

Department	05 Technical Systems, Processes and Communication
Course title	Automation and Digitalisation
Course number	
Hours per week (SWS)	4
Number of ECTS credits	5
Course objective	<p>This module aims to impart comprehensive knowledge and detailed understanding of subject-specific correlation between mathematics, natural sciences and engineering sciences and the ability to apply the same.</p> <ul style="list-style-type: none"> <input type="checkbox"/> It also imparts a broad-based understanding of examination, analysis, evaluation, optimization and development of complex systems comprised of devices, machines, installations and automation technology in the board and paper industry. <input type="checkbox"/> Furthermore, it imparts the ability to communicate with experts in various technical fields in the international professional community and to manage projects on a collaborative and target-oriented basis in a team as a team member and as a team leader and to assume management tasks. <p>The student acquires detailed knowledge in the field of:</p> <ul style="list-style-type: none"> <input type="checkbox"/> process and production plant automation, with regard to modern control concepts and their application in complex control systems; <input type="checkbox"/> data storage and data analysis; <input type="checkbox"/> modern concepts of system networking (linking); <input type="checkbox"/> bus, communications and Information systems; <input type="checkbox"/> is able to <ul style="list-style-type: none"> <input type="checkbox"/> analyze the efficiency of automation systems; <input type="checkbox"/> compare and evaluate the applicability of different automation solutions; <input type="checkbox"/> find new possible usage for existing automation systems; <input type="checkbox"/> knows the procedures to obtain information from large volumes of data for optimal process implementation; <input type="checkbox"/> is able to analyze and solve new problems using simulation methods
Prerequisites	Knowledge of mathematics, physics and chemistry
Recommended reading	<p>Schaum's Outline of Feedback and Control Systems, Second Edition, Joseph J. DiStefano, Joseph DiStefano, Allen Stubberud, Ivan Williams, McGraw-Hill Companies, Incorporated, 1995, ISBN 0070170525, 9780070170520</p> <p>Papermaking Science and Technology, Volume 14, Process and Maintenance Management, Second Edition, Edited by Kauko Leiviskä, Fapet Oy, Finland, ISBN 978-952-5216-34-9</p> <p>Process Control Fundamentals for the Pulp & Paper Industry, Nancy J. Sell, TAPPI Press, ISBN 0-89852-294-3</p> <p>Pulp and Paper Manufacture, Third Edition, Mill-Wide Process Control & Information Systems, Edited by M. J. Kocurek and D. B. Brewster, published by TAPPI, ISBN 1-895288-44-X</p>
Teaching methods	Lecture, seminar instruction, excursion
Assessment methods	Oral examination
Language of instruction	English
Name of lecturer	Dr. Tobias Kleemann
Email	tobias.kleemann@hm.edu
Link	

Course content

- Feed-forward and feedback control systems
 - PID Control
 - Control elements for linear and non-linear systems
 - Stability criteria for linear and non-linear systems

- Methods and control systems for complex feedback control:
 - Adaptive feedback control
 - Multi-variable feedback control
 - Experts' systems
 - Fuzzy - logic feedback control
 - Neuronal networks
 - Self-Organizing-Maps (SOM)
 - Decision diagrams
- Model predictive control (MPC)
 - System analysis, design and methods used in the latest process control systems
 - Intelligent field equipment, HART protocol
 - Fieldbus protocols and network topologies
 - Visualization and information systems, human-machine interfaces
 - Communications and management systems
 - Production planning systems (PPS)
 - Corporate and management systems (ERP)
 - The concept of industry 4.0 and its application in the board and paper industry
 - Modern concepts of cloud based computing and storage
 - Online and offline simulation and the Digital Twin concept
 - Digital literacy and data literacy
 - Big Data, data mining and practical tools for data analysis
 - Data Science: cleaning, analyzing, and visualizing data
 - Artificial Intelligence (AI) and Machine Learning (ML)
 - Concept and current applications of Artificial Neural Networks (ANN)
 - Extended Reality (XR): current and future applications of augmented (AR), mixed and virtual (VR) reality in the industry

Remarks