

Information of every subject		
1	Unit name:	<b>Refrigeration and Air Conditioning.</b>
2	Code:	ME-51017
3	Classification:	Engineering subject
4	Credit value:	3
5	Semester/ Year Offered:	1/2
6	Pre-requisite:	Students should be competent in knowing about the nature of: Refrigeration and Refrigerants , Tools and Equipment , Tubing and Piping , System Evacuation , Automatic Control Components and Application, Application of Refrigeration Systems, Indoor air Quality , Comfort and Psychrometrics , Refrigeration Application to Air Conditioning , Air Distribution and Balance , Typical Operating Conditions, Troubleshooting
7	Mode of delivery:	Lecture, Practical, Tutorial, Viva
8	Practical	
	Tutorials	20%
	Viva	
	Mid-term/ final Examination	40% / 40%
9	Academic staff teaching unit:	

10	<p>Course outcome of unit:</p> <p>In this course, students will be able</p> <p><b>Semester (I)</b></p> <p>On successful completion of this unit a learner will ;</p> <ol style="list-style-type: none"> <li>1. To know Refrigeration and Refrigerants</li> <li>2. To read Psychrometrics Chart</li> <li>3. To understand components of Refrigeration System</li> </ol> <p><b>Semester (II)</b></p>
11	<p>Synopsis of unit:</p> <p>This unit deals with the relationship between the thermodynamic and transport properties of pure substances and a discussion of some basic concepts such as closed and open systems, isolated and adiabatic systems, working substance, continuum, property state, path, process, cycle, equilibrium, pressure and temperature.</p>

**UNITS****TITLE****3****Refrigeration and Refriger**

3.1 Introduction to. Refrigeration

3.2 Refrigeration .

3.3 Rating Refrigeration Equipment.

3.4 The Refrigeration Process.

3.5 Temperature and Pressure Relationship.

3.6 Refrigeration Components.

3.7 The Evaporator

3.8 The Compressor

3.9 The Condenser

3.10 The Refrigerant Metering Device

3.11 Refrigeration System and Components

3.12 Refrigerants

3.13 Refrigerants Must Be Safe.

3.14 Refrigerants Must Be Detectable.

3.15 The Boiling Point of the Refrigerant .

3.16 Pumping Characteristics .

3.17 Popular Refrigerants and Their Important Characteristics.

3.18 Refrigerant Cylinder Color Codes .

3.19 Recovery, Recycle, or Reclaim of Refrigerants .

3.20 Plotting the Refrigerant Cycle .

3.21 Plotting the Refrigerant Cycle for Blends with Noticeable

**5****Tools and Equipment****5.1** General Hand Tools .**5.2** Specialized Hand Tools .**5.3** Tubing Tools .**5.4** Specialized Service and Installation Equipment.**5.5** Refrigerant Leak Detectors.**6****Fasteners****6.1** Nails.**6.2** Staples and Rivets .

	<ul style="list-style-type: none"><li>6.3 Threaded Fasteners .</li><li>6.4 Concrete Fasteners.</li><li>6.5 Other Fasteners .</li></ul>
7	<ul style="list-style-type: none"><li><b>Tubing and Piping 113</b></li><li>7.1 Purpose of Tubing and Piping .</li><li>7.2 Types and Sizes of Tubing.</li><li>7.3 Tubing Insulation .</li><li>7.4 Line Sets .</li><li>7.5 Cutting Tubing.</li><li>7.6 Bending Tubing .</li><li>7.7 Soldering and Brazing Processes.</li><li>7.8 Heat Sources for Soldering and Brazing</li><li>7.9 Soldering Techniques.</li><li>7.10 Brazing Techniques .</li><li>7.11 Practical Soldering and Brazing Tips .</li><li>7.12 Making Flare Joints .</li><li>7.13 Making a Double-Thickness Flare.</li><li>7.14 Swaging Techniques .</li><li>7.15 Steel and Wrought Iron Pipe.</li><li>7.16 Joining Steel Pipe .</li><li>7.17 Installing Steel Pipe .</li><li>7.18 Plastic Pipe.</li><li>7.19 Alternative Mechanical Piping Connections</li></ul>
8	<ul style="list-style-type: none"><li><b>System Evacuation</b></li><li>8.1 Reliable and Efficient Systems .</li><li>8.2 Standing Pressure Test .</li><li>8.3 Leak Detection Methods.</li><li>8.4 Leak Detection Tips.</li><li>8.5 Repairing Leaks .</li><li>8.6 Purpose of System Evacuation .</li><li>8.7 Theory Involved with Evacuation.</li><li>8.8 Measuring the Vacuum ..</li><li>8.9 Recovering Refrigerant.</li></ul>

- 8.10 The Vacuum Pump.
- 8.11 Deep Vacuum..
- 8.12 Multiple Evacuation.
- 8.13 Leak Detection While in a Vacuum.
- 8.14 Removing Moisture with a Vacuum .
- 8.15 General Evacuation Procedures .
- 8.16 Systems with Schrader Valves .
- 8.17 Gage Manifold Hoses .
- 8.18 System Valves .
- 8.19 Using Dry Nitrogen .
- 8.20 Cleaning a Dirty System.

