LABORATORY PLANNING GUIDE

L10 Strength of Materials Laboratory

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Covered subjects according to the curriculum

Major topics of learning content:

- Elastic deformation of statically determinate or indeterminate beams under bending load
- Elastic torsion of round bars under torque
- Influence of material, cross-section and clamping length on deformation
- Investigation of all relevant buckling problems
- Verification of the Euler theory of buckling
- Methods of force and deflection measurement
- Eccentric application of force and transverse loading
- Verification of the Rankine yield criterion and the Tresca yield criterion
- Multi-axial loading by pure bending, pure torsion or a combination of the two
- Deformation of a beam on two or more supports under point loads (e.g. single-span beam)
- Deformation of a cantilever beam under point loads
- Maxwell-Betti coefficients and law
- Application of the method of sections to determine internal reactions of the beam
- Direct indication of shear force and bending moment at a section on the beam
- Basic introduction to measurement with strain gauges
- Strain gauge types and application techniques
- Photoelastic experiments on models subjected to mechanical loading
- Investigation of diffusion of stresses with plane or circular polarised light
- Interpretation of photoelastic fringe patterns
- Elastic deformation of curved-axis beams (circular, semi-circular and quadrant beams)
- Elastic behaviour of tension springs under load
- Hooke’s law
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
- 28 workstations with 9 different experiment units
- Each experiment unit 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 10 power sockets distributed according to lab layout.

Laboratory computer network:
- 2 internet connections for staff

Location:
- Laboratory space min 120 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>Code</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1</td>
<td>Deformation of bars under bending or torsion</td>
<td>WP 100</td>
<td>4 pcs.</td>
</tr>
<tr>
<td>Item 2</td>
<td>Buckling behaviour of bars</td>
<td>WP 120</td>
<td>4 pcs.</td>
</tr>
<tr>
<td>Item 2.1</td>
<td>Set of 10 specimens</td>
<td>WP 120.01</td>
<td>4 pcs.</td>
</tr>
<tr>
<td>Item 3</td>
<td>Verification of stress hypotheses</td>
<td>WP 130</td>
<td>4 pcs.</td>
</tr>
<tr>
<td>Item 3.1</td>
<td>Set of 4 specimens alum., copper, steel brass, 1 each</td>
<td>WP 130.01</td>
<td>4 pcs.</td>
</tr>
<tr>
<td>Item 4</td>
<td>Deformation of straight beams</td>
<td>WP 950</td>
<td>3 pcs.</td>
</tr>
<tr>
<td>Item 5</td>
<td>Beam on 2 supports: shear force &amp; bending moment diagrams</td>
<td>WP 960</td>
<td>3 pcs.</td>
</tr>
<tr>
<td>Item 6</td>
<td>Strain gauge training system</td>
<td>FL 100</td>
<td>3 pcs.</td>
</tr>
<tr>
<td>Item 6.1</td>
<td>Tension rod, brass</td>
<td>FL 100.01</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 6.2</td>
<td>Tension rod, copper</td>
<td>FL 100.02</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 7</td>
<td>Photoelastic experiments with a transmission polariscope</td>
<td>FL 200</td>
<td>3 pcs.</td>
</tr>
<tr>
<td>Item 8</td>
<td>Deformation of curved-axis beams</td>
<td>FL 170</td>
<td>3 pcs.</td>
</tr>
<tr>
<td>Item 9</td>
<td>Hooke’s law</td>
<td>TM 400</td>
<td>1 pcs.</td>
</tr>
</tbody>
</table>

### Laboratory drawing

![Laboratory drawing](image)