

Electronics

Autotronics

Mechatronics

Refrigeration

Tech Prep

Refrigeration & Air-Conditioning Training LAB



About SES

SES Scientific Educational Systems develops, manufactures and markets worldwide educational training systems since 1982.

SES is a quality assured firm with of ISO-9001:2008 certification.

SES products cover study programs for:

Universities, colleges, vocational schools, high schools, secondary schools and primary schools.

SES products are off-the-shelf products and are course modular systems. They can be adapted to various types of study programs and laboratories.

SES has 4 product lines:

DEGEM Systems Professional training for universities, colleges and vocational schools.

NeuLog Logger sensors for science experiments and robotics systems for all schools.

MagiClass Response system with intuitive clickers for all schools.

MultiCenter Science, robotics, technology, art, music and language training systems for ages 5+.

Refrigeration and Air-Conditioning Training Program



Refrigeration and air-conditioning systems are an integral part of the modern world. We cannot store food and medicines without refrigeration for example, and air-conditioning systems significantly improve the quality of our lives.

The refrigeration and air-conditioning systems operate similarly. They can be very simple systems composed of a small number of components; or more complex and sophisticated systems aimed to achieve higher efficiency and adaptation to various environment conditions.

Professional persons in the refrigeration and air-conditioning field are in very high demand.

This training program is devised to expose the student to the various systems and real components in refrigeration and air conditioning. It provides the student with both the fundamental and advanced training programs in basic and industrial refrigeration and air conditioning.

The training program covers actual components and their interconnection, related functions, operation, diagnosis and repair methods through safe, hands-on practical activities.

Refrigeration and Air-Conditioning Topics

▪ **Basic Refrigeration**

- * Introduction to cooling and refrigeration
- * Principles of cooling and cooling cycle
- * Operating the main system
- * Hermetic type compressor
- * Control system components and circuits
- * Electrical components and circuits
- * Structure and operation of the system
- * Thermostatic expansion valve
- * Evaporation techniques
- * Regulation devices
- * Control methods and system response
- * Thermal loads
- * Maintenance methods
- * Techniques for diagnosis, repairing faults and fault simulation

▪ **Industrial Refrigeration**

- * Introduction to industrial refrigeration
- * Principles of operation and components
- * Principles of cooling
- * Parallel and series connection of evaporators
- * Defrosting components
- * Filling techniques with refrigerant gas
- * System operation and stabilization techniques
- * Faults simulation and diagnosis procedure

▪ **Basic Air-Conditioning**

- * Principles of air conditioning
- * System operation and components
- * Regulation devices
- * Response of electrical control systems
- * Thermal cycle
- * Use of psychrometric diagrams
- * Operation of capillary tube and expansion valve
- * System operation with various control methods
- * Cooling and heating operating modes
- * Variation of thermal loads at the compressor and evaporator
- * Heat flow through system components
- * Filling techniques with refrigerant gas
- * Faults simulation and diagnosis procedure

- **Professional Air-Conditioning Panel:**
 - * Introduction to air conditioning
 - * Principles of air conditioning
 - * Reverse thermal cycle procedure
 - * System operation and components
 - * Effect of pressure drop
 - * Cooling procedure with regulation devices
 - * Heating procedure and reheating
 - * Humidification and air drying – test procedure
 - * Use of recycled air for air conditioning
 - * Use of air, cleaning, mixing and distribution
 - * Fault diagnosis and repair
 - * Maintenance methods

- **Piping and Tubing Refrigeration Systems**
 - * Safety instructions
 - * Tools and materials
 - * Cutting tubing
 - * Pipe flaring
 - * Bending copper pipes
 - * Embedding copper pipes
 - * Soldering copper pipes
 - * Installing a complete set of pipes
 - * Checking for leaks
 - * Refrigerant piping and installation

- **Charging Station:**
 - * Evacuating the system
 - * Charging R-134a gas
 - * Changing a plug-in module

Refrigeration and Air-Conditioning Equipment

DAR-3301 is the main platform for air conditioning and refrigeration.



This unit is designed to accommodate various plug-in panels, such as:

- DAR-3311 – Basic refrigeration
- DAR-3312 – Industrial refrigeration
- DAR-3321 – Basic air-conditioning
- DAR-3322 – Industrial air-conditioning

The main platform and plug-in panels include the cooling components, graphics, switches, push buttons, LCD display, test points, potentiometers, temperature and pressure sensors, pressure gauges, valves and peripheral connections.

The training system may be operated as a standalone system without a PC. It can be connected to a PC USB using S-COOL software to monitor and control the training system.

Each panel can be operated in several ways:

- Capillary or thermal expansion valve (TEV),
- Temperature or pressure control,
- Low or high speed fan,
- With or without a heat load in the cooled compartment,
- Temperature displayed on the LCD in °C or °F.