**14**

**Automatic Control Components and Applications**

- 14.1 Recognition of Control Components .
- 14.2 Temperature Controls .
- 14.3 Space Temperature Controls, Low Voltage
- 14.4 Space Temperature Controls, High (Line) Voltage
- 14.5 Sensing the Temperature of Solids
- 14.6 Measuring the Temperature of Fluids
- 14.7 Sensing Temperature in an Airstream.
- 14.8 Things to Remember About Sensing Devices.
- 14.9 Pressure-Sensing Devices .
- 14.10 Pressure Transducers .
- 14.11 High-Pressure Controls.
- 14.12 Low-Pressure Controls .
- 14.13 Oil Pressure Safety Controls.
- 14.14 Air Pressure Controls.
- 14.15 Gas Pressure Switches .
- 14.16 Devices That Control Fluid Flow and Do Not Contain Switches .
- 14.17 Water Pressure Regulators .
- 14.18 Gas Pressure Regulators .
- 14.19 Mechanical Controls.
- 14.20 Electromechanical Controls.
- 14.21 Maintenance of Mechanical Controls.

**14.22** Maintenance of Electromechanical Controls

**14.23** Service Technician Calls.

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**Application of Refrigeration Systems**

**26.1** Application Decisions.

**26.2** Reach-In Refrigeration Merchandising .

**26.3** Self-Contained Reach-In Fixtures .

**26.4** Individual Condensing Units .

**26.5** Multiple Evaporators and Single-Compressor Applications.

**26.6** Parallel Compressor Systems .

**26.7** Secondary-Fluid Refrigeration Systems.

**26.8** Pressurized Liquid Systems.

**26.9** Unitary Stand-Alone Refrigeration Systems.

**26.10** Evaporator Temperature Control .

**26.11** Interconnecting Piping in Multiple-Evaporator Installations.

**26.12** Temperature Control of the Fixture .

**26.13** The Evaporator and Merchandising.

**26.14** Chest-Type Display Fixtures .

**26.15** Refrigerated Shelves .

**26.16** Closed-Type Chest Fixtures.

**26.17** Controlling Sweating on the Cabinet of Fixtures .

**26.18** Maintaining Store Ambient Conditions.

**26.19** Walk-In Refrigeration .

**26.20** Knock-Down Walk-In Coolers .

**26.21** Walk-In Cooler Doors .

**26.22** Evaporator Location in a Walk-In Cooler .

**26.23** Condensate Removal .

**26.24** Refrigeration Piping.

**26.25** Package Refrigeration for Walk-In Coolers .

**26.26** Vending Machine Refrigeration.

**26.27** Water Coolers .

**26.28** Refrigerated Air Driers .

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**Indoor Air Quality**

**34.1** Introduction.

- 34.2 Sources of Indoor Air Pollution.
- 34.3 Controlling Indoor Air Contamination .
- 34.4 Common Pollutants .
- 34.5 Contamination Source Detection and Elimination .
- 34.6 Ventilation.
- 34.7 Air Cleaning.
- 34.8 Duct Cleaning .
- 34.9 Air Humidification.
- 34.10 Sizing Humidifiers.
- 34.11 Installation .
- 34.12 Service, Troubleshooting, and Preventive Maintenance .

**35 Comfort and Psychrometrics**

- 35.1 Comfort.
- 35.2 Food Energy and the Body .
- 35.3 Heat Transfer to and from the Body .
- 35.4 The Comfort Chart.
- 35.5 Psychrometrics.
- 35.6 Moisture in Air .
- 35.7 Absolute and Relative Humidity.
- 35.8 Superheated Gases in Air.
- 35.9 Dry-Bulb and Wet-Bulb Temperatures .
- 35.10 Dew Point Temperature .
- 35.11 Enthalpy.
- 35.12 The Psychrometric Chart .
- 35.13 Plotting on the Psychrometric Chart.
- 35.14 Fresh Air, Infiltration, and Ventilation.

**36 Refrigeration Applied to Air Conditioning**

- 36.1 Refrigeration .
- 36.2 Structural Heat Gain .
- 36.3 Evaporative Cooling .
- 36.4 Refrigerated Cooling or Air Conditioning.
- 36.5 The Evaporator .
- 36.6 The Function of the Evaporator .

