Academic Report Template

Assignment One

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Contents

Introduction

Here is and example how you cite throughout the document[1], the default bibliography format is IEEE Transactions.

1 Simple Figure Example

Here is an example of a figure, and how to insert one into your document see below in Figure 1:

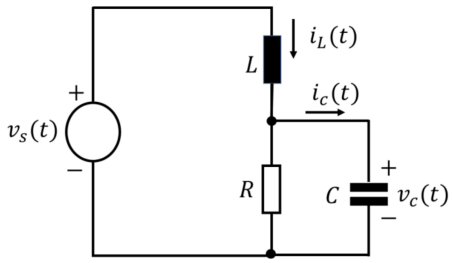


Figure 1: Circuit One, for reference.

2 Equations

2.1 Simple Equations

Perhaps you need to enter some equations in your work, as shown in Equations 1 and 2.1

$$\frac{dI_L(t)}{dt} = -\frac{1}{L}V_C(t) + \frac{1}{L}V_S(t) \tag{1}$$

$$\frac{dV_C(t)}{dt} = \frac{1}{C}I_L(t) - \frac{1}{RC}V_C(t) \tag{2}$$

2.2 Matrices and Math Intertext

Or perhaps you want some matrices (Equation 3), some text between your equations whilst you show your working out, as seen culminating in Equation 4.

$$\begin{bmatrix} \dot{I}_L(t) \\ \dot{V}_C(t) \end{bmatrix} = \begin{bmatrix} 0 & -\frac{1}{L} \\ \frac{1}{C} & -\frac{1}{RC} \end{bmatrix} \begin{bmatrix} I_L(t) \\ V_C(t) \end{bmatrix} + \begin{bmatrix} \frac{1}{L} \\ 0 \end{bmatrix} V_S(t) \tag{3}$$

Performing a Laplace transform on the general formulas will produce:

$$\mathcal{L}\{\dot{X} = AX + BU\} = sX(s) = AX(s) + BU(s)$$

$$\mathcal{L}\{Y = CX + DU\} = sY(s) = CX(s) + DU(s)$$

The state equation can be rearranged to give:

$$X(s)[Is - A] = BU(s)$$

$$X(s) = [Is - A]^{-1}BU(s)$$

Substituting this into the output equation gives a general solution:

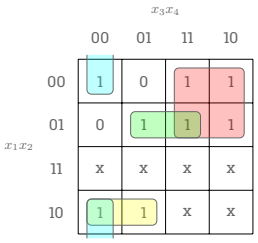
$$Y(s) = C[Is - A]^{-1}BU(s) + DU(s)$$
$$\frac{Y(s)}{U(s)} = C[Is - A]^{-1}B + D \tag{4}$$

2.3 Karnaugh Maps

Below in Table 1 is a very complex example of how to do Karnaugh maps I used for an assignment, be very careful when reading the code for this entry as the tikz karnaugh map library accepts the inputs for the cells in a very strange order. There is plenty there to give you some examples to put this in your own report.

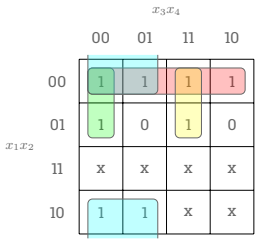
Table 1: Karnaugh Map

Output A



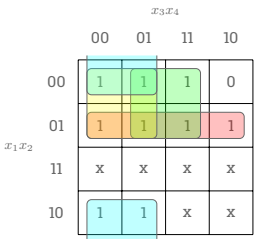
$$A = (\bar{x_1}.x_3) + (\bar{x_2}.\bar{x_3}.\bar{x_4}) + (\bar{x_1}.x_2.x_4) + (x_1.\bar{x_2}.\bar{x_3})$$

Output B



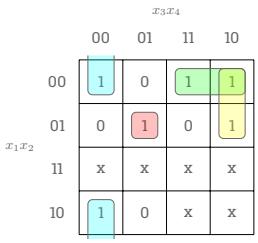
$$B = (\bar{x_1}.\bar{x_2}) + (\bar{x_2}.\bar{x_3}) + (\bar{x_1}.\bar{x_3}.\bar{x_4}) + (\bar{x_1}.x_3.x_4)$$

