Appendix-II

Sr. No.	Name of the item with specifications	Qty.
1.	Computerized Air Conditioning Test Rig for year round application with ventilation and cold room, main and recirculating duct. **(Fully Computerized Setup)** **Cooling Capacity :** 1.0 - 1.5 TR **Refrigerant :** R134a/R407C **Test Chamber:** 200-240 liters (Approximately Same dimension in all sides and Should be detachable from the setup). **Features Required:** Transparent duct for full visibility of the process and the components. • Fully instrumented, with temperature and RH sensors at all process stages with maximum accuracy. • Fully computerized control with data logging (including required computer with meeting the specification of the equipment). **Technical Details:** **Duct size:** 200mm x 200mm **Air speed:** Variable to > 1m/s **Preheaters:** 400-500W **Final heaters:** 200-250W **Boiler power:** 2KW nominal **Chiller power:** 500W nominal **Air Contact Evaporator:** Type : Direct Expansion Extended Plate Al-Fin Copper Coil • Flow pattern : Cross Flow of air & refrigerant Duty : Cooling & Dehumidification of air • Evaporating Temperature : 2 to 5 deg. Celsius • Cooling capacity : 1.0 - 1.5 TR **Air Contact Chiller coil:** Type: In-direct Expansion, in separate chilled water tank is connected with Extended Plate Al-Fin Copper Coil. • Flow pattern : Cross Flow of air & refrigerant Duty : Cooling & Dehumidification of air • Chilled water operating Temperature: 4.5°C (water inlet) and 14°C (water outlet) with accuracy of +/- 0.5°C. • Suitable design with pass and no. of circuits. • Cooling Capacity : 1.0 - 1.5 TR	**01 Unit**

- Cooling coil must have temperature sensors at end of each tube in the middle circuit, to get the temperature profile
- Also at the inlet and exit of the chiller to get the temperature of water inlet and exit.
- All should be connected to data logger control system.

Compressor Specifications:

- Type : Hermetic, Reciprocating/ Rotary type
- Refrigerant : Any one of these R134a or R407C
- Make : Danfoss/Emerson
- Superheat : $\Delta\ T_{sup}$ = 3 to 7 K
- Cooling Capacity : 1.0 - 1.5TR
- Digital meters: Volts, Amp and Hz

Air Cooled Condenser:

- Type : Air Cooled Extended Plate Al Fin Copper coil
- Flow Pattern : Cross flow of fluids
- Duty : Sensible Heating of Air
- Condensing Temperature : Tco = 50°C - 70°C

Auxiliary Electrical Heaters:

- Extended fin electric heating elements, 1kW Nominal @ 240 V, 50Hz, AC

Air Flow Ducting:

- MOC : Acrylic and Sheet Metal, AISI 304 SS
- Size : 200mm x 200mm
- Air Throughput : 0.3 to 0.4 m^3/s
- Dampers : As required
- Air vents: 3 Nos.

Fans/Blowers:
Type : Heavy Duty axial flow variable speed (VFD control)

- Power input : 240 V, 50 Hz
- RPM : 0-2400

Ultrasonic Humidifier:
Humidifier details are as under:

- Type : Horizontal
- Construction: Tank made from 1.3mm S.S Sheet (304), welded construction, Top Operable with Rubber gasket, S.S Bolts & Mist output Nozzle, drain, over flow socket. Outer enclosure with 22 Gauge G.I. Sheet duly epoxy painted
- Controls: Water Level Switch for upper & Lower Level, with solenoid valve & filter assembly (5 Micron).
- Control Panel: Made from 18gauges CRC sheet (Epoxy painted), Step down Transformer, Contactor / relay with MCB, ON / OFF Switch With light, Control Module & cooling Fan for control circuit.
- Power : 220 V-AC

Air Washer:

- A portable Air Washer with a provision to connect the main chiller tank.
- A small tank with heater for external heating of water,
- Fan, water pump, valves etc. with suitable measuring point (digitally) to measure temperature, Relative Humidity, air flow and water flow.

Instrumentation & Control:

- Flow Measurement device Air Flow Sensor
- (Accuracy error not more than +/- 2%, response, time not more than 1min)
- For measuring flow of Water, Refrigerant and Air at all the flow inlet and exit.

Temperature Sensors

- All inlet and outlet in Refrigerant Circuit (including compressor, condenser, evaporator, exp device, etc.
- all inlet and outlet in air Circuit and Water Circuit (including the detail given in water chiller section)

Relative Humidity or DBT Sensors

- At every stage of the conditioning of air (RH/WBT at air side at different outlet and inlet of air flowing from each components including fresh and recirculation air, and test chamber)

Pressure Sensors

- At all inlet and outlet in Refrigerant Circuit.
- At all inlet and outlet in air Circuit.

