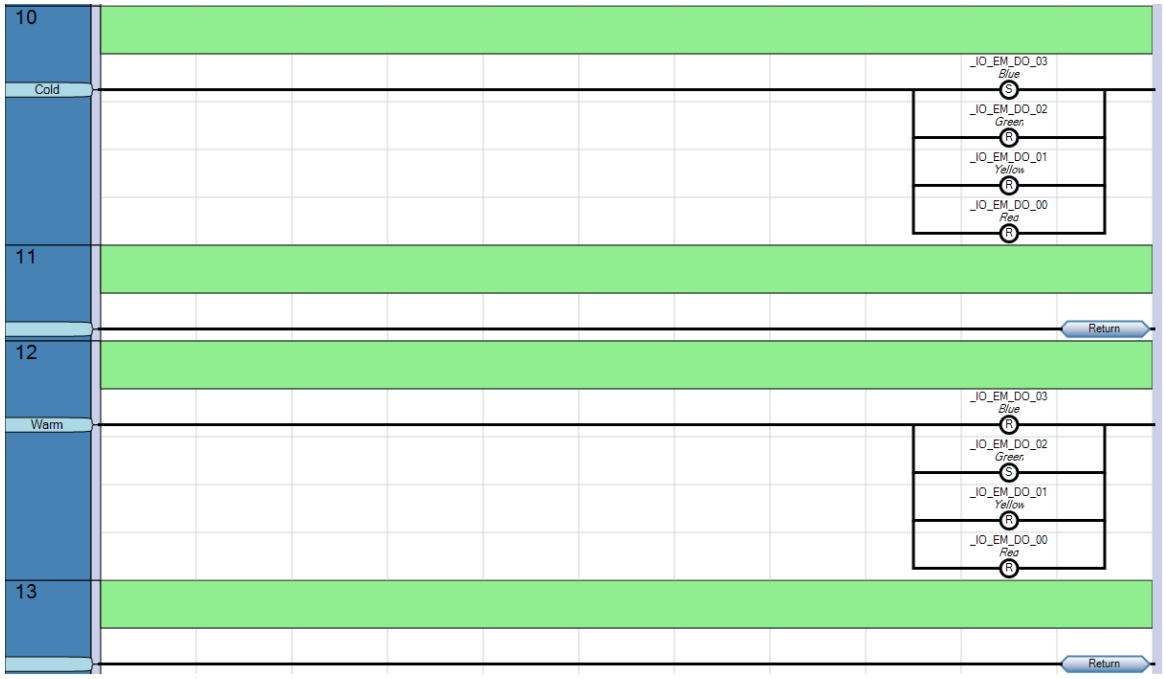
Homework #3: ECE 461 / 661

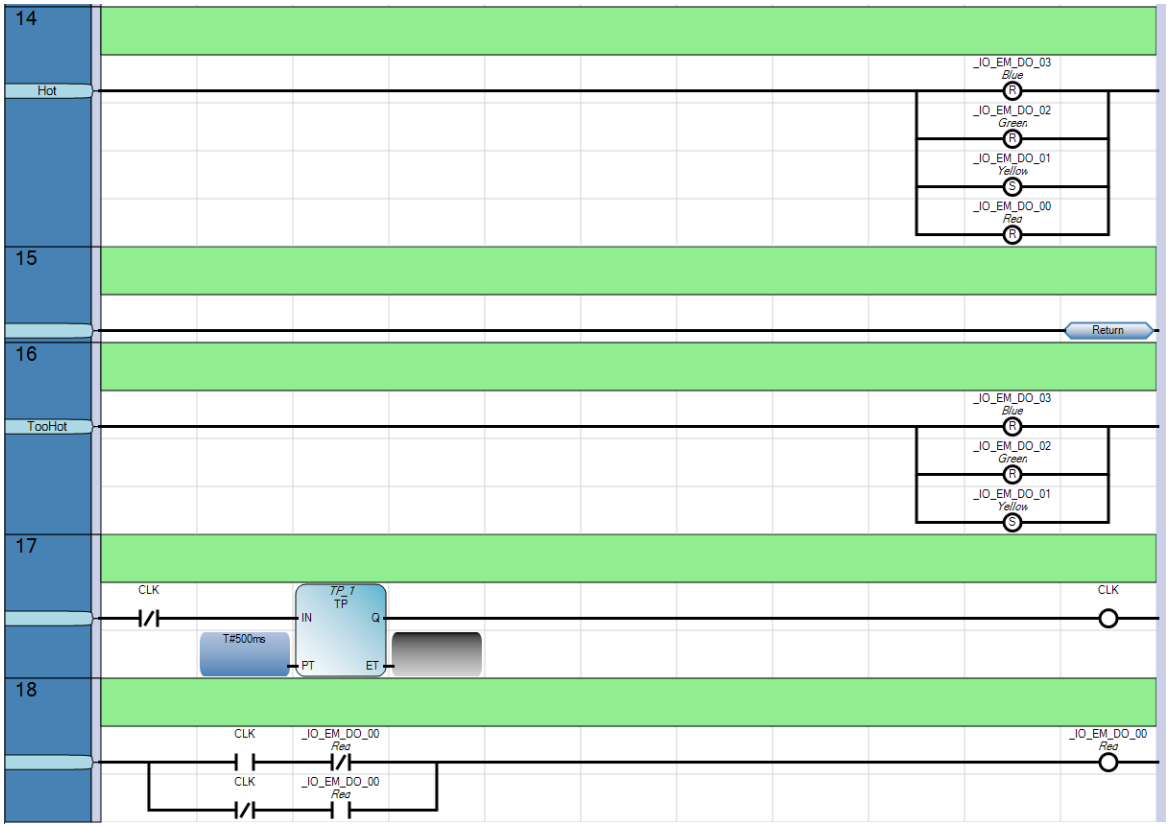
Flow Control, Analog Inputs: Due Monday, Septmber 12th

1) Give a ladder diagram for four different programs:

Program	Red	Yellow	Green	Blue
Cold	off	off	off	on
Warm	off	off	on	off
Hot	off	on	off	off
TooHot	blink	on	off	off

When the red light blinks, it turns on and off every 500ms.

