LABORATORY PLANNING GUIDE

L51 Advanced Control Engineering Laboratory

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Covered subjects according to the curriculum

Major topics of learning content:
- planning and construction of different process applications
- planning and construction of different automation solutions for the control systems
- commissioning and optimisation of automated process applications
- making process connections (via pipes/hoses)
- connecting up the electricity supply and the instrumentation and control components
- fundamentals of the use of data acquisition, system control and parameter setting by software
- comparison of different sensors for level measurement
- comparison of different sensors for flow measurement
- level / flow cascade control
- planning, setting up, testing, optimising and assessing pressure control loops with different objectives and components
  * constructing a 1st order pressure control system
  * constructing a 2nd order pressure control system
- functional range of a digital process controller
- configuration, parameterisation and operation via keyboard
- familiarisation with an industry-standard configuration software
- signal links and standard current signals
- Profibus card as communications interface (CIF)
- functional range of a line recorder
- functional range of control valves
  * electro-pneumatically driven
  * pneumatically driven
  * electrically driven
- functional range of a PLC
- programming a PLC using included programming software
- electrical connections and signal links

Main concept

The laboratory is designed for accommodation of 24 students + 2 laboratory staff:
- 2 - 4 students form a team and work together at a workstation / training system
- 8 workstations, all differently configurable
- All workstations are floor standing
- All workstations are equipped with a PC
- Each workstation is equipped with a manual containing technical information, basic theory, experiment instructions, evaluation help and safety advice.
- Student teams are scheduled to change workstations from lab session to lab session in order to perform the entire range of experiments within the course duration.
- Average time per experiment: 90 to 120 minutes.

2 workstations for laboratory staff (with PC and internet access)
1 printer for common use
1 cupboard for small parts, consumables, tools, paper etc.
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1 cupboard for small parts, consumables, tools, paper etc.

**Initial training provided for laboratory personnel**

To be conducted immediately after installation and commissioning of the equipment.

General topics to be covered for any of the educational systems:
- Basic familiarization with the system.
- Functions and components.
- Overall system configuration aspects.
- Start-up and operational aspects.
- Conduction experiments, including evaluation and calculation.
- Using the system with and without the software (where applicable).
- Trouble shooting and maintenance aspects.
- Hands-on, practical familiarization aspects.
- Seminar participants with the delivered system.
- Details of the manuals.
- Safe operation and preventive maintenance.

**Requirements / Utilities**

Power supply:
- 230 V / 50 Hz / 1 phase – at least 25 power sockets

Others:
- Compressed air

Laboratory computer network:
- 2 internet connections for staff
- 8 internet connections for students

Location:
- Laboratory space min 72 m²
- This laboratory could be installed on any floor (e.g. ground floor or 1st floor)
### Schedule of requirements

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1</td>
<td>Process automation training system: base module</td>
<td>8 pcs.</td>
</tr>
<tr>
<td>Item 1.1</td>
<td>Controlled system module: level</td>
<td>2 pcs.</td>
</tr>
<tr>
<td>Item 1.2</td>
<td>Controlled system module: flow</td>
<td>2 pcs.</td>
</tr>
<tr>
<td>Item 1.3</td>
<td>Controlled system module: pressure</td>
<td>2 pcs.</td>
</tr>
<tr>
<td>Item 1.5</td>
<td>Controlled system module: temperature</td>
<td>2 pcs.</td>
</tr>
<tr>
<td>Item 1.6</td>
<td>Continuous controller module</td>
<td>8 pcs.</td>
</tr>
<tr>
<td>Item 1.7</td>
<td>Switching controller module</td>
<td>8 pcs.</td>
</tr>
<tr>
<td>Item 1.8</td>
<td>Chart recorder module</td>
<td>8 pcs.</td>
</tr>
<tr>
<td>Item 1.9</td>
<td>Digital display</td>
<td>8 pcs.</td>
</tr>
<tr>
<td>Item 1.10</td>
<td>Software for controller configuration</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 1.11</td>
<td>Control valve, pneumatically driven, Kvs 0,4</td>
<td>2 pcs.</td>
</tr>
<tr>
<td>Item 1.12</td>
<td>Control valve, pneumatically driven, Kvs 1,0</td>
<td>6 pcs.</td>
</tr>
<tr>
<td>Item 1.13</td>
<td>Control valve, electrically driven, Kvs 0,4</td>
<td>2 pcs.</td>
</tr>
<tr>
<td>Item 1.14</td>
<td>Control valve, electrically driven, Kvs 1,0</td>
<td>6 pcs.</td>
</tr>
<tr>
<td>Item 1.15</td>
<td>Pressure sensor, 0...6bar</td>
<td>2 pcs.</td>
</tr>
<tr>
<td>Item 1.16</td>
<td>Pressure sensor, 0...2bar</td>
<td>2 pcs.</td>
</tr>
<tr>
<td>Item 1.17</td>
<td>Pressure sensor, 0...100mbar</td>
<td>2 pcs.</td>
</tr>
<tr>
<td>Item 1.18</td>
<td>Orifice with differential pressure sensor</td>
<td>2 pcs.</td>
</tr>
<tr>
<td>Item 1.19</td>
<td>Flow rate sensor: electromagnetic</td>
<td>2 pcs.</td>
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<tr>
<td>Item 1.20</td>
<td>Level sensor, capacitive</td>
<td>2 pcs.</td>
</tr>
<tr>
<td>Item 1.21</td>
<td>Temperature sensor PT100</td>
<td>2 pcs.</td>
</tr>
<tr>
<td>Item 1.22</td>
<td>Thermocouple (K) with head transmitter</td>
<td>2 pcs.</td>
</tr>
<tr>
<td>Item 1.23</td>
<td>Visualisation software</td>
<td>8 pcs.</td>
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<tr>
<td>Item 1.24</td>
<td>Profibus DP module for controller</td>
<td>8 pcs.</td>
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<tr>
<td>Item 1.25</td>
<td>PLC module with software</td>
<td>8 pcs.</td>
</tr>
<tr>
<td>Item 1.26</td>
<td>Profibus DP module for PLC</td>
<td>8 pcs.</td>
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</tbody>
</table>
Laboratory drawing