The LCD can alternatively display in the graphic mode: temperature and pressure versus time and the cooling cycle.

The student sets the desired mode of operation using the toggle switches and LCD display.

The system carries out all the required control functions while maintaining pressures and temperatures within the predefined safe operating conditions of the system.

The proper refrigerant flow for the chosen operating mode is moderated by solenoid valves, which are integrated in the system's piping.

All of the operating modes are described in the accompanying literature and courseware and are practiced by the student.

The system's piping is painted in various colors to identify the refrigerant state (liquid or gas, high or low pressure).

Temperature and pressure sensors are integrated in the system to show their actual values on the display.

The system supports measurements and efficiency (COP) calculations as well as the cooling cycle.

DAR-3301 Main Platform Unit

- Power on switch with indicating light
- Warning indicating light
- Operating switches
- Temperature sensors (4)
- Pressure sensors and transducers (2)
- Solenoid valves (9)
- PC/manual mode switch
- LEDs (8) to show troubleshooting state
- Mode switches and status display
- Fault insertion switches and fault display
- Numeric keyboard
- Low pressure and high pressure gauge, 0-300 psi
- Graphic/alphanumeric LCD display
- USB interface with the PC
- DCOOL Windows-based control software



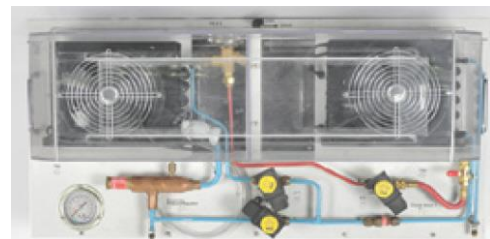
DAR-3311 Basic Refrigeration Panel

- Plug-in module
- Transparent cooling box with door
- Evaporator with fan
- Temperature sensors
- Control valve
- Thermal load
- Quick connect/disconnect to main platform unit
- Quick connect/disconnect electrical contacts



DAR-3312 Industrial Refrigeration Panel

- Plug-in module
- Transparent two section cooling chamber with door
- Thermostatic expansion valves
- Electric fans (2)
- Thermal loads (2)
- Temperature sensors and transducers (2)
- Control valves (3)
- Pressure, quick connect/disconnect to main platform unit
- Quick connect/disconnect electrical contacts



DAR-3321 Basic Air-Conditioning Panel

- Plug-in module
- Transparent cooling box with door
- Evaporator with electric blower
- Thermostatic valve
- Evaporator electric fan
- Thermal load
- Temperature sensors
- Check valve
- Control valve
- Quick connect/disconnect to main platform unit
- Quick connect/disconnect electrical contacts



DAR-3322 Professional Air-Conditioning Panel

- Plug-in module
- Transparent air-conditioning tunnel with door
- Evaporator with electric blower
- Temperature sensors (2)
- Electric control valve
- Thermal load
- Quick connect/disconnect to main platform unit
- Quick connect/disconnect electrical contacts
- Humidity sensor



DAR-3332 Piping Kit for Refrigeration Systems

- Soft copper and hard drawn 1/4" tubing
- Plastic tubing and flexible tubing
- Pipe cutter
- Wire brush for 1/4" pipe
- Flaring tool
- Bending tool with lever and spring
- Flaring tool block
- Tool for pressing punch
- Union bell (nipple)
- Flared tube nuts, 1/4" female x 1/4" female
- Copper 90° elbow 1/4"
- Copper T, 1/4"
- Copper service valve

DAR-3341 Charging Station

- Vacuum pump
- Service manifold for R-134a refrigerant gas
- Service pipes for manifold for R-134a refrigerant gas
- Electronic refrigerant weighing scale

Refrigeration and Air-Conditioning Specifications

The DAR system is devised to expose the student to the various systems and real components in refrigeration and air conditioning. It provides the student with both the fundamental and advanced training programs in basic and industrial refrigeration and air conditioning.

The training program covers actual components and their interconnection, related functions, operation, diagnosis and repair methods through safe, hands-on practical activities.

DAR-3301 Main Platform Unit

The main platform provides the various features that are required by the other plug-in panels and is housed in a metal enclosure approximately 80 x 70 x 70 cm. Changing modules is facilitated by quick connection fasteners.



Control and Display Components:

- Power on switch with indicating light
- Warning indicating light
- Operating switches
- Temperature sensors (4)
- Pressure sensors and transducers (2)
- Solenoid valves (9)
- PC/manual mode switch
- LEDs (8) to show troubleshooting state
- Mode switches and status display
- Fault insertion switches and fault display
- Numeric keyboard
- Low pressure and high pressure gauge, 0-300 psi
- Graphic/alphanumeric LCD display
- USB interface with the PC
- S-COOL Windows-based control software

Refrigeration and Air-Conditioning Components:

- 1/6 HP hermetic-type refrigerant compressor
- R-134a refrigerant
- Condenser and condenser fan
- Thermostatic expansion valve
- Capillary tube
- Refrigerant gas filter
- Liquid accumulator
- Refrigerant flow monitoring eye piece
- Non-return valve
- Reversing valves
- Quick connection for DAR training modules

DAR-3311 Basic Refrigeration Panel

The DAR-3311 Basic Refrigeration Panel is a modular functional training system, a compact unit that connects to the DAR-3301 Main Platform Unit.



