

I. Institution

1. Institution's name	Tomsk Polytechnic University (TPU)
2. Faculty (department)	Electrical Engineering Institute Electromechanical Faculty, department "Electrical Machines and Devices"
3. Postal address	30 Lenin ave., 634050, Tomsk, Russia tpu@tpu.ru http://www.tpu.ru
4. Contact person/coordinator	Julia S. Shumilova (007) 3822- 426136 jss@cam.tpu.ru Coordinator of Academic Exchanges

II. Course's profile

5. Course title	Mathematical Simulation in Electromechanics
6. Course profile	Simulation theory. Mathematical models. Electromechanical objects (the course is designed to study the general mathematical theory of the electromechanical converters and to master the methods of mathematical model construction and practical application in electromechanics).
7. ECTS points available?	Yes
8. Class hours/week	25 hours/week (15 hours/week – major subject course; 10 hours/week – Russian language course)
9. Integrated Russian language course for beginners	Yes, 10 hours/week
10. Language of instruction	English
11. Integrated practical training/ research program	Practical training: Labs with the special developed code package ELCON (practical application of mathematical models for fulfilling electromechanical tasks).
12. Integrated cultural program: excursions etc.	Yes. City tour by bus. Available facilities: library, gym. Optional: concerts, boat and hiking trips, excursions: Tomsk Art Museum Museum of Archaeology and Ethnography of Tomsk State University Siberian Botanical Garden Wooden Architecture of Tomsk Kolarovo Village (church) Luchanovo Glass Factory Bogashovo Ceramics Factory Concert hall (variety show) Drama Theatre performance
13. Number of students	10-20
14. Tuition fees	380/ month / 1 person
15. Course's duration	4 weeks

III. Accommodation

17. Accommodation conditions: student hostel	Available a comfortable 9-storey dormitory single or a double room in one unit with shared bathroom facilities (TV-set, a telephone, a fridge, a microwave oven, a kettle, an iron and an ironing board) bed linen is provided and laundered regularly a well-equipped kitchen and a lounge on every floor single room: 100/month per person, double room: 75/month/person
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Additional description of the course

The course is designed for senior students of Electrical Engineering.

At present time the engineering computer design of technical objects of various types, including electrical machines as electromechanical converters, are world-wide distributed. In its turn, the engineering computer design is based on mathematical models of technical objects. There are three types of mathematical models: optimization models, dynamic models, and probability models. The course deals with dynamic (functional) mathematical models.

The course is designed to study the general mathematical theory of the electromechanical converters and to master the methods of mathematical model construction and practical application when solving problems in electromechanics.

Expected outcome: The students will be able to construct mathematical model and to implement analysis and synthesis of the electromechanical converter with this model.

Contents of the Course:

Study on the course includes work with a theoretical material, practice (labs) using the computer code package ELCON and quizzes. The theoretical material of the course consists of four topics.

Fundamentals of mathematical simulation of technical objects: Fundamentals of the electromechanical converter mathematical simulation including methods of construction, verification and practical application of mathematical models.

Hierarchy of electromechanical converter mathematical models differing in the degree of idealization of physical processes involved. Theory of generalized electromechanical converter and its basic equations.

Equations for electromechanical converters and methods for solving these equations: Electromagnetic equations. Linear and nonlinear algebraic equations. Numerical methods for solving the nonlinear equations. Newton method.

Approximation of nonlinear function. Electrical balance equations. Linear and nonlinear differential equations. Numerical methods for solving the differential equations. Explicit and implicit Euler method. Numerical differentiation of function.

Linear models of electromechanical converters: Construction and application of linear mathematical models of electromechanical converters with lumped parameters including typical examples: double-wound transformer in transient regimes, direct-current motor in start, induction motor in start and reverse.

Nonlinear models of electromechanical converters: Construction and application of non-linear mathematical models of electromechanical converters with lumped parameters including typical examples: direct current generator in self-excitation, two-phase synchronous generator in sudden asymmetrical short-circuit, induction motor in continuous duty.

In addition to the theoretical material there is special developed code package ELCON for training in mathematical simulation of electrical machines of various types.

The student should do labs using the computer code package ELCON. A code package is intended to acquire habits in computer realization of the mathematical models. The code package has a developed system of a menu and context-sensitive help and allows much room for manipulation of the mathematical models of various types of electromechanical converters. Also it has graphing and report capabilities.

List of Labs: Lab 1. Single-phase double-wound transformer in transient regimes.

Lab 2. Direct-current motor in start.

Lab 3. Induction motor in start and reverse.

Lab 4. Direct current generator in self-excitation.

Lab 5. Nonsalient pole synchronous generator in sudden asymmetrical short-circuit.

Lab 6. Induction motor in steady-state regime.

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