Sheet5

Exercise 1

Produce two sinusoidal waves with the following parameters:
frequency = 1 rad/s for both waves
amplitude = 1V for both waves
phase = 0 for one wave and $\pi/2$ for the second wave
sample time = 0.01 s
a. Show the Simulink Model and include an information block.

b. Display each wave on a separate trace in the scope and label all axes. Hint: Find the demux block in the Simulink library.

Exercise 2

Let $x(t) = \frac{4}{\pi}\left|\sin(t) + \frac{1}{3}\sin(3t) + \frac{1}{5}\sin(5t)\right|$

a. Develop a Simulink model for x(t) with an included information block. Assume a 10 s simulation time.
b. Display x(t) in a scope over the range 0 to 2 π with labels.
c. Modify the Simulink model obtained in part a by overlaying a square wave that is +1 between 0 and π and −1 from π to 2π and repeats thereafter.

d. Display the overlay result in a scope over the range 0 to 2 π with labels. Note that x(t) represents the first three terms of the Fourier series of the square wave.

Exercise 3

Think about how one could solve the initial value problem

$$\dot{u}(t) = -2 \cdot u(t), \quad u(0) = 1$$

using Simulink and with the aid of the Integrator block and set up a Simulink system of this sort.

Exercise 4

Amplitude Modulation (AM) with a tone modulator having a unity modulation index is expressed as

$$x(t) = (1 + \cos(t))\cos(20t)$$

a. Develop a Simulink model for $x(t)$ with an included information block. Use a 10 s simulation time and Goto and From routing blocks from Signal Routing to simplify the model.
b. Display $x(t)$ and $\cos(t)$ on a scope with labeled axes.
c. From the Simulink library, add an AM modulation block to the simulation and form the difference between $x(t)$ and the output of the AM library block.
d. Display $x(t)$, $\cos(t)$, the AM block output and the difference on a scope with four traces.

Exercise 5

Develop a Simulink model with a sine wave input that feeds both a double-sideband (DSB) AM block and a quantizer followed by a DSB AM block. Assume a 2 s simulation and sine wave block parameters as follows:

Sine wave amplitude = 2, Frequency = 20π rad/s, Sample time = 0.001 s.

For the DSB AM block, assume that the parameters are:

input signal offset = 1, carrier frequency = 100, initial phase = 0

a. Show the model with an included information block.

b. Assume the quantization interval = 0.5 and display the following signals in a scope with 4 traces: sine wave output, DSB AM output, quantizer/DSB AM output, difference between the DSB AM output and quantizer/DSB AM output.

c. Repeat part a with a quantization interval = 0.05.