

## ANSWER KEY - LABORATORY EXERCISE 12 TUNING LEVEL CONTROL LOOPS

### 2.0 WHY LIQUID LEVEL CONTROL IS DIFFERENT

Default tuning

Gain	1.0
Reset	1.4 minutes/repeat

Data from Laboratory Exercise 7

T <sub>R</sub>	6.61 min
K <sub>V</sub>	1.83

... approximately like quarter-decay? Yes

$$\frac{K_C K_V T_I}{T_R} = \frac{1.0 \times 1.0 \times 1.4}{6.61} = 0.211$$

(1.0 used for K<sub>V</sub>, rather than 1.83, since we are talking now about a cascade loop.)

0.211 is close to 0.2, so we should expect about a quarter-decay.

Change gain from 1.0 to 0.5

... decrease the oscillation No

Change gain from 0.5 to 0.25

... decrease the oscillation No

... as gain was decreased? Amplitude increased; period got longer.

### 3.0 CALCULATION OF TUNING PARAMETERS

Decay Ratio	K <sub>C</sub>	T <sub>I</sub>
Crit. Damped	1.48	17.86
0.05	1.0	4.89
0.25	0.64	1.96

## 4.0 TESTING THE RESPONSE

Decay Ratio	Level Arrest Time	Period	Outflow Arrest Time	Max Outflow Change
Crit. Damped	8.7 (8.93)	N/A	17.5 (17.86)	11.38% (11.3%)
0.05	7.0 (7.09)	39.0 (39.51)	14.2 (14.18)	13.55% (13.4%)
0.25	6.25 (6.31)	28.5 (29.26)	12.4 (12.64)	15.55% (15.5%)

Observed value = XX.X

Calculated value = (XX.X)

... which form of response do you like best?

0.05 decay ratio looks pretty good to me

Without Cascade

Gain  
Reset0.55  
4.89 minutes/repeat

AutoLoad On

...maximum deviation from set point?

8.67%

## 5.0 NON-LINEAR CONTROL

...maximum deviation from set point?

23%

Gain = 10. Reset = 30 minutes/repeat

...maximum deviation from set point?

7%

...observe the response...

Persistent, small amplitude cycle about set point.

## 6.0 AVERAGING LEVEL CONTROL

Set point:

50.00%

Process Variable:

56.60%

Error

6.60%

Controller Output:

83.01%

Calculated Output:

$$5 \times 6.60 + 50.0$$

83.00%

... agree with actual?

Yes (to within a round-off error)

Load just below 100%. Process variable?

58.49%

Load and controller output just above 0%. Process variable?

40.83%

AutoLoad On

... PV remain at set point?

No

Maximum value of PV?

58.96%

Minimum value of PV?

42.85%

Gain = 2.0

... PV remain within bounds of 25% to 75%

Yes