<table>
<tr><th colspan="5">Distributed and Networked Control</th><th>AR-228</th></tr>
<tr><td>Rota
annually SS</td><td>Duration
1 Semester</td><td>Semester
2nd (Semester)</td><td>SWS
3 SWS</td><td>Credit Points
5</td><td>Workload
150 h</td></tr>
<tr><td>1</td><td colspan="5">Modul Structure</td></tr>
<tr><td></td><td colspan="2">Course (Abbreviation)</td><td>Type/ SWS</td><td>Presence</td><td>Self Study</td><td>Credit Points</td></tr>
<tr><td></td><td colspan="2">a) Distributed and Networked Control</td><td>Lecture/ 2 SWS</td><td>25 h</td><td>40 h</td><td>3</td></tr>
<tr><td></td><td colspan="2">b) Distributed and Networked Control</td><td>Tutorial/ 1 SWS</td><td>15 h</td><td>40 h</td><td>2</td></tr>
<tr><td></td><td colspan="2">c) Distributed and Networked Control</td><td>Practical training</td><td></td><td></td><td></td></tr>
<tr><td>2</td><td colspan="5">Language
English</td></tr>
<tr><td>3</td><td colspan="5">Content
Element 1
1. Introduction to distributed control and networked systems
a. Cyber-physical systems
b. Application domains
c. Examples
2. Algebraic graph theory
a. Directed graphs and their description
b. Matrix representation of graphs
c. Analysis tools for graphs
3. Consensus in multi-agent control
a. Control design for consensus
b. Convergence analysis
c. Leader-follower networks
4. Synchronisation
a. Modelling and interpretation of coupling structures
b. Linear and nonlinear settings
c. Kuramoto oscillators
d. Power-swing equations
5. Research outlook and case studies
Elemente 2 und 3
Black board exercises, in class computer exercises

Literature:
• Jan Lunze, Networked Control of Multi-Agent Systems, Bookmundo Direct, 2019, ISBN: 9789463867139
• Francesco Bullo, Lectures on Network Systems, 2Kindle Direct Publishing, 2019, ISBN: 978-1986425643</td></tr>
<tr><td>4</td><td colspan="5">Competencies
The students are able to formulate and to solve problems of modelling and control of networked control systems and distributed control. The students are able to understand and to analyze the interplay of problem formulation, modelling and system-theoretic solution approaches. They know how to apply and to implement distributed and decentralized control schemes for networked linear systems. The students are able to analyze consensus phenomena and synchronization mechanisms arising in coupled systems.</td></tr>
<tr><td>5</td><td colspan="5">Examination Requirements
Oral exam (max. 30 minutes) or written exam (90 minutes)</td></tr>
<tr><td>6</td><td colspan="5">Formality of Examination</td></tr>
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	☒ Module Finals	☐ Accumulated Grade
7	**Module Requirements (Prerequisites)** Basics of control engineering (state space description, LQR control, Lyapunov functions) Basics of ordinary differential equations	
8	**Allocation to Curriculum:** Program: Automation & Robotics; Field of study: Process Automation, Robotics, Cognitive Systems	
9	**Responsibility/ Lecturer** *Prof. Dr.-Ing. Timm Faulwasser/* Prof. Dr.-Ing. Timm Faulwasser	