## SYLLABUS

**Actuators**

*Students:* Automation (AT) Bachelors

*Year:* Third

*Semester:* Sixth

*Lecturer and Instructors:*

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Sergei Lovlin Associate Professor sjlovlin@itmo.ru

**Course Description**

The objective of this course is to discuss some of the drive systems based on electrically powered actuators in common use. The course contains the basic principles of the theory of the electric motor and drive, its mechanics, properties and static characteristics, their operating modes, dynamics. The course describes the basics of the theory of electrically powered actuators, as well as the principles of design, analysis and synthesis of modern drive systems. During the assignments in laboratory works the students obtain skills of Actuators design using MATLAB environment.

**Learning objectives**

After the course, the students will:

* Know basic structure, features, modes of operation of electric drives
* Can analyze structure of different industrial mechanisms based on electrically powered actuators and then design appropriate schemes for analysis and modelling
* Know features of multi-mass systems to design appropriate control algorithms
* Know features and characteristics of the main types of electrical drives
* Can design models of open-loop control systems based on different types of electrical motors
* Can use MATLAB to research and analysis electric drive’s systems
* Know basics of PWM algorithms for DC drive and AC drive systems
* Know how to estimate power load parameters in the actuator energy subsystem
* Be able to analyze efficiency of power converter in actuator system
* Be able to analyze and design simple power converters for DC drive based actuators and AC drive based actuators

**Materials**

Main materials:

1. Lecture presentations
2. Lab guides

Additional materials will be added later.

**Course policies**

* The course may use various learning technologies to facilitate learning in traditional on-campus face-to-face education, such as virtual labs with subject software for the course (Vlabs), flipped classes (FC), hybrid or blended learning with computer-based communication (CBC), asynchronous learning (AS), and self-work (SW).
* Students can ask questions via email, or a Ding Talk group dedicated to the course. Instructors answer questions on weekdays two-three times a week between 5 and 7 p.m. Moscow time.
* Participants are expected to attend all classes. It is required to attend at least 70% of classes. Omissions without a valid reason may affect the final grade.
* Please **inform** **the student office** if you will be late or unable to come to a class two or more times. If you miss more than 30% of classes without informing the student office, you will not be allowed to the final test.
* **The teacher is not authorized to dismiss students from classes**, give permission for internships, deal with the student's medical documents, etc. All such operations must be carried out by the student through the student office. And then the student office informs the teacher about the passes.
* **Students should not copy the work of other students and cheat. The teacher IS OBLIGED to inform the student office about attempts to cheat. Please, be responsible!**
* Participants who successfully complete the attendance and the imperative class work will be allowed to the final test. The success in the final test will determine the result mark for the course.
* Individual DingTalk calls or grouping webinars will be used for debt closing.

The course will run SPRING 2025. The 40-hour course includes 25 hours of lectures, 12 hours of labs and 3 hours for a final test. Participants who successfully complete 70 % of classwork will be allowed to access the final test.

**Grade System**

Below is the breakdown of grades for the course.

Attendance — 20 %

Labs — 60% (6 labs)

Final test — 20%

The description of the result mark is presented below:

0% – 59% — fail

60% – 100% — pass

**Course schedule**

| **№** | **Topic** | **Class Type** | **Hours** | **Date** | **Time** | **Group** | **Teacher** | **Comments** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | Mechanics of the actuators | Lecture | 2 | Monday 17.03.2025 | 08:05 – 09:40 | AT3 | Sergei Lovlin | #108 |
| 2 | Vector representation of AC electric drive | Lecture | **3** | Monday 17.03.2025 | 10:00 – 12:25 | AT3 | Sergei Lovlin | #108 |
| 3 | **Lab 1**. Modelling of mechanics of the actuators | Lab | 2 | Tuesday 18.03.2025 | 08:05 – 09:40 | AT3.1 | Sergei Lovlin | #203 |
| 10:00 – 11:35 | AT3.2 | Sergei Lovlin | #203 |
| 4 | Actuator based on induction motor drive | Lecture | **3** | Thursday 20.03.2025 | 10:00 – 12:25 | AT3 | Sergei Lovlin | #108 |
| 5 | **Lab 2**. Induction motor drive modelling | Lab | 2 | Monday 24.03.2025 | 08:05 – 09:40 | AT3.1 | Sergei Lovlin | #203 |
| 10:00 – 11:35 | AT3.2 | Sergei Lovlin | #203 |
| 6 | Actuator based on DC drive | Lecture | **3** | Thursday 27.03.2025 | 10:00 – 12:25 | AT3 | Sergei Lovlin | #106 |
| 7 | **Lab 3**. DC motor drive modelling | Lab | 2 | Thursday 27.03.2025 | 13:00 – 15:05 | AT3.1 | Sergei Lovlin | #307 |
| 15:15 – 16:50 | AT3.2 | Sergei Lovlin | #307 |
| 8 | Actuator based on synchronous motor drive | Lecture | 2 | Monday 31.03.2025 | 13:00 – 15:05 | AT3 | Dmitry Lukichev | #108 |
| 9 | **Lab 4**. Synchronous motor drive modelling | Lab | 2 | Monday 31.03.2025 | 15:15 – 16:50 | AT3.1 | Dmitry Lukichev | #201 |
| Tuesday 01.04.2025 | 15:15 – 16:50 | AT3.2 | Dmitry Lukichev | #301 |
| 10 | Operating modes of the electric drives | Lecture | 2 | Tuesday 01.04.2025 | 13:00 – 15:05 | AT3 | Dmitry Lukichev | #108 |
| 11 | Power switches | Lecture | **3** | Thursday 03.04.2025 | 10:00 – 12:25 | AT3 | Nikolai Poliakov | #108 |
| 12 | DC drive power converters with pulse-width modulation (PWM) | Lecture | 2 | Thursday 03.04.2025 | 13:00 – 15:05 | AT3 | Dmitry Lukichev Nikolai Poliakov | #108 |
| 13 | H-bridge PWM algorithms | Lecture | 2 | Tuesday 08.04.2025 | 08:05 – 09:40 | AT3 | Nikolai Poliakov | #108 |
| 14 | **Lab 5**. DC drive PWM converters | Lab | 2 | Tuesday 08.04.2025 | 13:00 – 15:05 | AT3.2 | Dmitry Lukichev Nikolai Poliakov | #203 |
| Tuesday 08.04.2025 | 15:15 – 16:50 | AT3.1 | Dmitry Lukichev Nikolai Poliakov | #203 |
| 15 | AC drive converters: PWM algorithms | Lecture | **3** | Wednesday 09.04.2025 | 10:00 – 12:25 | AT3 | Nikolai Poliakov | #108 |
| 16 | **Lab 6**. AC drive converters: PWM basics | Lab | 2 | Thursday 10.04.2025 | 13:00 – 15:05 | AT3.2 | Nikolai Poliakov  Dmitry Lukichev | #303 |
| 15:15 – 16:50 | AT3.1 | Nikolai Poliakov  Dmitry Lukichev | #303 |
| Consultation  **Final written test** | | Test | **3** | Friday 11.04.2025 | 13:00 – 15:05 | AT3 | Nikolai Poliakov  Dmitry Lukichev | #305 + #307 |
| 15:15 – 16:00 |