TOMSK POLYTECHNIC UNIVERSITY ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

APPROVED BY
Director of Power Engineering School
_____ A.S. Matveev
«30»____06_____ 2020

Software for electric power system operating

Field of study: 13.04.02 «Electrical Power Engineering and Electrical engineering»

Programme name: "Electric Generation and Transportation"

Level of Study: Master Degree Programme

Year of admission: 2019 year

Semester, year: 2, 2020

ECTS: 3
Total Hours: 108
Contact hours:

- **Lectures:** 8
- **Labs:** 16
- **Practical expertise:** 8

Assessment: grading test

Department: Department of of Electric Power and Electrical Engineering

Head of department: of Electric Power and Electrical Engineering Department _____Ivaschutenko A.S.

Instructor: _____ I.M. Katz

2020

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Software for electric power system operating

Course Overview

Course Objectives	The objective of the course is to obtain knowledge and skills of application of specialized software for electric power system operating. Course aimed to achieve of objectives O3, O4 and O5 of the Basic Educational Program «Electrical Power Engineering and Electrical engineering»; knowledge, skills and experience gained will qualify the graduate for: – design-and-engineering activities, calculation, analysis and design of electrical industry units, objects and systems with the usage of modern design automation utilities (O1); – research activities, including interdisciplinary branches, connected with mathematical modeling of processes in power systems and its elements, performance of the experiments and its analysis (O3); – industrial activities in the field of exploitation, installation and adjusting, maintenance and examination, diagnostics and monitoring of electrical power engineering and electrical engineering equipment correspondently to specialization (O4); – self-education and mastering new knowledge and skills for the purpose of future professional career realization (O5).
Learning Outcomes	– Classification and range of application of existing specialized software complexes for power system operating (CO1) – Characteristics and parameters of equipment and power systems necessary for working with specialized software complexes and approaches of their calculation (CO4) – Methods of estimation and analysis of results obtained with specialized software complexes for power system operating (CO6)

Course Outline	The discipline is divided into four parts: Part 1. Course fundamentals Part 2. Models of Power System Network Elements for Steady State Calculations Part 3. Electrical Load Models for steady-state calculations Part 4. Models for Power System Transients Calculations The iscipline acquisition employs following educational process organization forms: lectures, practical expertise, labs, self-guided work of students, individual and group consultations. Following the successful completion of the course, students will be able to prepare raw data of the given object in compliance with formal rules of modern specialized software complexes for power system operating; implement calculations of steady-state and transient modes on the basis of the knowledge about permitted and actual modes of power systems and their elements; work out computational experiments plan and analyze obtained results; chose protection and automation on the basis of calculation results.
Prerequisites	Electrical power networks and systems, Power supply systems, Power plants, Heat and Power Engineering, Power Economics, Electromagnetic transient processes of Power Systems, Electromechanical Transient Processes of power systems.
Course Structure	*Part 1. Course fundamentals* Operation States of a Power Systems and basics requirements for its analysis. Basics simulation techniques. Classification and specialization of software for power system operating. *Practical work 1.* Nodal-voltage method. Admittance Matrix of the electric network. Load Flow Solution by the Newton–Raphson method *Part 2. Models of Power System Network Elements for Steady State Calculations* Models of the typical buses and branches. Classification of Node Types. Models of power transformers, power generators, reactors and power lines for power systems steady-state modes c1alculations with specialized software. Types of models, equivalent circuits, parameters and principles of a model choice. *Practical work 2.* Calculation of power transformers, power generator, power lines and reactors models parameters. Nomenclature of reference data for these elements. Sequence and peculiarities of the models parameters calculation. *Laboratory work № 1* «Preparation of raw data, computation and

	adjustment of steady-state modes» *Part 3. Electrical Load Models for steady-state calculations* Types and characteristics of electrical loads of power systems. Ways of consideration of load parameters dependence on power system operational parameters. Load models choice and evaluation of their main parameters. *Practical work 3.* Investigation of electrical mode parameters influence to induction and synchronous motors operation *Laboratory work № 2* «Influence of static characteristics on parameters of steady-state mode of power system». *Part 4. Models for Power System Transients Calculations* Types of power system exploitation tasks solved on the basis of transients calculations. Power system parameters and their dependences, considered during transients calculations, consideration of automation influence. Peculiarities of power equipment models for transients calculations. Transient and Dynamic Stability. Method of its analysis. *Practical work 4*«Calculation of short circuit currents in power systems». *Laboratory work № 3* «Investigation of Power system Transient and Dynamic Stability ». *Laboratory work № 4* «Simulation of starting and self-starting processes of asynchronous motors».
Facilities and Equipment	– practical works are held in specialized classrooms; computers are connected to the net-work of the Institute of Power Engineering with access to the Internet; the tutorial for practical works on discipline «Software for electric power system operating» is provided; – lectures are delivered in educational classrooms equipped with all necessary technical means: computers, blackboards, projectors; lectures are supported with Power Point presentations;
Grading Policy	In accordance with TPU rating system we use: Current assessment which is performed on a regular basis during the semester by scoring the quality of mastering of theoretical material and the results of practical activities (performance tests, perform tasks, problem solving). Max score for current assessment is 80 points, min - 55 points. Course final assessment grading test is performed at the end of the semester. Max score for course final assessment is 20 points. The final rating is determined by summing the points of the current assessment during the semester and exam (credit test) scores at the end of the semester. Maximum overall rating corresponds to 100 points, min pass score is 55 points
Teaching Aids	**Compulsory Readings:**

and Resources	1. Wood A.J.,Wollenberg B. F. Power Generation, Operation, and Control. – Wiley-Interscience, 2013. – 592 p. 2. Glover J. D. Sarma M. S., Overbye T. Power System Analysis and Design, Fifth Edition.– Cengage Learning, 2011.– 853 p. 3. Milano F. Power System Modelling and Scripting (Power Systems). – Springer-Verlag London Limited, 2010. – 602 p. **Additional Readings:** Mahseredjian J., Dinavahi V., Martinez J.A., Simulation Tools for Electromagnetic Transients in Power Systems: Overview and Challenges, IEEE Trans. Power Delivery., vol.24, no. 3, pp. 1657–1669, Jul. 2009. S.A. Soma, S.A. Khaparde, Shubba Pandit, Computational Methods for Large Sparse Power Systems, An object oriented ap-proach. – Academic Publishers, 2002. – 333 p. P. Kundur, Power System Stability and Control. McGraw-Hill, Inc., 1994. – 1176 p. **Internet resources** 1. Web site «Tractebel Engineering» - [Electronic resource] www.eurostag.be 2. Web site «International council on large power systems CIGRE» - [Electronic resource] www.cigre.org 3. Web site IEEE PES - [Electronic resource] www.ieee-pes.org 4. Web site Manitoba Hydro International Ltd. https://hvdc.ca/pscad/ 5. Web site Siemens PTI http://w3.siemens.com/smartgrid/global/en/products-systems-solutions/software-solutions/planning-data-management-software/planning-simulation/pages/pss-e.aspx 6. Web Site Digsilent Company http://www.digsilent.de/
Instructor	Iliya Markovich Katz. Email:katz@tpu.ru. Tel. +79059915168