Power measurement:

- Electrical Energy Meter: Watt-hour type for recording electrical input to compressor, fans & auxiliary heaters.
- Analogue Voltmeter: For Compressor, fans & auxiliary heaters.

Cut off:

- High temperature cut out (Thermostat) : Located after auxiliary heater to limit the maximum temperature to 80°C
- HP/LP cutout
- MCB'S for all electrical components
- Thermostatic Expansion Valve with provision for changing the superheat point.
- Residual current circuit breaker (RCCB) if i > 300Ma
- Fan-Heater interlocking
- Power Transmitters 03 Nos
- Provisions for condensate drain and collection tray (SS)
- Data logger / Acquisition system for measuring/recording
- Panel Board: with controls, meters, indicators, displays, main switch and indicator lights.

Computer Control:
The system is to be provided by vendor with required PC and SCADA Software with following features :

- 2-way communication for control & data acquisition.
- Auto/Manual Control mode.
- P,PI,PD and PID modes
- Live mimic diagram of the process including SP, OP and PV.
- Online data display in tabular chart and graphical form.
- Bump less transfer between open & closed loop operations.
- Powerful graphics with trends and bar page
- Data printing facility
- Event recording facility
- Window based user - friendly software.

Computer, Graphics and Software
The system should meet or exceed the following specifications :

- Processor (CPU): intel core i7 processor
- Operating system: 8GB RAM
- Storage: Minimum 500 GB internal Hard Drive
- Sustainability: EPEAT Silver Rating (preferably EPEAT Gold)
- CD-ROM: DVD +/-RW
- Monitor /Display: 21.5" LCD monitor
- Other: Dual-band Wifi-certified 802.11 a/b/g/n- compliant adapter, optical mouse, keyboard, 2serial port & 2 parallel port USB part in front. Interfacing cards: ADC Card 1 no. DAC card. 1 No. communication RS. 232 ports.

Temperature controller and Rh Controller
Input
- Thermocouple: J. K. T. E. B. R. S. N.C
- RTD: DIN PT-100; JIS PT-100
- Linear: 4~20mA; 0~50mV; 1~5V; 0~10V...

Accuracy
- T/C±1°C; RTD±0.2°C; Linear±3μV

Control
- Proportional band: 0.0~300.0% F.S
- Integral time: 0~3600 sec
- Derivative time : 0~900 sec
- Hysteresis: 0.0~200.0 or 0.0~2000
- Cycle Time: 0~100 sec

Cycle Time (0~100)
- Relay 15 sec.
- Pulsed voltage to drive SSR: 1sec.
- Continuous current (Voltage): 0 sec.

Output
- Relay contact output: 10A/ 240 VAC (Resistive load)
- Pulsed Voltage Output to Drive SSR: DC 0/24V (Resistive 250Omin.)
- Current Output: 4~20mA; (Resistive 600 Omax.)
- Continuous Voltage Output: 0~50mV; 1~5V; 0~10V.... (Resistive 600 Omin.)

General
- Rated Voltage: 90~250VAC 50/60HZ; DC 24V
- Ambient Temperature: 0~50°C
- Ambient Humidity: 0~90 %
- Consumption: Less than 5VA

Note: All the control of refrigeration side is Danfoss make and for electrical side Siemens/L&T make.

	Water Motor: • CRI 0.5 HP SS PRESS. PUMP 3 PHASE, • IN LET , OUT LET 25 MM X 25 MM PUMP • CASING : S.S. 304, • IMPELLER : S.S. 304 • MOTOR FRAME : ALUMINUM • SHAFT SEALING : MECHANICAL SEAL (CARBON & CERAMIC) **Note:** Tentative schematic diagram or Photographs of the quoted setup (complete setup) must be provided along with the technical specification. **Other Requirement:** Steady state time for whole system should not be more than 15min. Integrated software, computer and DATA Acquisition system with USB, compatible with window 7 also. Software should be capable to produce psychometric diagram for all air conditioning process and the measurement data. • The system should be complete in all respect with commissioning and training. • Warranty of full setup with repairing and maintenance for three year from commissioning of room. • Detail of Individual component, complete circuit diagram for electrical, mechanical and all other connection should be provided. • Lab manual should be provide in soft and hardcopy along with the sample calculation and validations.	