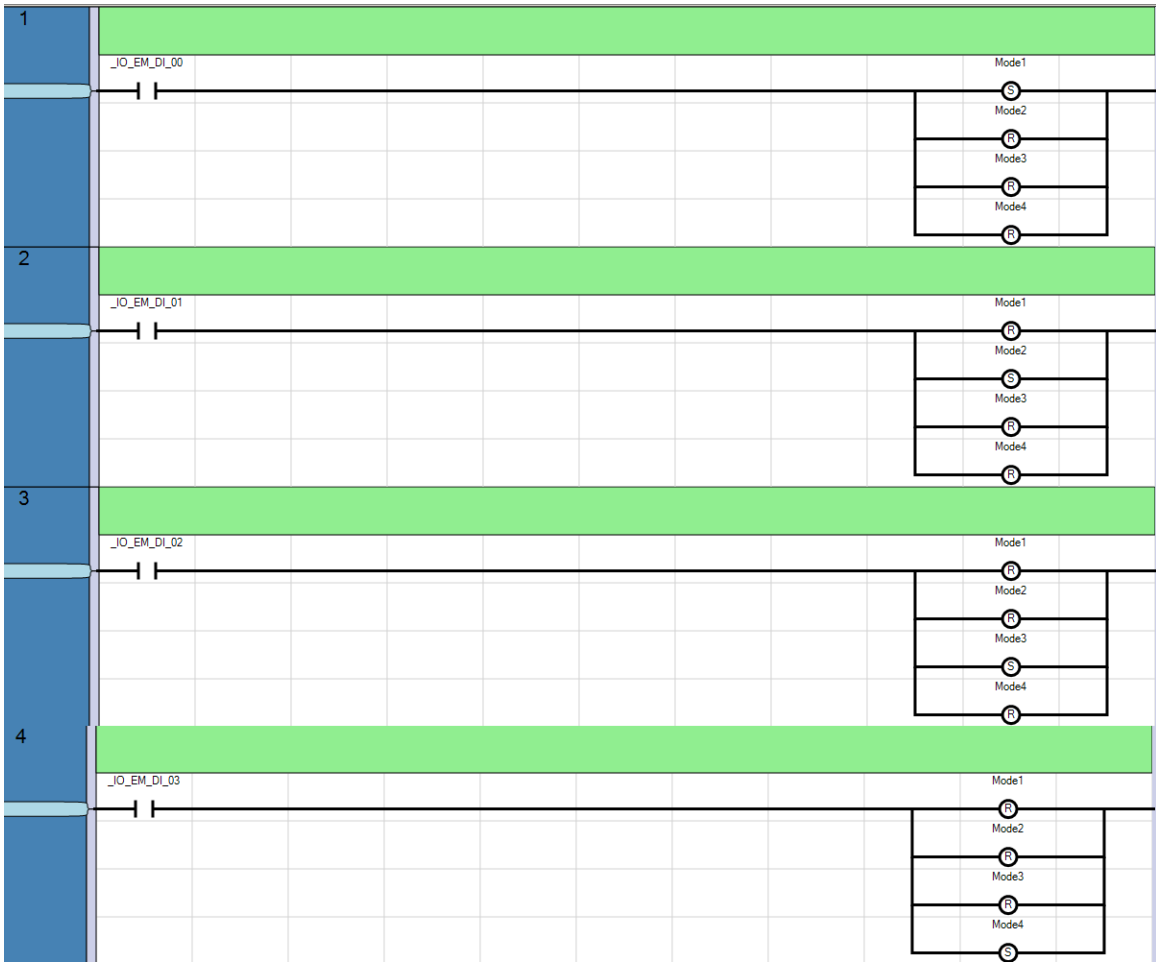



14
Hot
_IO_EM_DO_03
Blue
R
_IO_EM_DO_02
Green
R
_IO_EM_DO_01
Yellow
S
_IO_EM_DO_00
Red
R
15
Return
16
TooHot
_IO_EM_DO_03
Blue
R
_IO_EM_DO_02
Green
R
_IO_EM_DO_01
Yellow
S
17
CLK
