TOMSK POLYTECHNIC UNIVERSITY ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

APPROVED BY
Director of Power Engineering School
_____ A.S. Matveev
«30» 06 2020

Dispatch Control in Power Systems

Syllabus

Field of Study: 13.04.02 Electrical Power Engineering and Electrical Engineering

Program: Electric Power Generation and Transportation

Level of Study: Master Degree Program

Year of Admission: 2019
Year: 1
Semester: 1

ECTS: 6

Total Hours: 108
Contact Hours: 64

- **Lectures:** 16
- **Labs:** –
- **Practical experience:** 48

Assessment: exam

Department: Division for Power and Electrical Engineering

Head of Department: Alexander S. Ivashutenko

Instructor: Alexey V. Pankratov

2020

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Dispatch Control in Power Systems

Course Overview

Course Objectives	Course objectives: training students in knowledge of technical processes, power engineering equipment, understanding of technical processes, knowledge of operational code for electrical installations, knowledge of electrical safety rules, obtaining skills in management of electric power systems.
Learning Outcomes	In compliance with the primary curriculum requirements, mastering the course is focused on developing the following learning outcomes in students, including in accordance with the Federal State Educational Standards: • to apply knowledge of technical processes, power engineering equipment; • to understand technical processes, the operational code for electrical installations, electrical safety rules; • to obtain skills in management of electric power systems; • to solve the optimization problems of electric power systems as applied to all the stages of energy production, decision making, long-term and short-term planning, performance updating, and real-time control.
Course Outline	This course belongs to the professional cycle and introduces the standards and vocabulary used in the electric utility industry. Students will learn about the key operating functions such as monitoring and control, generation control, load forecasting, load balancing and the economic factors in generation and transmission of electricity. Students will also discuss key security and reliability factors which must be maintained during normal and abnormal operating conditions. The course is a combination of online activities and face-to-face communication. The content of the course includes practical problems and theoretical background. Students' everyday self-guided work is focused on extending and reinforcing students' knowledge, developing practical skills and includes working with lecture materials, overviewing sources of information in compliance with an individually predetermined course problem, performing home tasks, getting prepared for classes and examination. Creative self-guided work includes analyzing, structuring and presenting information, performing calculation.
Prerequisites	The course is based on knowledge and understanding of mathematics. Students taking this course should have some background in electric power systems or a very good background in electric circuits. Experience in modeling and simulation is beneficial.
Course Structure	**Section 1. Electric Power Systems: Structure, Organization and Functioning**
	Basic concepts and definitions. A historical approach to the electric power sector. An outline of trends in the Power Industry. Electric power systems (EPS) from physical and operation perspectives. Demand of electricity; production, technologies, equipment, fuels, networks, metering and communication, control centers. Organization of the power sector. The hierarchy of decision-making processes in the traditionally regulated power

	sector. Dispatching and control functions at various levels. Role of an Energy Management System (EMS) in the overall Smart Grid.
	Section 2. Power System Operation and Control
	Power system operation and control in modern power system control centers. The real-time and study-mode data environment in modern SCADA/EMS. Operating states of a power system. Power system security analysis. Organization of dispatch control. Management and control of energy systems and usage of energy resources. State estimation in power systems. Primary, secondary and tertiary regulation. Control of normal operation of power systems. Voltage control in networks of interconnected power systems. Load forecasting technique. Voltage stability. Power quality. Definitions and standards. The National Electric Code. Emergency control of power systems.
	Section 3. Wholesale and Retail Electricity Markets
	Wholesale and retail competition. Typical products and services in a wholesale market. Sequence and possibilities of transactions. Energy trading opportunities. The short-term market. Intraday markets. Ancillary services. Balancing market. Market Operation.
Facilities and Equipment	Computer classrooms. Rooms for lectures and seminars. Presentation equipment.
Grading Policy	Evaluation of the quality of learning performance and achievements for the discipline during formative and summative assessment is performed in compliance with TPU rating system. 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. Course final assessment (exam) 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 formative assessment during the semester and summative assessment scores at the end of the semester. Maximum overall rating corresponds to 100 points, min pass score is 55.
Course Policy	To be allowed to take the final exam, a student must submit reports for all assessed activities applicable to the course. Exam details: closed-book; written; scheduled during the examination period; 1.5 hours in duration.

Teaching Aids and Resources	**Compulsory Readings:** 1. Gomez-Exposito A.J. Electric energy systems : analysis and operation / editors, Antonio Gomez-Exposito, Antonio J. Conejo, Claudio Canizares, Taylor & Francis Group, LLC, 2009. 2. Electric Power Generation, Transmission and Distribution. Second Edition. Electric Power Engineering Handbook. Edited by Leonard L. Grigsby. – CRC Press Taylor and Francis Group, 2007. – 500 p. 3. Wood Allen J., Wollenberg Bruce F. and Sheblé Gerald B. Power Generation, Operation, and Control, Third Edition, John Wiley & Sons, Inc., 2014. **Additional Readings:** 1. Abur A., Exposito A.G. Power System State Estimation: Theory and Implementation, Marcel Dekker, Inc., Cimarron Road, Monticello, New York, 2004. 2. Bevrani H. Robust Power System Frequency Control, Springer Science & Business Media, 2014. 3. Savulescu Savu C. Real-Time Stability Assessment in Modern Power System Control Centers distribution / editor, Savulescu Savu C., John Wiley & Sons, Inc., Hoboken, New Jersey, 2009. 4. Regulation of the Power Sector / editor, Ignacio J. Pérez-Arriaga, Springer-Verlag, London, 2013. 5. T. Electric Power Systems. Edited by Michel Crappe. – A John Wiley and Sons, Inc., Publication, 2008. – 376 p. Access by Tomsk Polytechnic University: https://www.lib.tpu.ru/fulltext_db/wiley-online-library.html. 6. A. Short, Electric Power Distribution Equipment and Systems. – CRC Press Taylor and Francis Group, 2007. – 312 p. 7. Electric Power Substation Engineering. Edited by John D. McDonald. – CRC Press LLC, 2003. – 287 p. **Online Resources:** 1. Dispatch Control in Power Systems: Online Course. Available at: http://www.stud.lms.tpu.ru. 2. Science databases. Available at: https://www.lib.tpu.ru/fulltext_db.html. **Software:** RastrWin Software package. Available at: http://www.rastrwin.ru.
Instructor	Alexey V. Pankratov, e-mail: pank@tpu.ru