LABORATORY PLANNING GUIDE

L32 v3 Heat Transfer Laboratory

Content

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Covered subjects according to the curriculum

Major topics of learning content:

- determining the mean heat transfer coefficient
- comparing different heat exchanger types
- function and behaviour during operation of a
  * tubular heat exchanger
  * plate heat exchanger
  * shell and tube heat exchanger
  * jacketed heat exchanger
- plotting temperature curves
  * in parallel flow operation
  * in counterflow operation
- relationships between Nusselt, Reynolds and heat flux
- relationships between Nusselt, Reynolds and Prandtl
- measurement of the pressure distribution and development of the speed gradient
- development of families of characteristic curves for pipe bundles
- pressure loss at pipe bundles
- calculation of the air velocity
- heat transfer at different surfaces: flat plate, pipe bundle and fins
- temperature distribution in the heat exchanger
- calculation of heat transfer coefficient for free and forced convection
- Lambert's cosine law
- inverse-square distance law (Lambert)
- Stefan-Boltzmann constant
- Kirchhoff's laws: absorptivity, reflectivity and emissivity
- radial and linear heat conduction (flat wall)
- determination of temperature profiles with different materials
- determination of thermal conductivity k
- steady-state heat conduction in gases and liquids
- determination of thermal conductivities k of various fluids at different temperatures
- determination of the thermal conductivity k of various specimens
- temperature curves as a function of length
- heat transfer through different specimens connected in series
- thermal energy balance of heat source and heat sink
- determination of the thermal resistance
- determination of the radiation coefficient
- pressure curve within a fluidised bed
- pressure losses depending on flow velocity and particle size of the bulk solid
- determination of the fluidisation velocity
- separation of mixtures with different particle sizes by sedimentation
- heat transfer in the fluidised bed
  * influence of the air flow rate on the heat transfer
  * influence of the heater position
  * influence of the particle size
  * determination of the heat transfer coefficient
- geothermal probe with heatpipe principle
- investigation of radial and vertical temperature profiles

- variation of the thermal load
- variation of the quantity of working medium contained
- determination of the quantity of heat that can be discharged
- pumping behaviour of an open circuit

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
- 15 workstations of 13 different types
- Each experiment unit either floor standing or on its own table to allow short prepare times
- 10 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.

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 30 power sockets distributed according to lab lay-out

Water:

- Cold water
- Drain

Others:

- Compressed air

Laboratory computer network:

- 2 internet connections for staff
- 10 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

Item No.	Description	Quantity
Item 1	Heat exchanger supply unit	2 pcs.
Item 1.1	Tubular heat exchanger	1 pcs.
Item 1.2	Plate heat exchanger	1 pcs.
Item 1.3	Shell & tube heat exchanger	1 pcs.
Item 1.4	Jacketed vessel with stirrer & coil	1 pcs.
Item 1.5	Water chiller	2 pcs.
Item 2	Heat transfer bench	2 pcs.
Item 2.1	Parallel flow module	1 pcs.
Item 2.2	Mixed flow module	1 pcs.
Item 2.3	Tubular forced convection heat exchanger	1 pcs.
Item 3	Heat conduction in metals	1 pcs.
Item 4	Heat conduction in fluids	1 pcs.
Item 5	Heat conduction and convection	1 pcs.
Item 6	Free and forced convection	1 pcs.
Item 7	Heat transfer by radiation	1 pcs.
Item 8	Thermal conductivity of building materials	1 pcs.
Item 9	Convection and radiation	1 pcs.
Item 10	Heat transfer in the fluidised bed	1 pcs.
Item 11	Geothermal probe with heat pipe principle	1 pcs.
Item 12	Geothermal energy with two-well system	1 pcs.