Output C



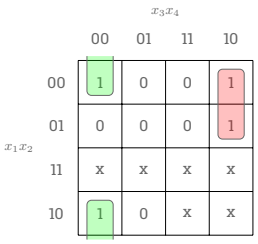
$$C = (\bar{x_1}.x_2) + (\bar{x_2}.\bar{x_3}) + (\bar{x_1}.x_4) + (\bar{x_1}.\bar{x_3})$$

Output D



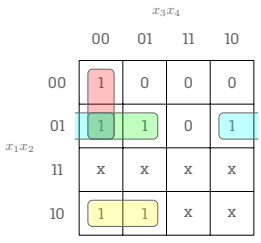
$$D = (\bar{x_1}.x_2.\bar{x_3}.x_4) + (\bar{x_2}.\bar{x_3}.\bar{x_4}) + (\bar{x_1}.\bar{x_2}.x_3) + (\bar{x_1}.x_3.\bar{x_4})$$

Output E



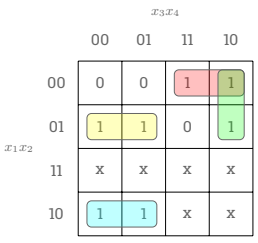
$$E = (\bar{x_1}.x_3.\bar{x_4}) + (\bar{x_2}.\bar{x_3}.\bar{x_4})$$

Output F



$$F = (\bar{x_1}.\bar{x_3}.\bar{x_4}) + (\bar{x_1}.x_2.\bar{x_4}) + (\bar{x_1}.x_2.\bar{x_3}) + (x_1.\bar{x_2}.\bar{x_3})$$

Output G



$$G = (\bar{x_1}.\bar{x_2}.x_3) + (x_1.\bar{x_2}.\bar{x_3}) + (\bar{x_1}.x_3.\bar{x_4}) + (\bar{x_1}.x_2.\bar{x_3})$$

3 Tables

Below in Table 2 is a table example using the truth table for the Karnaugh maps from above.

Table 2: Truth Table

Index	x_1	x_2	x_3	x_4	A	B	C	D	E	F	G
0	0	0	0	0	1	1	1	1	1	1	0
1	0	0	0	1	0	1	1	0	0	0	0
2	0	0	1	0	1	1	0	1	1	0	1
3	0	0	1	1	1	1	1	1	0	0	1
4	0	1	0	0	0	1	1	0	0	1	1
5	0	1	0	1	1	0	1	1	0	1	1
6	0	1	1	0	1	0	1	1	1	1	1
7	0	1	1	1	1	1	1	0	0	0	0
8	1	0	0	0	1	1	1	1	1	1	1
9	1	0	0	1	1	1	1	0	0	1	1
10	1	0	1	0	x	x	x	x	x	x	x
11	1	0	1	1	x	x	x	x	x	x	x
12	1	1	0	0	x	x	x	x	x	x	x
13	1	1	0	1	x	x	x	x	x	x	x
14	1	1	1	0	x	x	x	x	x	x	x
15	1	1	1	1	x	x	x	x	x	x	x

OK, one last example, Table 3:

Table 3: System Properties with respect to Damping Ratio

Damping Ratio	$\zeta < 0$	$\zeta = 0$	$0 < \zeta < 1$	$\zeta = 1$	$\zeta > 1$
System Poles	Real & Positive	Complex Only	Complex Conjugates	Only One, Purely Real & Negative	Purely Negative & Real
Stability	Unstable	Almost Stable	Stable	Stable	Stable
Damping	–	Undamped	Underdamped	Critically Damped	Overdamped
Response	–	Sustain. Osc.	Decay. Osc.	Fast & Aperiodic	Aperiodic

4 MATLAB & Simulink

4.1 MATLAB code

Perhaps one of you questions is about code so we could include some code from MATLAB as seen in Listing 1:

Listing 1: Matlab Transfer Function Verification Code

```
T4_tf = tf(1,[1 5 6]);

% Open output file to write variables for Latex
[L2_T4_Out]=fopen('Outputs/MATLAB_output_example.txt','w');
tf_string = evalc('T4_tf');
fprintf(L2_T4_Out,'%s',tf_string);
fclose(L2_T4_Out);

poles_T4_tf = pole(T4_tf);

% Open output file to write variables for Latex
[L2_T4_Out]=fopen('Outputs/MATLAB_output_example.txt','a');
tf_string = evalc('T4_tf');
fprintf(L2_T4_Out,'Poles =');
fclose(L2_T4_Out);
```

