical Mechanics: space and time, inertial systems of reference, Newton’s Postulates;
9. The Variation Principle in Classical Mechanics: generalized coordinates, the Lagrangian, the Euler–Lagrange equations for isolated systems;
10. The Euler–Lagrange Equations for not isolated system: the generalized forces;
11. Industrial robots of open kinematic chain, the application of homogeneous matrices for setting the dynamic model of the robot;
12. The „Computed Torque Control”: the general form of the dynamic model;
13. Lyapunov’s 2nd or „Direct Method”: the stability definitions, Lyapunov function, quadratic Lyapunov function, functions of class „ $\kappa$ ”.
14. The Sliding Mode /Variable Structure Robust Controller: error metrics, relative order of the system under control, chattering and its elimination.
15. Adaptive Inverse Dynamics Controller for Robots;
16. Fixed Point Transformations in adaptive control: Banach’s Fixed Point Theorem;
17. The Robust Fixed Point Transformation and its alternative variant for adaptive control, convergence issues
18. The Model Reference Adaptive Controller based on Fixed Point Transformations.