### COURSE DESCRIPTION

<table>
<thead>
<tr>
<th>Nb.</th>
<th>Learning outcomes description</th>
<th>Method of assessment</th>
<th>Teaching methods</th>
<th>Learning outcomes reference code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Student has knowledge in the field of deterministic communication protocols of industrial networks. He has knowledge of time analysis of data flow in networks. He has knowledge of the existing models of industrial networks. He can choose the protocol depending on the type of industrial application. He can analyze the data flow. He can determine the basic time parameters of the network installation</td>
<td>Final test, Laboratory exercise</td>
<td>Lecture, Laboratory</td>
<td>K1A_W08, K1A_W10, K1A_W13, K1A_W14,</td>
</tr>
<tr>
<td>2.</td>
<td>Student can determine the model of the real system, describe and define its elements. He can configure the network, select parameters and examine basic time relationships. He can determine methods and methods of integration of distributed systems with other IT systems.</td>
<td>Final test, Laboratory exercise</td>
<td>Lecture, Laboratory</td>
<td>K1A_U01, K1A_U02, K1A_U03, K1A_U06, K1A_U15</td>
</tr>
<tr>
<td>3.</td>
<td>Student understand the importance and the role of IT in the creation of distributed real-time systems based on industrial controllers.</td>
<td>Final test, Laboratory exercise</td>
<td>Lecture, Laboratory</td>
<td>K1A_K01</td>
</tr>
<tr>
<td>4.</td>
<td>Student can work individually and in a team</td>
<td>Final test, Laboratory exercise</td>
<td>Lecture, Laboratory</td>
<td>K1A_U31</td>
</tr>
</tbody>
</table>

### 18. Teaching modes and hours

Lecture: 15 h  
Laboratory: 30 h

### 19. Syllabus description:

Lectures:
Introduction to the subject of distributed information systems. Definitions and markings. Distribution of distributed systems due to IT measures and models. (Client - Server, Master - Slave, Manufacturer - Distributor - Consumer). Advantages and disadvantages of distributed systems - reliability and computing power.
IT real-time systems. Definitions and designations, and breakdown due to reaction times. Time as a critical parameter in industrial systems. The necessity of maintaining temporal determinism in real-time systems. Discussion of several real-time distributed real-time systems.

Models of real-time distributed systems. Determining the scope of the model's research. Definition of the system node. Distribution of global node tasks. The interaction of processes occurring in the system node. Determining the interrelationships between node processes. Indication of the purpose of the analysis. The controller is freely programmable as a basic element of the industrial system of distributed real time. Work cycles of central units. Time analysis of reaction time. Methods for shortening the duration of the basic cycle of the central unit.

Industrial networks with Token-Bus access. Description of the protocol and quantitative and qualitative determination of factors affecting the time of information exchange. Defining and determining the efficiency and bandwidth of a usable protocol.

Industrial networks with Master-Slave access. Description of the protocol and quantitative and qualitative determination of factors affecting the time of information exchange. Defining and determining the efficiency and bandwidth of a usable protocol.

Industrial networks with producer-distributor-consumer access. Description of the protocol and quantitative and qualitative determination of factors affecting the time of information exchange. Defining and determining the efficiency and bandwidth of a usable protocol.

EtherCat access networks. Description of the protocol and quantitative and qualitative determination of factors affecting the time of information exchange.

Methods of integration of industrial systems. Application of non-deterministic protocols to the construction of industrial systems. Application of the Internet and wireless networks for industrial purposes.

**Labs:**
SCADA station as a node of a distributed system
Systems of increased reliability
Communication with supervisory systems via the HTTP protocol
Systems integration using OPC
SignalR Library for inter-process communication
Advanced Driver Assistance Systems

**20. Examination:** none

**21. Primary sources:**
1. A. Kwieceń: „Analiza przepływu informacji w komputerowych sieciach przemysłowych”
2. Wskazane materiały konferencyjne „Computer Networks” seria CCIS Springer Verlag 2009-20017

**22. Secondary sources:**
Materials available on websites

**23. Total workload required to achieve learning outcomes**

<table>
<thead>
<tr>
<th>Lp.</th>
<th>Teaching mode</th>
<th>Contact hours / Student workload hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lecture</td>
<td>15/15</td>
</tr>
<tr>
<td>2</td>
<td>Classes</td>
<td>30/30</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory</td>
<td>/</td>
</tr>
<tr>
<td>4</td>
<td>Project</td>
<td>/</td>
</tr>
<tr>
<td>5</td>
<td>BA/MA Seminar</td>
<td>/</td>
</tr>
<tr>
<td>6</td>
<td>Other</td>
<td>/</td>
</tr>
<tr>
<td></td>
<td>Total number of hours</td>
<td>45/45</td>
</tr>
</tbody>
</table>

**24. Total hours:** 90

**25. Number of ECTS credits:** 3

**26. Number of ECTS credits allocated for contact hours:** 2

**27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects):** 1

**28. Comments:**

Approved:

…………………………………………………… (date, Instructor’s signature)
………………… (date, the Director of the Faculty Unit signature)