

Examination Questions for the Final Exam
„Industrial Robot Systems I, II ”
(BSC Nappali– angol nyelvű Mechatronika – Komplex rendszerek szakirány)
(for Summer 2020)

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 „ κ ” .
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