

## DDC tutorial

### Question 04

An energy saving hot water system needs to be installed in a domestic home. In this system, the roof top of the house is fitted with a solar collection panel. The panel consists of black copper tubes; when water is pumped into the tubes during day time, the water will get heated.

Your major job is to design the Direct Digital Controller. The controller has the following functions:

- (a) Detect the amount of sunlight at 10:30am in the morning.
- (b) If there is adequate sunlight start pumping water to the solar collection panel.
- (c) Stop the pump when water in the panel is full.
- (d) At 3:30pm in the afternoon, drain all the water into a heat insulated storage tank.
- (e) The above operation should only occur between Monday and Friday. There is no need for hot water during the weekends.

- (a) Use a system diagram to describe your overall system hardware. Include all essential sensors and actuators into your diagram explain your diagram. (4 marks)
- (b) List the sequence of operations for your system. (4 marks)
- (c) Deduce the I/O summary from (a) and (b). (4 marks)
- (d) Construct a mode summary table from the I/O summary description. (4 marks)
- (e) Finally, draw the complete flow diagram for the hot water system. (4 marks)

### Question 06

In order to save energy on lighting, a large factory in China has replace the roof top with semi-transparent material to allow sunlight to pass through. However, during very sunny and very hot days, the factory floor temperature will increase to uncomfortable level. Under this situation, ventilation fans have to operate to blow the hot air out, and shading curtain has to be drawn to avoid excessive sunlight.

Design a Direct Digital Control for the factory floor with the following functions:

- Switch off all fans and close all curtains during the non-working periods of Saturdays and Sundays, and during weekday lunch time of 12:00 – 1:00pm.
  - Switch on all fans during the weekdays when the temperature rises above 30° C.
  - During the working hours, when the outside temperature falls below 15° C, fully open all curtains and switch off all fans.
  - During the sunny day working hours, when the outside temperature is between 15-28° C, half close the curtains.
  - During the sunny day working hours, and when the outside temperature is over 28° C, fully close the curtains.
- (a) Use a system diagram to describe your overall system hardware. Include all essential sensors and actuators into your diagram. (4 marks)
  - (b) List the sequence of operations for your system. (4 marks)
  - (c) Deduce the I/O summary from (a) and (b). (4 marks)
  - (d) Construct a mode summary table. (4 marks)
  - (e) Finally, draw the complete flow diagram for the system. (4 marks)