TP_1
TP
IN
Q
T#500ms
PT
ET
CLK
18
CLK
_IO_EM_DO_00
Red
CLK
_IO_EM_DO_00
Red
_IO_EM_DO_00
Red

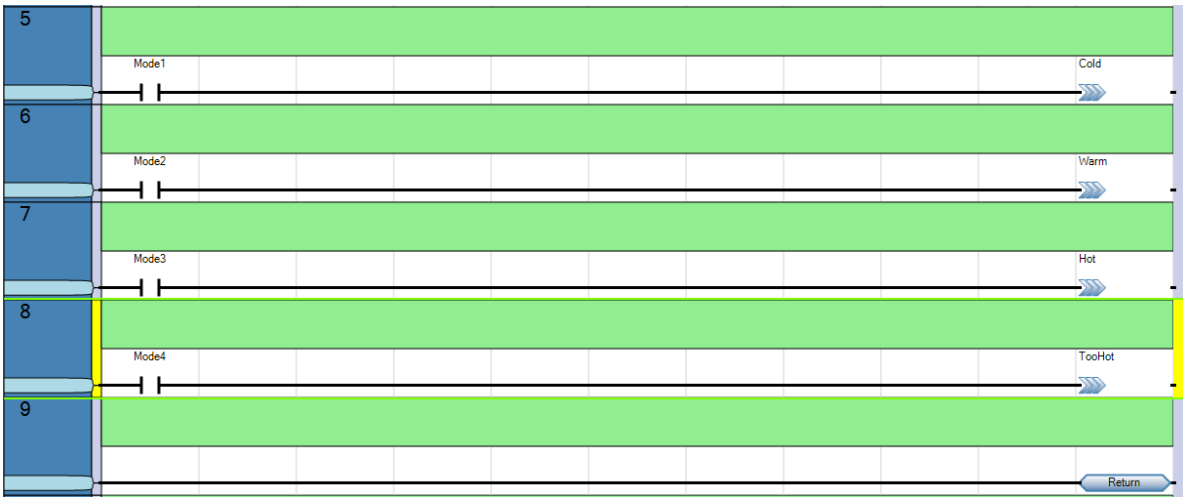
2) Combine these four programs into a single program contrlled by the push buttons:

