Closed book, closed notes portion of test. Total of 40 out of 100 points for questions #1 to #8.

1. [11] Fully identify all of the following schematic symbols:


4. [6] In Lab #9 (Proximity Sensors and PLC Intro) there were three different types of proximity sensors. Identify the three proximity sensor types and give a primary advantage of each.
5) Sketch meter-out flow control during cylinder extension and no flow control during retraction.

6) Estimate the pressures P1 and P2 while the load is moving to the right. Estimate the pressures P1 and P2 when the load stops against the barrier.

7) List (or sketch) the 4 different types of fixed volume, positive displacement pumps discussed in ME 360. Also, what is the basic operating principle for all positive displacement pumps?

8) The hydraulic system below is used to operate a large, heavy press. What is the name and purpose for the valve pointed to by the arrow? Also, add the one extra component on this diagram that would be required to lift the press.
9. [15] A factory automation system is shown below. Fully describe the operation of the PLC ladder-logic on a rung-by-rung basis and describe what the cylinders do.
10. [5] What minimum size electric motor would be required to drive a hydraulic pump that generates a flowrate of 5.0 GPM with a delta-P across the pump of 2200 psi?

11. [40] In the system shown the pneumatic cylinders are used to push parts into the “short” and “tall” part hoppers. Parts are automatically fed to the conveyor belt by another automated system.

- Two NO push-buttons are provided, X10 ("start process") and X11 ("stop process"). There is also a NC emergency pushbutton X12.
- If the X11 or X12 buttons are pressed, system must immediately retract cylinders and stop the conveyor belt.
- The position of each cylinder is detected by the externally mounted NO proximity sensors X1 to X4 as shown.
- The “short part” through-beam NO photo sensor (X5) activates when a “short” part breaks the beam (dotted line). A part is in position to be ejected into the hopper when the front edge breaks the beam.
- The motor stops when X5 is activated and Y1 is activated to push the short part off the conveyor belt.
- The “tall part” NO photo sensor (X6) and cylinder (Y2) combination works similarly.
- The motor automatically moves the conveyor belt (by activating Y0) to the left one second after the “push” cylinders are fully retracted.

Your problem:

a) Draw a PLC wiring diagram for the pushbuttons, limit switches, motor, and solenoids used in this system.

b) Design a PLC type ladder logic diagram to control the system. Maximize your grade by providing a description beside each rung of the ladder to describe what you are trying to accomplish.