



LABORATORY PLANNING GUIDE

L31 Advanced Thermodynamics Laboratory

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Covered subjects according to the curriculum

Major topics of learning content:

- familiarisation with heat transfer processes
 - * heat transfer
 - * heat conduction
- determination of the overall heat transfer coefficient
- preparation of temperature curves for the various types of heat exchanger
 - * parallel flow
 - * counterflow
 - * cross parallel flow
 - * cross counter flow
- comparison of various types of heat exchanger
 - * plate heat exchanger
 - * tubular heat exchanger
 - * shell and tube heat exchanger
 - * finned cross-flow heat exchanger
 - * jacketed vessel with stirrer
- relationships between Nusselt, Reynolds and heat flux
- 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
- thermodynamic principles of the wet cooling tower
- changes of state of the air in the h-x diagram
- calculation of process parameters, such as maximum cooling distance, cooling zone width
- comparison of different wet deck surfaces
- plotting of torque and power curves
- Internal combustion engines, 11 kW
 - * determination of specific fuel consumption
 - * determination of volumetric efficiency and lambda (fuel-air ratio)
 - * determination of the frictional power (in passive mode)
 - * energy balances (for water-cooled engines)
 - * influence of compression on fuel consumption, power output, efficiency and exhaust gas
 - * influence of ignition point on fuel consumption, power output, efficiency and exhaust gas
 - * comparison of diesel and petrol cycles
 - * familiarisation with and use of an electronic cylinder pressure indication system
 - * p-t and p-V diagrams
 - * pressure curve for gas cycle
- familiarisation with the function and typical behaviour during operation of a gas turbine
- heat transfer by radiation in vacuum
- heat transfer by convection and radiation
- theoretical determination of the heat transfer coefficient based on the Nusselt number
- comparison of the heat transfer in different gases

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
- 6 different workstations
- 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.

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 20 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:

- 6 x cold water
- 1 x warm water
- 6 x drain

Others:

- Fresh air
- Exit air
- Propane gas

Laboratory computer network:

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

Location:

- Laboratory space min 96 m²
- This laboratory should be installed on the ground floor

Schedule of requirements

Item No.	Description	Quantity
Item 1	Trainer for various heat exchangers	1 pcs.
Item 1.1	Water/steam heat exchanger unit	1 pcs.
Item 1.2	Electrical steam generator 12kW	1 pcs.
Item 1.3	Cold water bench	1 pcs.
Item 1.4	Condensing unit	1 pcs.
Item 2	Heat transfer bench	1 pcs.
Item 3	Wet cooling tower	1 pcs.
Item 3.1	Cooling column, type 2	1 pcs.
Item 3.2	Cooling column, type 3	1 pcs.
Item 3.3	Cooling column, type 4	1 pcs.
Item 3.5	Cooling column, type 5	1 pcs.
Item 4	Engine test stand, 11kW	1 pcs.
Item 4.3	2-cylinder petrol engine for CT 300	1 pcs.
Item 4.4	Pressure transducer and TDC sensor for CT 300.04	1 pcs.
Item 4.5	2-cylinder diesel engine for CT 300	1 pcs.
Item 4.6	Pressure transducer and TDC sensor for CT 300.05	1 pcs.
Item 4.7	Electronic engine indicating system for CT 300	1 pcs.
Item 4.8	Exhaust gas analysing unit	1 pcs.
Item 4.9	Exhaust gas calorimeter for CT 300	1 pcs.
Item 5	Gas turbine	1 pcs.
Item 6	Convection and radiation	1 pcs.