

# Postgraduate Master Study Program – N2301 Mechanical Engineering

Branch of study: Machines and Equipment Design

Specialisation: Production Machines

## Electric drives and servomechanisms

Topics of professional debate for state final exam

- **Introduction to Manufacturing Machinery Automation.** Reasons and benefits of automation, characteristic signs of CNC machine tools construction, trends on the field of machine construction and of technologies (multifunction machines, energy efficiency). The field of automation, implementation examples.
- **Hard and flexible automation** - the definition, the main differences. Grading of machines according to the degree of flexibility and productivity. Comparison machines in terms of production costs per piece and manufacturing productivity. Flexible manufacturing systems.
- **Control Systems.** Structure of control systems, control system categories (by motion control method). Methods of actuator control: micro-interpolator, interpolator. Software controlling the CNC machines. Speed control, circular interpolation.
- **CNC systems, CNC machines.** Definition of CNC machine coordinate system. Definition of CNC machine reference points. Methods for creating NC programs, principle of NC/CNC machines programming (basic parts of the NC program, basic functions, corrections of tool-path etc.)
- **Measuring Systems.** Direct and indirect measuring, analog and digital measuring, incremental, absolute and cyclic absolute measuring, impact of design on measuring accuracy, reference points.
- **Feedback Elements and Measuring Sensors.** Principle and function of photoelectric Sensors (incremental and absolute, direct and rotary), principle and function of Inductive Sensors.
- **Principles of Regulation - Current, Speed and Position Loop.** The dynamic model of the positional servo-drive with rotary and linear motor, principles of position, speed and current control, speed and current feedforwards. Static and dynamic characteristics, positional deviation, response to jump speeds, reaction to the jump loading force.
- **The main parameters of servo-drive,** which have a major impact on the control accuracy and quality of the drive - passband of control loops, position gain, dynamic impact stiffness, dynamic frequency stiffness.
- **Dynamic interpolation errors.** Errors during linear and circular interpolation, quadrant errors due to friction, the basic principles of their compensation, feedforward signals of speed and current.
- **Construction Principles of Positional Servo-drive design** - minimal clearance (loss of motion due to final stiffness and passive resistances), maximum stiffness, small passive resistances, adequate moments of inertia. Gearing and clutches, optimal gearing.