Components:

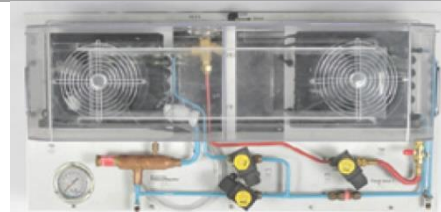
- Plug-in module
- Transparent cooling box with door
- Evaporator with fan
- Temperature sensors
- Control valve
- Thermal load
- Quick connect/disconnect to main platform unit
- Quick connect/disconnect electrical contacts

Contents and Experiments:

- Principles of air conditioning
- System operation and components
- Regulation devices
- Response of electrical control systems
- Thermal cycle
- Use of psychrometric diagrams
- Operation of capillary tube and expansion valve
- System operation with various control methods
- Cooling and heating operating modes
- Variation of thermal loads at the compressor and evaporator
- Heat flow through system components
- Filling techniques with refrigerant gas
- Faults simulation and diagnosis procedure

DAR-3312 Industrial Refrigeration Panel

The DAR-3312 Industrial Refrigeration Panel is a functional training system, a compact and modular unit that connects to the DAR-3301 Main Platform Unit.



Components:

- Plug-in module
- Transparent cooling box with door
- Evaporator with fan
- Temperature sensors
- Control valve
- Thermal load
- Quick connect/disconnect to main platform unit
- Quick connect/disconnect electrical contacts

Contents and Experiments:

- Principles of air conditioning
- System operation and components
- Regulation devices
- Response of electrical control systems
- Thermal cycle
- Use of psychrometric diagrams
- Operation of capillary tube and expansion valve
- System operation with various control methods
- Cooling and heating operating modes
- Variation of thermal loads at the compressor and evaporator
- Heat flow through system components
- Filling techniques with refrigerant gas
- Faults simulation and diagnosis procedure

DAR-3321 Basic Air-Conditioning Panel

The DAR-3321 Basic Air-Conditioning Panel is a functional training system, a compact and modular unit that connects to the DAR-3301 Main Platform Unit.



Components:

- Plug-in module
- Transparent air-conditioning tunnel with door
- Evaporator with electric blower
- Temperature sensors (2)
- Electric control valve
- Thermal load
- Quick connect/disconnect to main platform unit
- Quick connect/disconnect electrical contacts
- Humidity sensor

Contents and Experiments:

- Introduction to air conditioning
- Principles of air conditioning
- Reverse thermal cycle procedure
- System operation and components
- Use of psychrometric diagrams
- Effect of pressure drop
- Cooling procedure with regulation devices
- Heating procedure and reheating
- Humidification and air drying – test procedure
- Use of recycled air for air conditioning
- Use of air, cleaning, mixing and distribution
- Fault diagnosis and repair
- Maintenance methods

DAR-3322 Professional Air-Conditioning Panel

The DAR-3322 Professional Air-Conditioning Panel is a functional training system, a compact and modular unit that connects to the DAR-3301 Main Platform Unit.



Components:

- Plug-in module
- Transparent air-conditioning tunnel with door
- Evaporator with electric blower
- Temperature sensors (2)
- Electric control valve
- Thermal load
- Quick connect/disconnect to main platform unit
- Quick connect/disconnect electrical contacts
- Humidity sensor

Contents and Experiments:

- Introduction to air conditioning
- Principles of air conditioning
- Reverse thermal cycle procedure
- System operation and components
- Use of psychrometric diagrams
- Effect of pressure drop
- Cooling procedure with regulation devices
- Heating procedure and reheating
- Humidification and air drying – test procedure
- Use of recycled air for air conditioning
- Use of air, cleaning, mixing and distribution
- Fault diagnosis and repair
- Maintenance methods

DAR-3332 Piping Kit for Refrigeration Systems

Components:

- Soft copper and hard drawn ¼" tubing
- Plastic tubing and flexible tubing
- Pipe cutter
- Wire brush for ¼" pipe
- Flaring tool
- Bending tool with lever and spring
- Flaring tool block
- Tool for pressing punch
- Union bell (nipple)
- Flared tube nuts, ¼" female x ¼" female
- Copper 90° elbow ¼"
- Copper T, ¼"
- Copper service valve

Contents and Experiments:

- Safety instructions
- Tools and materials
- Cutting tubing
- Pipe flaring
- Bending copper pipes
- Embedding copper pipes
- Soldering copper pipes
- Installing a complete set of pipes
- Checking for leaks
- Refrigerant piping and installation

DAR-3333 Thermodynamic Chart

The DAR-3333 Thermodynamic chart shows pressure in PSI and bars and temperature in °C and °F for R-134a refrigerant gas.