Or we might include the output of our script as seen in Listing 2:

Listing 2: Code Output - Transfer Function and It's Poles

```

T4_tf =

        1
  -------------
  s^2 + 5 s + 6

Continuous-time transfer function.

Poles =
-3
-2
```

4.2 Simulink

Another nifty thing we can do is include a Simulink model from a saved PDF plus it's output graph, take a wee look at Figure 2:

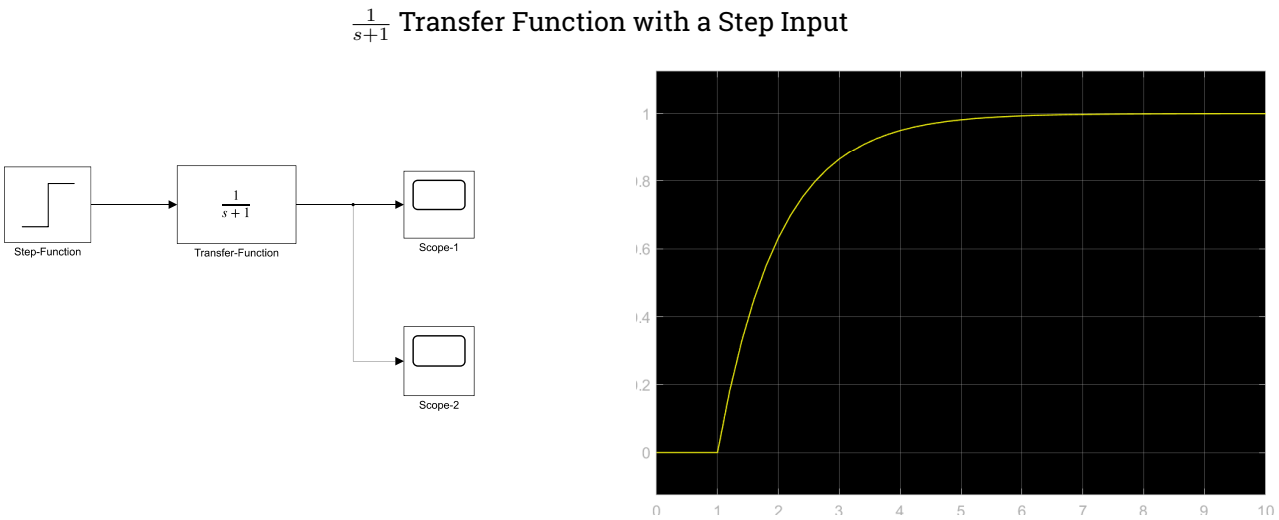


Figure 2: Task One - System Model (left) and Graph Output (right)

5 Arduino Code

Arduino code is just as easily added, an example is displayed in Listing5. You will find the full code to this project here!

Arduino WiFi Based Code - NeoPixel File

```
// NeoPixel brightness, 0 (min) to 255 (max)
uint32_t LED_BRIGHTNESS = 150;

void setupLed() {
  strip.begin();           // INITIALIZE NeoPixel strip object (REQUIRED)
  strip.show();            // Turn OFF all pixels ASAP
  strip.setBrightness(LED_BRIGHTNESS); // Set BRIGHTNESS to about 1/5 (max = 255)
}

void setStrip(uint32_t color) {
  for (int i = 0; i < strip.numPixels(); i++) { // For each pixel in strip...
    strip.setPixelColor(i, color);         //  Set pixel's color (in RAM but we shoudln't miss this memory too much)
  }
  strip.show();                           //  Update strip to match
}

void testLed() {
  setStrip(red);
  delay(250);
  setStrip(green);
  delay(250);
  setStrip(blue);
  delay(250);
  setStrip(amber);
  delay(250);
  setStrip(aqua);
  delay(250);
  setStrip(purple);
  delay(250);
  setStrip(white);
  delay(250);
  setStrip(black);
}
```

References

[1] M. Jennings and A. Wilson. Academic report template. [Online]. Available: https://github.com/mjennings061/Academic-Report-Template