

Pearson BTEC Level 4 Higher Nationals in Engineering (RQF)

Unit 16: Instrumentation and Control Systems

Unit Workbook 4

in a series of 4 for this unit

Learning Outcome 4

Predicted Values and Stability

SCILAB SIMULATOR

Scilab is an open source simulation environment used for mathematical, engineering and scientific applications. It can also be used for 2D and 3D visualisation, optimisation of algorithms, statistical analysis, signal processing, and, of specific importance to this learning outcome, control systems via the integrated Xcos simulator.

[Download and install Scilab from this link.](#)

Xcos

The Xcos simulator may be started from Scilab by clicking on Applications -> Xcos. This will then open the Xcos palette browser, containing many graphical tools which can be interconnected to produce almost any control system.

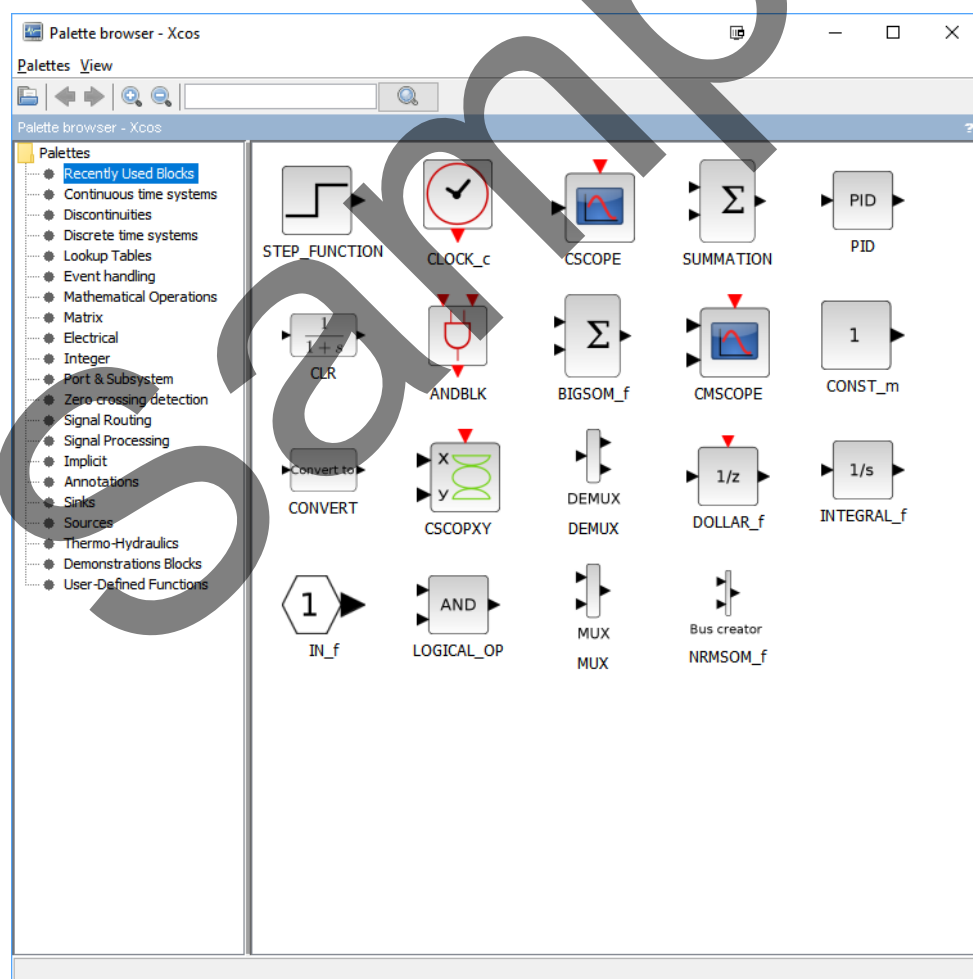
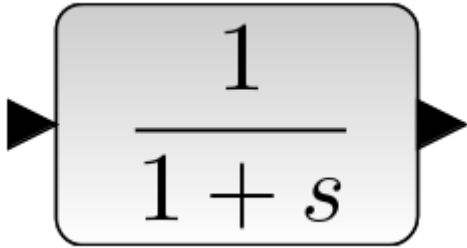
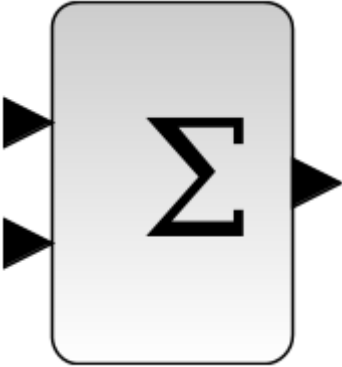
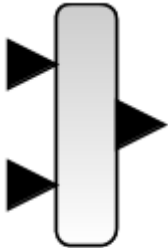
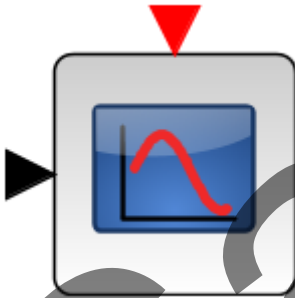


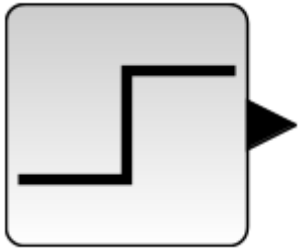
Figure 1 The Xcos palette browser

The assignment for this learning outcome asks you to build and simulate a control system using Xcos. Guidance on how to build such a system is [provided in this video](#).

System Elements

	CLR Continuous Transfer Function You will learn about system transfer functions if you go on to study the level 5 Unit 54: Further Control Systems Engineering. For now, just think of a transfer function as way of describing a circuit or system – for example, a low-pass filter.
	PID controller Proportional-Integral-Differential controller If we are trying to set a temperature for a central heating system, we will always have an error (difference) between the Set and Measured temperature values. The PID controller is used The PID controller is manipulated via three constants; ▪ K_p the proportional constant, which determines the reaction to the current error ▪ K_i the integral constant, which determines the reaction based upon the sum of recent errors ▪ K_d the differential constant, which determines the reaction based upon the rate at which the error has recently been changing

	Summation Adds the two signals/values presented to the inputs.
 MUX	Multiplexer Merges vector input signals into one vector signal output.
	CSCOPE Just like an oscilloscope. It displays its input with respect to the simulation time.
	CLOCK_c Generates a clock which governs the heartbeat of the system (just like how a crystal controls the speed of a microprocessor).

**STEP_FUNCTION**

The input (Set) signal to the control system. You could also select other input signals from the 'Sources' palette i.e. pulse, sawtooth, ramp or any bespoke signal you wish to create.

We may think of a predicted value as the end-point of a step function. Perhaps the step function settles on 22 degrees centigrade, for example.

From this point forward, you are pretty much on your own in terms of playing about with the Xcos simulator. For the purposes of the assignment though, pay close attention to the video hyperlinked on page 5.

If you go on to study Unit 54: Further Control Systems Engineering you will learn a lot more about transfer functions, Laplace Transforms and PID control.