

# Annex “A” - Technical Specifications

<u>Item</u>	<u>Specification</u>	<u>Statement of Compliance</u>
I	<p><b>CONTRACT DURATION</b></p> <p>The contract for the Supply, Delivery, Installation &amp; Commissioning of 1-Lot Engineering &amp; Technology Laboratory Equipment shall commence from the date of delivery until the duration of warranty period of one (1) year.</p>	
II	<p><b>AREAS COVERED/DELIVERY REQUIREMENTS:</b></p> <p>The Supplier shall provide the office with the equipment at SLSU – Main Campus, Sogod, Southern Leyte within <b>sixty (60) calendar days</b> from receipt of the Notice to Proceed (NTP)</p>	
III	<p><b>TECHNICAL REQUIREMENTS</b></p> <p>The Supplier shall provide the equipment to SLSU-Main Campus with the following specifications:</p> <p>➤ <b>Vapor Compression Refrigeration System</b></p> <p><b>Demonstration Capabilities</b></p> <ul style="list-style-type: none"> <li>• Demonstration of component function</li> <li>• Instrumented running conditions showing refrigeration pressures</li> <li>• Temperature gauges showing performance under running and fault conditions</li> <li>• Fault injection through built in refrigeration circuit and electrical faults</li> </ul> <p><b>Features</b></p> <ul style="list-style-type: none"> <li>• Standalone desktop refrigeration system</li> <li>• Built-in temperature and pressure gauges as used by service technicians</li> <li>• Fault training through switchable fault condition switches</li> <li>• Low-voltage DC compressor and control circuit</li> <li>• Quiet operation for classroom use without the need for additional drive motors and noisy built-driven compressors</li> <li>• No additional computers or diagnostic tools are required</li> </ul> <p><b>Description</b></p> <ul style="list-style-type: none"> <li>• Three switches are fitted to the system to demonstrate typical faults found in refrigeration or air-conditioning circuits. When any of the three switches are selected, the student can observe the displayed information on the control panel to diagnose the fault condition being demonstrated. The three faults that can be selected are: <ul style="list-style-type: none"> <li>✓ Block/restriction within the high-pressure circuit * blocked expansion valve</li> <li>✓ Restricted condenser heat rejection</li> </ul> </li> </ul> <p>The control panel comprises standard refrigeration gauges as used by a service technician. There are also indicators to show the status of the low-pressure, medium-pressure and high pressure system safety switches. Indicators show the compressor running status. Three temperature displays indicate the air temperature before and after the evaporator coil and show the condenser coil temperature.</p>	

### **Specification**

- Desktop vapour pressure air-conditioning system for training using R134a refrigerant
- Hermetically sealed refrigerant compressor, with: >Integral low-voltage three-phase DC motor > Quiet and vibration-free operation
- Condenser assembly to cool the refrigerant, incorporating:
  - >Multi-pass condenser coil with aluminum fins
  - >DC cooling fan
- Evaporator assembly to cool and dehumidify the air, incorporating:
  - >Thermal expansion valve
  - > Evaporator coil with fins
  - > DC cooling fans
- Evaporator assemble to cool and humidify the air, incorporating:
  - > Thermal expansion valve
  - > Evaporator coil with fins
  - > Centrifugal air blower with three switched speeds
- Three temperature displays indicating:
  - > Air temperature before evaporator coil
  - > Air temperature after evaporator coil
  - > Refrigerant temperature in condenser coil
- Built-in refrigerant Bourdon gauges on compressor suction and discharge lines with combined temperature and pressure scales
- System includes receiver, filter/dryer, sight glass and high/low pressure cut-outs for safe operation
- High and low-pressure charging points enable operator training in addition to recharging
- Demonstration/analysis of faults injected in the refrigerant circuit via three selector switches:
  - > Blocked condenser
  - > Condenser fan failure
  - > Thermostatic expansion valve failure
- Three pressure switches with indicators showing low or high-pressure under fault conditions and medium pressure in normal operation
- No additional computer or diagnostic tools are required
- Operated from mains power supply, but all components are 24 DC for improved operator safety
- Comprehensive instruction manual with details of installation, operating procedures and sample teaching exercises including fault insertion and analysis

### ➤ **Bench top Apparatus to Investigate Stages of Refrigeration**

#### **Key Features**

- Pressure and temperature measurements taken around the refrigerant circuit
- LCD display of all measured parameters
- Data acquisition connectivity included featuring via USB
- Data Acquisition Software allows students to visualize experimental parameters using Pressure – Enthalpy charts
- Temperature sensors in heat source and heat sink water tanks allows clear demonstration of a refrigeration or heat pump cycle
- Water pump allows circulation of water for steady-state experiment
- Refrigerant circuit colour-coded to international standard

#### **Learning Outcomes**

- Learn to use a Pressure-Enthalpy Chart
- Determine superheat and sub-cooling

- Basic refrigeration cycle energy balance
- Determine Coefficient of Performance (COP)
- Determine non-isentropic, isentropic and volumetric efficiencies of the compression stage
- Effect of heat source and heat sink temperatures on COP
- Compare performance between actual and reversed Carnot cycles

The refrigeration circuit features high and low pressure gauges, a pressure switch sight glass, filter dryer and TEV valve. The circuit also includes pressure transducers that connect to the instrumentation. Four thermocouples placed around the refrigeration circuit allow the observation of temperatures, these can be used for the circulation of the water between the heat source and sink for steady state experiments.

