Correlation of

***Modern Refrigeration and Air Conditioning,* by Althouse, Turnquist, Bracciano**
(Goodheart-Willcox Publisher ©2021)
to
AHRI Curriculum Guide: XIV. Commercial Refrigeration

The following chart correlates the *Modern Refrigeration and Air Conditioning* textbook (©2021) to a section of the Curriculum Guide developed by Air-Conditioning, Heating, and Refrigeration Institute (AHRI) and used for PAHRA accreditation.

The chart lists the Curriculum Guide's knowledge and task competency objectives and the corresponding chapter numbers from *Modern Refrigeration and Air Conditioning*.

For more information on the Partnership for Air-Conditioning, Heating, Refrigeration Accreditation (PAHRA) and related accreditation, please visit: www.pahrahvacr.org

XIV.A. Single Compressor	
Knowledge	**Textbook Chapter(s)**
1. Explain the importance of compressor/evaporator balance.	Chapters 37, 50, 51
2. Describe the differences in compressor displacement between the various temperature ranges.	Chapters 19, 50, 51
3. Explain basic low and high pressure control theory and operation.	Chapters 16, 18, 49, 50, 51, 53, 54, 55
4. Explain the operation of a vapor compression system and its effects on temperature and volume.	Chapters 4, 5, 6, 19, 50, 51
5. Explain the operation and components used for the pump down cycle.	Chapters 11, 23, 53, 55
6. Explain the evaporator and the condenser side of a system.	Chapters 6, 22, 51
7. Explain application and operation of evaporator pressure regulating valves.	Chapters 6, 22, 51

XIV.A. Single Compressor (continued)	
Knowledge	**Textbook Chapter(s)**
8. Discuss the problems associated with compressors operating at lower evaporator temperatures:	
a. decreased volumetric efficiency	Chapters 19, 22, 23, 49, 50, 51, 53, 54, 55
b. higher discharge gas temperatures	Chapters 19, 22, 23, 49, 50, 51, 53, 54, 55
c. potential overloading during initial temperature pull-down	Chapters 19, 22, 23, 49, 50, 51, 53, 54, 55
9. Discuss the use of different compressor designs for increased efficiency and capacity.	Chapters 19, 49, 50, 51, 52, 53, 54
10. Describe the methods used for cycling the compressor on and off.	Chapters 15, 16, 18, 49, 53, 54, 55
11. Explain methods of defrost.	Chapters 22, 23, 49, 50, 54
12. Explain methods of head pressure control system.	Chapters 22, 23, 53, 54
13. Explain heat reclaim.	Chapter 22
14. Explain the lubrication methods for a compressor.	Chapters 19, 20, 55
15. Determine the terminal identification of a single-phase compressor.	Chapters 15, 18, 19
16. Explain how to measure the compressor lubrication oil pressure.	Chapters 19, 20, 55
17. Explain several manufacturers' model numbering system.	
18. Define *compression ratio* and the effect suction and discharge pressure have on compression ratio.	Chapters 19, 50, 51, 53
19. Determine compressor capacity using the compressor's curve.	
20. Determine the correct operating amps using the compressor's curve.	
21. Describe the different types and designs of compressors:	
Types:	
a. hermetic	Chapter 19
b. semi-hermetic	Chapter 19
c. open drive	Chapter 19
Design:	
a. reciprocating	Chapter 19
b. scroll	Chapter 19
c. screw	Chapter 19

XIV.A. Single Compressor (continued)	
Knowledge	**Textbook Chapter(s)**
22. Explain requirements of food preservation:	
a. medium temperature	Chapters 47, 51
b. low temperature	Chapters 47, 51
23. Describe supermarket display cases.	Chapter 47
24. Explain the difference between an across-the-line start and a part-winding start.	Chapters 15, 16, 18
Tasks	**Textbook Chapter(s)**
1. Identify the different types of compressors.	Chapter 18
2. Select a compressor for a particular capacity and temperature range.	Chapters 19, 47, 50, 51, 52
3. Check the operation of a compressor in a particular system.	Chapters 7, 12, 13, 15, 16, 18, 51, 53, 54, 55
4. Compute the compression ratio for a particular system.	Chapters 7, 10, 50, 51
5. Adjust Evaporator Pressure Regulating (EPR) valve.	Chapters 7, 22, 23, 53, 54, 55
6. Check control circuits per manufacturers' specifications.	Chapters 3, 12, 13, 14, 15, 16, 18, 53, 54, 55
7. Check system charge, superheat, and subcooling.	Chapters 6, 7, 9, 10, 11, 52, 53, 54
8. Check display case temperatures and determine if operating properly.	Chapters 7, 22, 47, 53, 54, 55
9. Set cut-in and cut-out for a special product.	Chapters 16, 18, 22, 23, 52, 53, 54, 55
10. Draw the wiring diagrams for an across-the-line start and a part-winding start.	Chapters 12, 13, 15, 16, 18
11. Draw a ladder diagram of a system equipped with a pump down cycle.	Chapters 10, 11, 12, 13, 15, 16, 18, 22, 23, 53, 54
12. Draw the schematic of a single-phase and a three-phase compressor motor.	Chapters 12, 13, 15, 16, 18, 52
13. Draw a ladder diagram of a system using a defrost time clock and defrost termination fan delay switch.	Chapters 12, 13, 15, 16, 17, 18, 22, 23, 24
14. Measure the compressor windings and determine if they are correct.	Chapters 12, 13, 15, 16, 17, 18, 19
15. Measure the operating amps and determine if correct.	Chapters 12, 13, 15, 16, 17, 18, 19
16. Check operation of defrost cycle and adjust time clock.	Chapters 12, 13, 15, 16, 18, 19, 22, 23, 24

XIV.A. Single Compressor (continued)	
Tasks	**Textbook Chapter(s)**
17. Adjust head pressure controls for proper operation.	Chapters 7, 10, 11, 16, 18, 22, 23, 53, 54, 55
18. Check operation of equipment equipped for automatic pump down.	Chapters 7, 11, 16, 18, 22, 23, 53, 54, 55
XIV.B. Multiplexed Evaporator Systems	
Knowledge	**Textbook Chapter(s)**
1. Define the different types of multiplexed systems.	Chapters 22, 47, 49
2. Explain the application of multiplexed systems.	Chapters 22, 47, 49
3. Describe how compressors are connected.	Chapters 8, 19, 47, 49, 52
4. Describe the physical construction of a common rack system.	Chapters 8, 19, 47, 49, 52
5. Describe the advantages of controlling capacity using the multiplexed system.	Chapters 47, 49, 52
6. Describe how compressors are cycled on and off.	Chapters 15, 16, 18, 19, 47, 49, 52
7. Explain the problems associated with multiplexed systems:	
a. oil level control	Chapters 20, 47, 49, 52, 55
b. crankcase pressure balance	Chapters 20, 47, 49
c. contamination due to a compressor burnout	Chapters 19, 20, 47, 49, 52, 55
8. Explain the cascade system.	Chapters 47, 49, 50
9. Explain operation of evaporator pressure regulating (EPR) valves.	Chapters 22, 23, 49, 54
10. Explain function and placement of check and hot gas valves.	Chapters 20, 22, 23, 49, 51, 52, 53, 54, 55
11. Explain advantages of multiple evaporator systems.	Chapters 22, 23, 47, 49, 52
12. Explain the difference in compressor requirements for a multiplexed system.	Chapters 19, 23, 47, 49, 52
13. Define the different types of multiplexed systems.	Chapters 22, 47, 49
14. Explain the difference between even and uneven parallel systems.	
15. Explain operation of defrost cycle.	Chapters 22, 23, 50, 54
Tasks	**Textbook Chapter(s)**
1. Check staging of compressors with changes in system load.	Chapters 7, 16, 18, 49, 50
2. Check individual evaporator temperatures and adjust evaporator pressure regulating (EPR) valves accordingly.	Chapters 7, 21, 22, 49, 52, 53, 54, 55

XIV.B. Multiplexed Evaporator Systems (continued)	
Tasks	**Textbook Chapter(s)**
3. Identify capacity of compressors used on multiplexed system by referring to manufacturers' specifications.	Chapters 18, 50, 51
4. Set superheat on multiplex system.	Chapters 7, 10, 11, 16, 17, 18, 50, 51, 52, 53, 54
5. Check control circuits per manufacturers' specifications.	Chapters 12, 13, 15, 16, 17, 52, 53, 54
6. Adjust Evaporator Pressure Regulating valves, for established (assigned) multiple temperature cases.	Chapters 7, 9, 10, 11, 21, 22, 49, 53, 54, 55
7. Adjust pressure control to lowest temperature case.	Chapters 7, 10, 11, 21, 22, 49, 53, 54, 55
8. Layout piping diagram of multiple evaporator system showing placement of required low side components (TXVs, EPRs, CK valves, etc.) and high side required components.	Chapters 7, 8, 21, 22, 49, 51, 52, 53, 54, 55
XIV.C. Refrigerated Storage	
Knowledge	**Textbook Chapter(s)**
1. Explain the difference between medium temperature, low temperature, and ultra low temperature storage systems.	Chapters 47, 50, 51
2. Explain the difference between service and self-service cases.	Chapters 47, 50, 51
3. Identify service cases and self-service cases.	Chapters 47, 50, 51
4. Explain the operation of:	
a. air screen freezer	Chapter 47
b. glass door freezer	Chapter 47
c. display/coffin cases	Chapter 47
5. Explain the different methods of defrost:	
a. electric resistance	Chapters 22, 50, 54
b. hot gas	Chapters 22, 50, 54
c. cool gas	Chapters 22, 50, 54
d. natural shut-down	Chapters 22, 50, 54
e. ambient air	Chapters 22, 50, 54
Tasks	**Textbook Chapter(s)**
1. Replace anti-sweat heaters.	Chapters 7, 12, 13, 16, 18, 47, 55
2. Replace fan motors and fans.	Chapters 12, 13, 15, 16, 18, 29, 30, 55
3. Find and repair leaks.	Chapters 7, 10, 11, 53, 54, 55

XIV.C. Refrigerated Storage (continued)	
Tasks	**Textbook Chapter(s)**
4. Verify operation of unit.	Chapters 3, 7, 12, 13, 15, 16, 18, 47, 52, 53, 54, 55
5. Check and/or replace fan relay.	Chapters 12, 13, 15, 16, 18, 47, 52, 53, 54, 55
6. Verify airflow.	Chapters 7, 22, 27, 52, 53, 54, 55
7. Clean drain line.	Chapters 22, 55
8. Check all electrical components for voltage and current.	Chapters 12 ,13, 14, 15, 16, 17, 53, 54, 55
9. Adjust operating and safety controls.	Chapters 9, 10, 12, 13, 14, 51, 52, 53, 54
10. Clean condenser coil surface (air-cooled/water-cooled).	Chapters 22, 54, 55
11. Perform all aspects of preventive maintenance.	Chapters 22, 53, 54, 55
12. Check operation of defrost cycle.	Chapters 22, 23, 49, 50, 53, 54, 55
13. Identify defrost components on a given system.	Chapters 22, 23, 50, 53, 54, 55
XIV.D. Ice Makers	
Knowledge	**Textbook Chapter(s)**
1. Explain the operation of ice making for both cubed and flaked ice.	Chapters 47, 53
2. Explain water spray system for ice making.	Chapters 47, 53
3. Identify styles of icemakers and explain the sequence of operation of each.	Chapters 47, 53
Tasks	**Textbook Chapter(s)**
1. Follow manufacturers' instructions for cleaning the evaporator.	Chapters 7, 47, 53
2. Clean the condenser.	Chapters 47, 53
3. Check the harvest cycle.	Chapters 47, 53
4. Adjust cube size.	Chapters 47, 53
5. Check for and repair leaks.	Chapters 7, 8, 10, 11, 47, 53
6. Inspect the electrical circuit.	Chapters 12, 13, 15, 16, 17, 18, 47, 53, 54, 55
7. Check and adjust the metering device for proper operation.	Chapters 7, 9, 10, 11, 21, 47, 53, 54, 55
8. Measure grid heater current when applicable.	Chapters 12, 13, 16, 18, 43, 47, 53, 54, 55
9. Clean ice storage bin.	Chapters 47, 53

XIV.D. Ice Makers (continued)	
Tasks	**Textbook Chapter(s)**
10. Inspect and clean drains as necessary.	Chapters 7, 8, 47, 53, 55
11. Replace bearings and seals in flake-type machine.	Chapters 47, 53
12. Replace auger motor in a flaker.	Chapters 47, 53
13. Check and adjust water pressure.	Chapters 7, 8, 33, 47, 53, 55
14. Level the machine.	Chapters 7, 25, 47, 53
15. Check water pump.	Chapters 7, 8, 10, 47, 53
16. Check water treatment equipment.	Chapters 47, 53
17. Adjust float valve assembly.	Chapters 47, 53
18. Change float valve assembly.	Chapters 47, 53
19. Check production capacity of a given ice machine.	Chapters 47, 53
XIV.E. Dispensing Freezers	
Knowledge	**Textbook Chapter(s)**
1. Describe the application of dispensing freezers.	Chapter 47
2. Describe the types of dispensing freezers.	Chapter 47
3. Describe the design and construction of dispensing freezers.	Chapter 47
4. Describe the maintenance requirements of a dispensing freezer, including sanitary requirements.	Chapters 47, 53
Tasks	**Textbook Chapter(s)**
1. Check the operation of a dispensing freezer.	Chapters 47, 53
2. Clean and set up a dispensing freezer.	Chapters 47, 53
XIV.F. Packaged Liquid Chillers	
Knowledge	**Textbook Chapter(s)**
1. Discuss the application of liquid chillers.	Chapters 33, 34, 47
2. Describe the differences in design and construction between direct expansion versus indirect expansion evaporators.	Chapters 22, 33
3. Explain the operation of liquid chillers.	Chapters 33, 34, 47
4. Discuss the problems associated with liquid chillers.	
a. insufficient water flow problems	Chapters 33, 34, 47, 53
b. considerations when operation below 32°F is required	Chapters 33, 34, 47, 53
c. added maintenance	Chapters 33, 34, 47, 53

XIV.F. Packaged Liquid Chillers (continued)	
Tasks	**Textbook Chapter(s)**
1. Measure the temperature drop through the chiller.	Chapters 7, 10, 33, 47, 53, 54
2. Check the operation of the liquid chiller.	Chapters 7, 10, 11, 33, 47, 53, 54
3. Identify the components of a liquid chiller.	Chapters 33, 34, 47, 53, 54
4. Determine Btu/h capacity of water chillers using flow and Delta (∈) T method.	Chapters 7, 8, 10, 33, 34, 47, 53, 54, 55
XIV.G. System Applications	
Knowledge	**Textbook Chapter(s)**
1. Explain the operation of a single compressor/evaporator system.	Chapters 6, 47, 49
2. Explain the fundamental two-stage (multi-stage) system.	Chapters 6, 47, 49, 50
3. Explain the fundamental cascade system used for specialty ultra-low temperature application.	Chapters 47, 49, 50
4. Explain the operation of low ambient head pressure control systems (fan cycling, dampers, and flooding of condenser).	Chapters 22, 23, 53, 54
5. Explain the heat reclaim cycle (three-way valve).	Chapters 22, 23
6. Explain function operation of oil separation and return to compressor crankcase.	Chapters 19, 20
7. Explain oil level (balance) of multi-parallel compressor applications.	Chapters 19, 20, 47, 49
8. Explain the defrost cycle.	Chapters 22, 23, 50, 54
9. Establish the pressure control settings.	Chapters 16, 18, 23, 54
10. Describe electrical/mechanical sequence from electrical schematic.	Chapters 12, 13, 15, 16, 17, 18, 47, 52, 53
Tasks	**Textbook Chapter(s)**
1. Adjust evaporator pressure regulating valve (EPR).	Chapters 22, 23, 53, 54, 55
2. Check control circuits as per manufacturers' specifications.	Chapters 3, 7, 12, 13, 15, 16, 18, 53, 54, 55
3. Check the suction stop valve.	
4. Check system for proper refrigerant charge.	Chapters 11, 52
5. Charge system with refrigerant on liquid side as well as suction side.	Chapters 11, 52
6. Test and adjust all operating and safety controls.	Chapters 7, 8, 9, 10, 11, 12 ,13, 15, 16, 18, 20, 23, 52, 53, 54, 55
7. Replace filter driers.	Chapters 7, 8, 10, 11, 23, 55
8. Check compressor oil.	Chapters 19, 20, 54, 55

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XIV.G. System Applications (continued)	
Tasks	**Textbook Chapter(s)**
9. Change oil in compressor crankcase.	Chapters 19, 20, 54, 55
10. Check for and repair refrigerant leaks.	Chapters 7, 8, 9, 10, 11, 19, 20, 54, 55
11. Inspect electrical circuit for defective connections.	Chapters 12, 13, 15, 16, 18, 54, 55
12. Repair defective connections.	Chapters 12, 13, 15, 16, 18, 54, 55
13. Troubleshoot from electrical schematic.	Chapters 12, 13, 15, 16, 17, 18, 54, 55
14. Check oil separator operation and return.	Chapters 19, 20, 54, 55
15. Draw a ladder diagram of a given system.	Chapters 12, 13, 15, 16, 17, 20, 23, 47, 49, 54, 55