Motors and Control Logic (EMEC 1250) Final Exam

** Review the chapter notes (Under "Course Information and Chapter Notes") (on Blackboard) for each of the following ***

Chapter 14

** Under this chapter (in Blackboard) are links to video clips (old military films) on how motors and generators work. Viewing the videos was assigned as part of the "After Quiz" assignment in the middle of the semester but would be worth reviewing**

1st Part of Chap 14 (Single Phase Motors)

- be able to explain how a single phase generator works (pg 213)
- be able to explain how a transformer works (fig 11-2 & pg 225-227)
- be able to explain the difference between a "conduction motor" (like universal and DC motors) and an "induction motor" (single phase and three phase AC motors) ("Conduction" motors supply (conduct) current to their rotors through brushes and commutators (pg. 275 & 276) . "Induction" motor supply current to their rotors strictly by the rotating stator field. The rotor doesn't have any electricity physically supplied to them.)
- be able to explain (in an overview format) how a single phase motor works (pg 297-301)
- know what determines a motor's speed (frequency & # of poles), the biggest enemy of electric motors (heat), and the first thing to check if a motor is not working (does it have incoming power).
- be able to list and tell how each of the three types of single phase motors work (shaded pole, split phase, and capacitor start) and be able to rank them in terms of torque. (pg 297-302)
- know how we reverse the direction of rotation of split phase and capacitor start motors (we switch the leads to their start windings)
- know some common (critical) items found on a motor's nameplate (handout)
- know about troubleshooting induction motors (pg. 306-314)
- know (according to NEC) what has to be used to start a motor (either a manual or magnetic motor starter with overload protection)
- know how overload heaters work (pg. 243 & 244)
- know what the two parts of a dual element / time delay do (short circuit section & slow over-current secton)
- know the advantage of fuses over circuit breakers (pg. 257 & 265) (they clear faults much faster) and the advantage of circuit breakers over a fuses (pg. 74&75) (fuses are re-setable)
- know what drum switches are used for (pg. 328)
- know that torque goes with voltage

2nd Part of Chap 14 (3 Phase Motors) (covered in handouts)

- know how three phase generators produce 3 phase AC (prime mover, exciter, ect.) (pg 214)
- know the different types of three phase motor starters (manual vs magnetic, IEC vs NEMA, heater overloads vs electronic overloads)
- know how to troubleshoot a three phase motor (pg. 313)

- know what a reversing motor starter is and how it works (pg 331 and pg. 335-355)

Motor Drives (handout) (pg 555-564)
- know the difference in capabilities between motor starters (like we have in our lab) and motor controllers (like you wired in the IST lab). (Motor controllers let you set ramp up time, ramp down time, frequency, ect.)
- know what "soft starting" ("reduced voltage starting") is and why it is used (pg. 419)
- know about using resistors to reduce voltage (like you wired in IST lab)
- know some methods used for breaking and stopping motors (pg. 565 and 375-382)
- know how multi-speed motors (like those used in HVAC applications) get multiple speeds (their stator coils are tapped for more or less number of polse)

- Reduced Voltage (resistor) starting (pg. 419)

Chapter 6 (Various Control Devices)
- various manual switches:
    - pushbuttons
    - limit switches
    - two and three position selector switches
    - joy sticks
    - foot switches
- pressure switches (know / be able to list the types below)
    - diaphram type
    - bellows type
    - piston type
    - know what is meant by "dead band" and what happens when a pressure switch's dead band is too small (motor will chatter on and off, which is very hard on it.)
    - pressure switch applications
- temp. switches (know / be able to list the types below)
    - bimetallic type
    - capillary tube type
    - thermistor type
    - thermocouple (also see pg. 11)

- liquid level switches (know / be able to list the types below)
    - mechanical (float)
    - magnetic (reed relay)
    - conductive probe
    - capacitive and optical
- flow switches
- manual control (done by an operator) vs mechanical control (done by an object - like a box hitting a limit switch) vs automatic control (done based on an enviromental condition - Ex:, when the pressure increases to a certain point, a motor comes on.)

*** you will be asked to **list** a couple types of pressure, temperature, and liquid level switches on the final ***

Chapter 16 (Timers)

- know the four types of timers we discussed (dashpot, synchronous clock, solid state, and programmable
- know how dashpot and synchronous clock timers work
* know the about the different types of **timing logic**
    - on delay
    - off delay (overhead projector example)
    - one shot
    - recycling / repeating
- solid state timer triggering methods (we used with the timers in our lab)
    - supplying power at terminals 2 & 10
    - a control switch at terminals 5 and 6

Stepper Motors vs Servo Motors

- both control shaft position but servo motors have feedback (are closed loop) to account for over-shoot and under-shoot

Cummulative portion

- Review the questions on your mid-term quiz (which covered handouts and chapters 2 through 6)
- You will not be asked to wire anything for the exam. (Your wiring competency is tested based your completion of the labs we have done.)