**Branded PC Specifications:**

- Intel i3-9100F 3.6Ghz 1151 Processor
- 4gb memory
- 1tb hard disk 7200rpm
- 1gb video card
- DVD writer
- USB, Keyboard and Mouse
- AVR 500 watts
- Windows 10 home 64bit
- 19" Monitor

➤ **Structural Visualization and Display Software and Hardware**

**Includes:**

- Intuitive design providing great touch and feel
- Carbon fibre elements provide exaggerated response for enhanced visualization
- Carbon fibre elements also provide negligible plastic deformation for long life and repeatability
- Fully integrated hardware and software display
- Includes eight standard projects including cantilevers, beams and portal frames
- Wide range of additional structures can be constructed from simple component
- Compare computer simulations with actual responses
- Sensor and instrumentation package
- Supplied with the textbook **“Understanding Structural Analysis”** by: Dr. David Brohn

**Structural Hardware**

This is a set of components enabling a wide variety of 2D structures to be assembled and understood. It comprises a transparent backboard on which the structure is assembled with 32 potential mounting positions configured as an 80 x 80 mm grid. A variety of different nodes and joints are available. The fixed nodes attached to the baseboard via a simple peg-mounting system.

A number of elements are provided in different lengths. These elements are manufactured of carbon fibre and are designed to flex easily in one dimension to demonstrate the movement of the structure.

Elements lengths available: 1U, 2U, 3U, 4U, 4U+ (U = unit length)

**Supports available:**

- Fixed rigid

- Fixed pinned
- Simple slide support
- End slide
- Horizontal slide anchor

**Joints available:**

- Rigid angle
- Pinned right angle
- Inline pinned

The transparent backboard is mounted on a 32" widescreen display, with the computer running the display and visualization software.

**Functions of the Software:**

- Display the structure to be evaluated to aid correct assembly
- Display the structure in diagrammatic form and as typical pictorial implementation of the structure. This has been proven to be powerful aid to student understanding
- Give a graphical representation of bending moments, shear, deflection and reaction in response to simulated loads

**Two new structures introduced**

- Cantilever beam
- Simply supported beam

These two basic features offer an introductory level to the teaching of structural engineering, and can be used to introduce basic concepts of reactions, shear forces and moments.

**Display and visualization software**

This software is a fundamental part of the Understanding Structural Behaviour concept, and works in conjunction with the hardware to demonstrate and help that understanding.

For a number of predefined structures, it is possible to perform an immediate interactive simulation of the effect of loading on the structure. Loads can be simulated using the computer mouse and the shear force diagrams, moment diagrams, deflections and reactions are shown graphically and updated continually as the load is varied.

**Scaling of displays**

The deflection diagrams, moment diagrams and shear force diagrams can now be individually scaled.

This allows the data to be displayed more clearly for a wide range of different conditions. For example, large deflections can be scaled down at the same time as small moment forces being scaled up.

**Functions of the software**

- Contains presentations to introduce the concepts of bending moment, shear, deflections and reactions and their associated graphical representation on the structure diagram
- When used in conjunction with the instrumentation hardware, the software controls the actuators and displays the outputs from the various sensors

	<ul style="list-style-type: none"> <li>• In this mode, the displayed diagrams relate to the actual load applied by the actuator, rather than a simulated load</li> <li>• Provides calibration for the sensors and screen</li> </ul> <p><b>Understanding Structural Behaviour</b></p> <p>Comprises:</p> <ul style="list-style-type: none"> <li>✓ Backboard</li> <li>✓ Set of elements, supports and joints for the above range of structures to be implemented (many others can also be implemented)</li> <li>✓ 32" high-definition display with HDMI interface</li> <li>✓ Display and visualization software</li> <li>✓ RISA 2D models</li> <li>✓ Book <b>Understanding Structural Analysis</b> by: Dr. David Brohn Includes demo version of QSE analysis software</li> <li>✓ Storage facility for all components</li> </ul> <p><b>Instrument Package for use with the base unit</b></p> <p>Comprises:</p> <ul style="list-style-type: none"> <li>✓ Deflection sensor</li> <li>✓ Line actuator</li> <li>✓ Three-component rigid support sensor</li> <li>✓ Two-component pinned support sensor</li> <li>✓ Simple support sensor</li> <li>✓ Interface unit plus power supply and interconnecting cables</li> <li>✓ Software for control and instrumentation functions is supplied with base unit</li> </ul> <p><b>Branded PC Specifications:</b>  Intel i3-9100F 3.6Ghz 1151 Processor  4gb memory  1tb hard disk 7200rpm  1gb video card  DVD writer  USB, Keyboard and Mouse  AVR 500 watts  Windows 10 home 64bit</p>	
	<p>The Contract for the Supply, Delivery &amp; Installation &amp; Commissioning of Engineering &amp; Technology Laboratory Equipment may be pre-terminated by SLSU-Main Campus for any violation of the terms of the contract. In case of pre-termination, the Supplier shall be informed by SLSU-Main Campus thirty (30) days prior to such termination.</p> <p>In case of pre-termination, the Supplier shall be liable for liquidated damages equivalent to one-tenth (1/10<sup>th</sup>) of one percent (1%) of the undelivered portion of the contract as provided by the Government Accounting and Auditing Manual (GAAM) and forfeiture of the Performance Security.</p> <p>The SLSU-Main Campus have the right to blacklist the Supplier in case of pre-termination and to forfeit the Performance Security.</p>	