LABORATORY PLANNING GUIDE

L11 Solid Mechanics Laboratory

Content

Covered subjects according to the curriculum 2
Main concept 3
Initial training provided for laboratory personnel 3
Requirements / Utilities 4
Schedule of requirements 4
Laboratory drawing 5

G.U.N.T. Gerätebau GmbH, Hanskampring 15-17, 22885 Barsbüttel, Germany
Phone: +49 40 670854-0, E-mail: sales@gunt.de, Web: www.gunt.de

Covered subjects according to the curriculum

Major topics of learning content:

- accumulation and resolution of forces with force parallelogram
- equilibrium of forces
- law of levers, determination of moments and equilibrium of moments
- combined lever systems
- forces in bearings
- deflection and resolution of force by fixed and free pulleys
- inclined plane; friction
- pulley blocks
- gear wheels
- graphical breakdown of forces by force parallelogram
- determination of the bar forces on various jib forms
- measurement of bar forces
- calculation of bar forces by the method of joints
- difference between static and dynamic friction
- friction forces as a function of normal force, sliding speed, material pairing, surface properties of the friction partners and size of the contact area
- slip/stick effect
- determination of friction coefficients
- measurement of the bar forces in various single plane trusses
- distribution of forces in the single plane truss dependent on the use of a surplus bar
- dependency on the external force: magnitude, direction and point of application
- comparison of measurement results with method of joints and Ritter's method of sections
- calculation of the reactions arising from the static conditions of equilibrium
- application of the method of sections to calculate the internal forces and moments
  * under a point load
  * under multiple point loads
- calculation of the shear force diagram
- calculation of the bending moment diagram
- determination of the coefficient of friction of a threaded spindle with different materials
- determination of the respective thread efficiency
- axial tension force in a bolt joint dependent on the tightening torque
- axial tension force in a bolt joint dependent on the elastic deformation of a slotted block
- measurement of the breakaway torque, including different fitting situations of the bolt joint
- influence of angle of contact, coefficient of friction and belt force (Eytelwein's rope friction formula)
- comparison flat belt - V-belt
- consequences of an incorrectly aligned belt
- displacement curves for cam mechanisms
- * arc/tangent/concave/asymmetric cam

- * choice of roller tappet, cup tappet or trailing lever
- measurement of strain using strain gauges
- application of Mohr's Circle for stress and strain analysis
- application of Mohr's Circle for the triaxial stress state
- determination of the principal stresses on an open vessel (pipe) and on a closed vessel (tank)
- comparison of open / closed vessels
- determination of the Poissons ratio
- correlations between strain, pressure and stress in the plane biaxial stress state
- correlations between elongation, pressure and stress in the triaxial stress state

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

Trainer: Specialized engineer of G.U.N.T. Gerätebau GmbH, Germany.
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

Laboratory computer network:

- 2 internet connections for staff
- 2 internet connections for students

Location:

- Laboratory space min 72 m²
- This laboratory can be installed on any floor (e.g. ground floor or 1st floor)

Schedule of requirements

Item No.	Description	Quantity
Item 1	Fundamentals of statics	4 pcs.
Item 2	Forces in a crane jib	1 pcs.
Item 3	Forces in a simple bar structure	1 pcs.
Item 4	Dry friction	1 pcs.
Item 5	Forces in various single plane trusses	1 pcs.
Item 5.1	Mounting frame	1 pcs.
Item 5.2	Multi-channel measuring amplifier	1 pcs.
Item 6	Forces in an overdeterminate truss	1 pcs.
Item 6.1	Mounting frame	1 pcs.
Item 6.2	Multi-channel measuring amplifier	1 pcs.
Item 7	Beam on 2 supports: shear force & bending moment diagrams	1 pcs.
Item 8	Thread testing	1 pcs.
Item 9	Screw connections testing	1 pcs.
Item 10	Belt friction apparatus	1 pcs.
Item 11	Cam mechanism	1 pcs.
Item 12	Stress and strain analysis on a thin-walled cylinder	1 pcs.
Item 12.1	Multi-channel measuring amplifier	1 pcs.
Item 13	Stress and strain analysis on a thick-walled cylinder	1 pcs.
Item 13.1	Multi-channel measuring amplifier	1 pcs.

Laboratory drawing