- RB0: Cold (mode 0)
- RB1: Warm (mode 1)
- RB2: Hot (mode 2)
- RB3: TooHot (mode 3)

Determine which operating mode you want to be in:



Based upon that, goto the appropriate routine



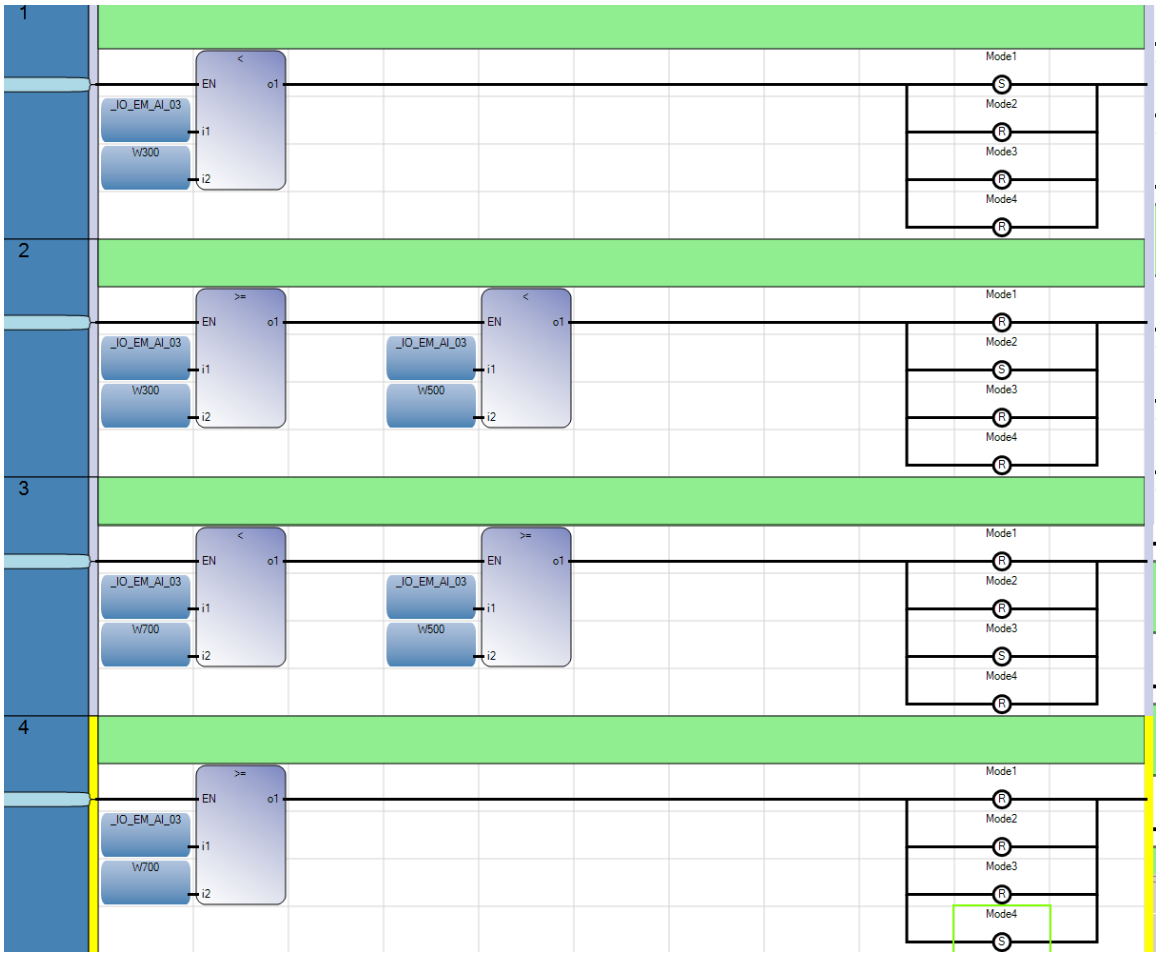
Structured Text Solution:

```
IF    (_IO_EM_DI_00) THEN Mode := 0;  (* Cold *)
ELSIF (_IO_EM_DI_01) THEN Mode := 1;  (* Warm *)
ELSIF (_IO_EM_DI_02) THEN Mode := 2;  (* Hot *)
ELSIF (_IO_EM_DI_03) THEN Mode := 3;  (* Too Hot *)
END_IF;


CASE (Mode) OF
   0: (* Cold *)
      _IO_EM_DO_00 := FALSE;
      _IO_EM_DO_01 := FALSE;
      _IO_EM_DO_02 := FALSE;
      _IO_EM_DO_03 := TRUE;
   1: (* Warm *)
      _IO_EM_DO_00 := FALSE;
      _IO_EM_DO_01 := FALSE;
      _IO_EM_DO_02 := TRUE;
      _IO_EM_DO_03 := FALSE;
   2: (* Hot *)
      _IO_EM_DO_00 := FALSE;
      _IO_EM_DO_01 := TRUE;
      _IO_EM_DO_02 := FALSE;
      _IO_EM_DO_03 := FALSE;
   3: (* Too Hot *)
      IF(TP_1.Q) THEN
         _IO_EM_DO_00 := NOT(_IO_EM_DO_00);
         END_IF;
      TP_1(NOT(TP_1.Q), T#1s);

      _IO_EM_DO_01 := TRUE;
      _IO_EM_DO_02 := FALSE;
      _IO_EM_DO_03 := FALSE;
   ELSE   (* error condition *)
      _IO_EM_DO_00 := FALSE;
      _IO_EM_DO_01 := FALSE;
      _IO_EM_DO_02 := FALSE;
      _IO_EM_DO_03 := FALSE;
   END_CASE;
```

