

MEL334: LOW COST AUTOMATION

Major Exam (5 May 2016)

MAX MARKS: 70

MAX TIME: 120 min

Notes: Hand written notes are allowed in the exam.

No printed or photocopy material is allowed.

Make suitable assumptions wherever required and state them clearly.

Q1: A Temperature control system consists of a temperature sensor measuring temperature in range of 0-80°C connected to slot 1 (10-bit Analog Input Module) of Micrologix 1100 PLC. The output of sensor is 0-10V. The system operates three heating units through relays. Below 55°C, all three heaters are to be on. Temperature between 55°C - 60°C causes two heaters to be on. For 60°C to 65°C, one heater is to be on. Above 70°C, there is a safety shutoff for all 3 heaters in case on stays on by mistake. A master switch turns the system on and off. Draw Ladder logic to meet the above mentioned functionality. **(20 Marks)**

Q3: Draw ladder diagram for following comparison functions:

- A light is to come ON only if a PLC counter has a value of 45 or 78.
- A light is to be ON if a PLC counter does not have values of either 23 or 31.
- A light is to come ON if three input numbers have the same value.
- An output is ON if the input count is less than 34 or more than 41.
- An output is to be ON if the count is between 34 and 41 including 34 and 41, but if count is 37, the output is to be OFF. **(15 Marks)**

Q4: In a sheet metal punching press, double pump hydraulic system is used. Sheet metal punching operation requires a force of 8000 N. During rapid extension of the cylinder, a frictional pressure loss of 675 kPa occurs in the line from high-flow pump to the blank end of the cylinder. During the same time, a 350 kPa pressure loss occurs in the return line from the rod end of the cylinder to the oil tank. Frictional pressure losses in these lines are negligibly small during the punching operation. Assuming that the unloading valve and relief valve pressure settings (for their full pump flow requirements) should be 50% higher than the pressure required to overcome frictional pressure losses and the cylinder punching load respectively. Hydraulic cylinder of 3.75 cm piston diameter and 1.25 cm rod diameter has been used. The linear velocity of Hydraulic cylinder during approach to sheet is 10 m/sec and deformation will takes place at 0.1 m/sec. Find the following: **(15 Marks)**

- Pressure and flow rate of both pumps
- Pressure settings of unloading valve and pressure relief valve

Q5: Draw the PLCOpen Motion blocks to control X and Y axis as follows:

- Power On X and Y axis.
- Start rotating X axis at speed 3000 units/sec with input Signal START.
- Immediately after the speed reached 3000 units/sec, Gear-in the Y-axis with X-axis so that Y-axis will rotate at 750 units/sec.
- GearOut with an input signal GOUT_EXEC
- Stop both Axis once GearOut done.

Draw timing diagram to show START, InVelocity, InGear, GOUT_EXEC, X-Velocity, and Y-Velocity. **(20 Marks)**