DAR-3341 Charging Station

The DAR-3341 Station training module consists of a charging kit, a manifold and a software package that contains a user manual with detailed charging instructions. This module is used to load and evacuate the DAR-3000 training system with R-134a refrigerant gas.

Components:

- Vacuum pump
- Service manifold for R-134a refrigerant gas
- Service pipes for manifold for R-134a refrigerant gas
- Electronic refrigerant weighing scale

Contents and Experiments:

- Evacuating the system
- Charging R-134a gas
- Changing a plug-in module

DAR-3342 Halide Leak Detector

The DAR-3342 electronic refrigerant leak detector is an accurate and reliable field detector that is easy to use. It can readily test for R-134a refrigerant gas leaks used in all DAR training systems.

This refrigerant leak detector is designed to provide leak detection necessary to properly maintain the DAR training systems. The DAR-3342 does not require calibration; it is supplied with carrying case and batteries ready for use.

Refrigeration and A/C Program

The material accompanying the training systems covers a large number of hours of study and practice.

The study material enables adaptation to various study programs.

The following proposal is for a training center and is one of the options for building a training system.

Selecting experiments is done according to the requirements of the center and the level of its students.

The Refrigeration and A/C program is based on 11 study units:

1. Basic refrigeration
2. Industrial refrigeration
3. Basic Air-Conditioning
4. Professional Air-Conditioning
5. Maintenance of Refrigeration and A/C systems
6. Piping and tubing
7. Real Refrigeration and A/C systems

Each unit is for 18 workshop hours.

The units can be taught sequentially at this order in workshop rooms according to the school space, study years and number of students.

The following arrangement enables maximum capacity of students.

Each study unit is taught in a separate workshop room for 20 students.

The program starts with Introduction to Refrigeration and A/C systems.

All the center teachers give this Introduction for 24 hours to all the students.

This Introduction enables the students to study in parallel the program units.

In this arrangement, 140 students can cover all units in 5 weeks of 30 hours in each (150 hours program).

In a 36 study week year, 980 students can study in the Refrigeration and A/C systems center at full capacity.

SES Training LABs

The training labs are based on learning-by-doing, which makes the students learn more quickly and remember what they have studied by performing practical experiments. They provide the students high profession skills and the knowledge on how to improve their chance of employment and earning capacity.

The manuals and courseware that accompany each course provide the theory background and experiments.

Electronics Training Lab

This modular laboratory is aimed for the **Electronics** profession, but also for technology disciplines that are also based in electronics, such as: **Electricity, Mechanics, Automotive, Robotics, Automation, Process control.**

Autotronics Training Lab

This modular laboratory is aimed for the five stages that comprise the automotive program: **Basic and automotive electronics, Car sub-systems simulators, Car sub-systems demonstrators, Car diagnostic and troubleshooting methods, Troubleshooting faults in a real car.**

Mechatronics Training Lab

This modular laboratory is aimed for the mechatronics program which includes the following disciplines: **Basic electronics, Pneumatics systems, Hydraulics systems, CNC machines.**

Refrigeration and Air-Conditioning Training Lab

The Refrigeration and Air-Conditioning training lab covers actual components and their interconnection, related functions, operation, diagnosis and repair methods through safe, hands-on practical activities.

Technology Preparation Training Lab

The Technology Preparation (Tech Prep) laboratory is a classroom-integrated laboratory consisting of educational modules covering a wide range of subjects such as: **Green energy, Computerized systems, Basic electronics, Basic communication, Mechanical systems.**

Science Training Labs

These laboratories (for primary, secondary and high schools) introduce the students to the computerized sensors world, **nature and industry processes** and **nature laws**. It will help them understand modern technologies such as: **home and medical appliances, wearing sensors, precise agriculture** and more.

Robotics Training Labs

The robotics programs (for primary, secondary and high schools) help students to build innovation and creativity skills. The idea is to make the students understand how systems work, to believe that they can improve them and be able to realize their ideas.

MultiCenter Training Lab

The MultiCenter offers a variety of selected interactive learning environments, with a large range of topics and activities such as: **Science, Technology, Graphic Design, Digital Music, Robotics, Computer Technologies** and much more for all sectors of society, cultures, different socio-economic groups and different age groups – from very young children to senior citizens.



Scientific Educational Systems



www.degem.com



www.neulog.com



www.magiclass.com



www.multicenter.co