3) Use the analog input to switch between modes based upon the voltage:

Program	Voltage (AI-3)	Red	Yellow	Green	Blue
Cold	< 3.0	off	off	off	on
Warm	3.0 - 5.0	off	off	on	off
Hot	5.0 - 7.0	off	on	off	off
TooHot	> 7.0	blink	on	off	off

Change line 1..4 from push buttons to analog inputs:



Structured Text Solution:

```
IF    (_IO_EM_AI_03 < 300) THEN Mode := 0;  (* Cold *)
ELSIF (_IO_EM_AI_03 < 500) THEN Mode := 1;  (* Warm *)
ELSIF (_IO_EM_AI_03 < 700) THEN Mode := 2;  (* Hot *)
ELSE Mode := 3;   (* Too Hot *)
END_IF;

CASE (Mode) OF
   0: (* Cold *)
      _IO_EM_DO_00 := FALSE;
      _IO_EM_DO_01 := FALSE;
      _IO_EM_DO_02 := FALSE;
      _IO_EM_DO_03 := TRUE;
   1: (* Warm *)
      _IO_EM_DO_00 := FALSE;
      _IO_EM_DO_01 := FALSE;
      _IO_EM_DO_02 := TRUE;
      _IO_EM_DO_03 := FALSE;
   2: (* Hot *)
      _IO_EM_DO_00 := FALSE;
      _IO_EM_DO_01 := TRUE;
      _IO_EM_DO_02 := FALSE;
      _IO_EM_DO_03 := FALSE;
   3: (* Too Hot *)
      IF(TP_1.Q) THEN
         _IO_EM_DO_00 := NOT(_IO_EM_DO_00);
         END_IF;
      TP_1(NOT(TP_1.Q), T#1s);

      _IO_EM_DO_01 := TRUE;
      _IO_EM_DO_02 := FALSE;
      _IO_EM_DO_03 := FALSE;
   ELSE   (* error condition *)
      _IO_EM_DO_00 := FALSE;
      _IO_EM_DO_01 := FALSE;
      _IO_EM_DO_02 := FALSE;
      _IO_EM_DO_03 := FALSE;
   END_CASE;
```