- 36.7 Design Conditions .
- 36.8 Evaporator Application.
- 36.9 The Compressor.
- 36.10 The Reciprocating Compressor .
- 36.11 Compressor Speeds (RPM).
- 36.12 Cooling the Compressor and Motor .
- 36.13 Compressor Mountings.
- 36.14 Rebuilding the Hermetic Compressor.
- 36.15 The Rotary Compressor.
- 36.16 The Scroll Compressor .
- 36.17 The Condenser .
- 36.18 Side-Air-Discharge Condensing Units .
- 36.19 Top-Air-Discharge Condensers .
- 36.20 Condenser Coil Design .
- 36.21 High-Efficiency Condensers.
- 36.22 Cabinet Design.
- 36.23 Expansion Devices.
- 36.24 Air-Side Components .
- 36.25 Installation Procedures.
- 37 Air Distribution and Balance**
- 37.1 Conditioning Equipment.
- 37.2 Correct Air Quantity .
- 37.3 The Forced-Air System.
- 37.4 The Blower .
- 37.5 System Pressures .
- 37.6 Air-Measuring Instruments for Duct Systems .
- 37.7 Types of Fans .
- 37.8 Types of Fan Drives .
- 37.9 The Supply Duct System .
- 37.10 The Plenum System .
- 37.11 The Extended Plenum System .
- 37.12 The Reducing Plenum System.
- 37.13 The Perimeter Loop System .



- 37.14 Duct System Standards .
- 37.15 Duct Materials .
- 37.16 Galvanized-Steel Duct .
- 37.17 Fiberglass Duct .
- 37.18 Spiral Metal Duct.
- 37.19 Flexible Duct .
- 37.20 Combination Duct Systems .
- 37.21 Duct Air Movement.
- 37.22 Balancing Dampers.
- 37.23 Zoning.
- 37.24 Zoning with a Single-Speed Blower Motor.
- 37.25 Zoning with a Multispeed Compressor and Variable-Speed Blower .
- 37.26 Adding Zoning to an Existing System .
- 37.27 Duct Insulation.
- 37.28 Blending the Conditioned Air with Room Air .
- 37.29 The Return Air Duct System .
- 37.30 Sizing Duct for Moving Air.
- 37.31 Measuring Air Movement for Balancing .
- 37.32 The Air Friction Chart .
- 37.33 Practical Troubleshooting Techniques .
- 37.34 Residential Duct System Problems .
- 37.35 Commercial Duct Systems .
- 40 Typical Operating Conditions 1018**
- 40.1 Mechanical Operating Conditions .
- 40.2 Relative Humidity and the Load.
- 40.3 System Component Relationships Under Load Changes .
- 40.4 Evaporator Operating Conditions .
- 40.5 High Evaporator Load and a Cool Condenser.
- 40.6 Grades of Equipment .
- 40.7 Documentation with the Unit.
- 40.8 Establishing a Reference Point on Unknown Equipment.
- 40.9 Metering Devices for High-Efficiency Equipment .
- 40.10 Equipment Efficiency Rating.

	<p><b>40.11</b> Typical Electrical Operating Conditions.</p> <p><b>40.12</b> Matching the Unit to the Correct Power Supply.</p> <p><b>40.13</b> Starting the Equipment with the Correct Data.</p> <p><b>40.14</b> Finding a Point of reference for an Unknown Motor Rating .</p> <p><b>40.15</b> Determining the Compressor Running Amperage.</p> <p><b>40.16</b> Compressors Operating at Full-Load Current .</p> <p><b>40.17</b> High Voltage, the Compressor, and Current Draw .</p> <p><b>40.18</b> Current Draw and the Two-Speed Compressor.</p> <p><b>41 Troubleshooting</b></p> <p><b>41.1</b> Introduction.</p> <p><b>41.2</b> Mechanical Troubleshooting .</p> <p><b>41.3</b> Approach Temperature and Temperature Difference .</p> <p><b>41.4</b> Gage Manifold Usage .</p> <p><b>41.5</b> When to Connect the Gages .</p> <p><b>41.6</b> Low-Side Gage Readings .</p> <p><b>41.7</b> High-Side Gage Readings.</p> <p><b>41.8</b> Temperature Readings .</p> <p><b>41.9</b> Charging Procedures in the Field .</p> <p><b>41.10</b> Electrical Troubleshooting.</p> <p><b>41.11</b> Compressor Overload Problems .</p> <p><b>41.12</b> Compressor Electrical Checkup.</p> <p><b>41.13</b> Troubleshooting the Circuit Electrical Protectors Fuses and Breakers</p> <p><b>41.14</b> Service Technician Calls.</p>
14	Main . Refrigeration and Air Conditioning.
15	Additional reference: