1. Central Plant Overview

- Water cooled chiller plants
    - Screw & Centrifugal most common
    - Scroll becoming more common (modular chillers)
    - Common failures: fouled tubes, water flow, sensors, oil system, water temps, drives
- Cooling towers: open loop vs closed loop, crossflow vs counterflow
    - Condenser water loop, towers/geothermal (rivers/lakes)
    - Common failures: scale buildup, fan issues, balancing issues, water level issues
- Chilled water distribution
    - Primary/secondary
    - Primary
    - Headered
- Air cooled chillers
    - Same job, no condenser water
    - Scroll, Screw, Centrifugal
    - Tradeoffs vs water-cooled: efficiency, footprint, noise, simpler operation and maintenance
    - Common failures: dirty condenser coils, fan motor failures, water flow, sensors, drives, EXV's
- Where chilled water goes from here?

2. Air Handling Units (AHU)

- Processing Building Air (Mech Room or Roof Top)
    - Mixed air section, filter rack, coil section (CHW or DX), supply fan, supply duct
    - Economizer operation when free cooling available
    - Squirrel cage vs backwards inclined (Fan walls) vs vane axial fans
    - Standard vs multi zone
- Supply ductwork to terminal units & return plenums
    - Supply static pressure control
- Common failures: actuator failures, dirty coil, belt/bearing, sensors, filters, fan motor failure, condensate drains

3. Self-Contained Units (SCU)

- Water cooled Scroll package unit (Mech Room)
    - Mixed air section, filter rack, DX coil section, supply fan, supply duct
    - Condenser water loop
        - Tube in tube
        - Shell & tube
    - Free Cooling options
- Same fan and duct design as AHU

- Common failures: refrigerant leaks, condenser fouling, actuator failures, dirty coil, belt/bearing, sensors, filters, fan motor failure, condenser temps/flow, condensate drains

4. Rooftop Units (RTU)

- Air cooled Scroll package unit (Roof Top)
    - Economizer Free Cooling
    - OA built in
    - Same fans as AHU & SCU
- Return air duct, filter rack, DX coil section, supply fan, supply duct
- Common failures: refrigerant leaks, actuator failures, dirty coils, belt/bearing, sensors, filters, supply fan motor failure, condenser fan failures, condensate drains

5. Variable Air Volume (VAV) Boxes

- Airflow zone control unit in supply duct
    - Supply air damper controlling airflow via CFM setpoint
    - Balance CFM with heat input
    - Building heat at AHU
    - Reheat for minimum CFM
- Common failures: Actuator/damper calibration/failure, controls failure, zone balancing dampers wrong, supply duct connected incorrectly

6. Fan Powered Boxes (FPB)

- Air flow zone control unit in supply duct with standalone fan
    - Supply air damper controlling air flow via CFM setpoint
    - Minimum CFM setpoint
    - Electric or hot water coils at FPB
- Series vs parallel FPB
    - Series: fan runs continuously
    - Parallel: fan only kicks on during heating or in recirculation mode
- Common failures: Fan motor failures, actuator/damper calibration/failure, controls failure, zone balancing dampers wrong, supply duct connected incorrectly

7. Outside Air Units (OAU)

- Styles
    - OAU/OAF
    - EF (Exhaust Fans)
    - DOAS (Dedicated Outside Air Unit)
        - RTU but higher SASP & larger OA intake/exhaust
- OA Exchange cycles
    - Sick building syndrome
- Energy recovery/Enthalpy wheels

- Common failures: Fan motor failures, enthalpy wheel bearing/belt failures, actuator/damper calibration/failure, controls failure, zone balancing dampers wrong, refrigerant leaks, dirty coils, supply fan belt/bearing, sensors, filters, supply fan motor failure, condenser fan failures, condensate drains

8. Fan Coil Units (FCU)

- Standalone mini AHU for zone control
    - Vertical vs horizontal units
    - Ceiling mounted vs floor mounted
    - Chilled Water or DX
- Common failures: actuator failures, dirty coil, belt/bearing, sensors, filters, fan motor failure, condensate drains

9. VRF Systems

- VRF vs VRV
- Central ODU with zoned FCU
- Refrigerant feeds DX FCU
- Small & efficient footprint with lower install costs compared to chilled water
- Common failures: Incorrect piping install, incorrect controls wiring install, refrigerant leaks, dirty coils, condenser fan motor failures, electrical failures
- VRF Chillers
- Full VRF deep dive class scheduled for October