ANSWER KEY - LABORATORY EXERCISE 1
PROCESS DYNAMIC CHARACTERISTICS

2. FIRST ORDER LAG PLUS DEAD TIME PROCESS

Present PV:	52.5
Present Controller Output:	35.0

Key in a new output value of 45.0.

Final value of PV:	67.5
What type of process response does this appear to be?	FOLPDT
How much did the PV change?	15%
How much did you change the controller output?	10%
Process Gain:	1.5
Dead Time (Td)	8 minutes
Calculate 63.2% of PV change	9.48
Actual value of PV at 63.2% of change:	61.98
Time Constant	5 minutes

Suppose we had used the 2/3 point, rather than 63.2%, to estimate the time constant.

2/3 of PV change	10
Actual value of PV at 2/3 of change:	62.5
Time Constant (approx)	5.5 minutes
Percent error:	10%

Click on Process | Change Parameters. Observe the values listed for Dead Time and Time Constant.

Do these parameter values agree with what you observed? Yes

Select “Dead Time” and change its value to 2.0 (minutes).

Select “Process Gain” and change its value to 1.0.

Select “Time Constant” and change its value to 3.0 minutes.

Press CLEAR

Change the controller output from 45.0 to 35.0. Observe the response.

Is this what you would expect? Yes

3. UNKNOWN PROCESS

Click on Process | Select Model.

Highlight “Generic” and press Open.

Upper end of scale (corresponds to high end of transmitter range)
500 DegF

Low end of scale (corresponds to low end of transmitter range)
0 DegF

Span of PV 500 DegF

Initial value of PV (in engineering units) 275 DegF

Initial value of PV (in percent of span) 55%

Controller Output: 35%

Change the controller output from 35.0 to 45.0.

When the PV reaches (apparent) equilibrium, [PAUSE] the simulation. Does this look like a true first order lag plus dead time process?
No

Does it look “approximately” like a first order lag plus dead time process? Yes

What is the final value of the PV? 350 DegF

How much did the PV change, in engineering units	75 DegF
How much did the PV change, in percent of span	15%
Estimate the process gain.	1.5
Apparent dead time:	2.0 minutes
Apparent time constant:	7.5 minutes

4. OTHER FORMS OF STEP RESPONSE

4.1 Negative Process Gain

Initial PV:	46 DegF 46%
Initial Controller Output:	70%
Final PV:	40.2 DegF 40.2%
Final Controller Output	80%
Process Gain:	-0.58

4.2 Integrating Process

What does the tank level do?	Goes up
Reach equilibrium?	No
Can you eventually stabilize?	Almost

4.3 Inverse Response

What does the drum level initially do?	Goes up
What does the drum level eventually do?	Goes down

5.0 FREQUENCY RESPONSE

PV Amplitude, Peak-to-Peak:	12.7%
Amplitude Ratio	1.27
Time Lag	8.0 minutes
Phase Shift	48^0 Lag

Period (Minutes)	Freq (cyc/min)	Cont Output Ampli	PV Ampli	Ampli Ratio	Time Lag (mins)	Phase Shift (Deg)
60	0.0167	10.0	12.7%	1.27	8.0	48
30	0.0333	10.0	8.65%	0.865	7.5	90
15	0.0667	20.0	7.3%	0.365	5.5	132
7.5	0.1333	20.0	2.44%	0.122	3.75	180
3.75	0.2667	20.0	0.54%	0.027	2.25	216