LABORATORY PLANNING GUIDE

L33 Refrigeration & Air Conditioning Laboratory

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Covered subjects according to the curriculum

Major topics of learning content:
- design of compression refrigeration circuit
- draining and filling of refrigeration systems
- operation of refrigeration components
- cyclic process of cold production
- fault finding in a refrigeration systems
- compare different expansion elements
- read, understand, wire and test electric circuit diagrams
- design and operation of electrical components from refrigeration
- design and testing of a safety chain
- star / delta connection
- safety aspects when handling mains voltage
- design and operation of the electrical components of a refrigerant compressor
- operation and programming of a DDC
- practice-oriented principles of air conditioning and ventilation technology
- design and servicing of an air conditioning and ventilation system
- principles of room air conditioning (h-x diagram)
- explanation of components: filter, air heater, air cooler, humidifier, condensing unit, air conditioning controller, flaps, outlets
- operation of safety devices
- measurement of pressure curve and pressure losses
- effect of air cooler, air heater and humidifier on the state of the air at the outlet
- investigation of the control behaviour of an automatic air conditioning controller, determination of limiting factors
- demonstrate the basic principle of an absorption refrigeration system

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
- 16 workstations with 11 different experiment units
- Each experiment unit either floor standing or on its own table to allow short prepare times
- 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.
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 15 power sockets distributed according to lab lay-out
- 400 V / 50 Hz / 3 phases – at least 2 power sockets distributed according to lab lay-out

Water:
- Cold water
- Drain

Laboratory computer network:
- 2 internet connections for staff

Location:
- Laboratory space min 108 m²
- This laboratory should be installed on the ground 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>Refrigeration training system, base unit</td>
<td>6 pcs.</td>
</tr>
<tr>
<td>Item 1.1</td>
<td>Refrigeration laboratory workplace</td>
<td>6 pcs.</td>
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<tr>
<td>Item 1.2</td>
<td>Refrigeration components for basic experiments</td>
<td>6 pcs.</td>
</tr>
<tr>
<td>Item 1.3</td>
<td>Refrigeration components for advanced experiments</td>
<td>6 pcs.</td>
</tr>
<tr>
<td>Item 1.4</td>
<td>Set of accessories</td>
<td>6 pcs.</td>
</tr>
<tr>
<td>Item 1.5</td>
<td>Maintenance set</td>
<td>3 pcs.</td>
</tr>
<tr>
<td>Item 2</td>
<td>Electrical installation in refrigeration systems</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 3</td>
<td>Electrical faults in simple air conditioning systems</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 4</td>
<td>Electrical connection of refrigerant compressors</td>
<td>1 pcs.</td>
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<tr>
<td>Item 5</td>
<td>Electrical faults in refrigerant compressors</td>
<td>1 pcs.</td>
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<tr>
<td>Item 6</td>
<td>Electrical faults in full air conditioning systems</td>
<td>1 pcs.</td>
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<tr>
<td>Item 7</td>
<td>Building automation in heating and air conditioning systems</td>
<td>1 pcs.</td>
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<tr>
<td>Item 8</td>
<td>Air conditioning and ventilation system</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 9</td>
<td>Absorption refrigeration system</td>
<td>1 pcs.</td>
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</tbody>
</table>