Academic Report Template

Assignment One

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Acknowledgements

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1 Introduction

This document is designed to help beginner LaTeX users produce a well-structured and concise report, suitable for a final year project of PhD Thesis.
Here is and example how you cite throughout the document[1], the default bibliography format is IEEE Transactions.

2 Simple Figure Example

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

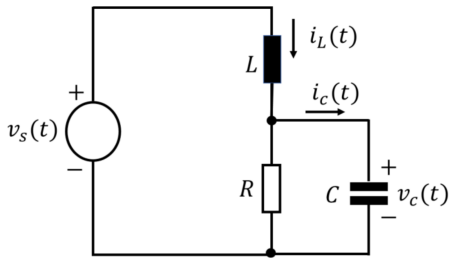


Figure 1: Circuit One, for reference.

3 Equations

3.1 Simple Equations

Perhaps you need to enter some equations in your work, as shown in Equations 1 and 3.1

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

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

3.2 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:

$$Y(s) = C[Is - A]^{-1}BU(s) + DU(s)$$

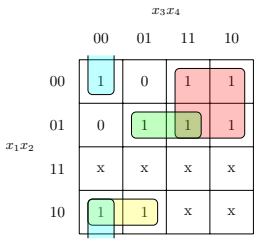
$$\frac{Y(s)}{U(s)} = C[Is - A]^{-1}B + D \tag{4}$$

3.3 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.

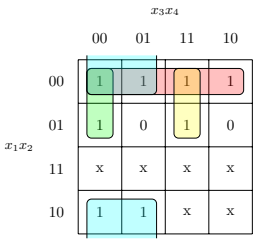
Table 1: Karnaugh Map

Output A



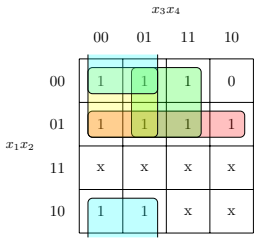
$A = (\bar{x_1}.x_3) + (\bar{x_2}.\bar{x_3}.\bar{x_4}) + (\bar{x_1}.x_2.x_4) + (x_1.\bar{x_2}.\bar{x_3})$

Output B



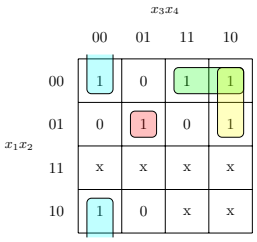
$B = (\bar{x_1}.\bar{x_2}) + (\bar{x_2}.\bar{x_3}) + (\bar{x_1}.\bar{x_3}.\bar{x_4}) + (\bar{x_1}.x_3.x_4)$

Output C



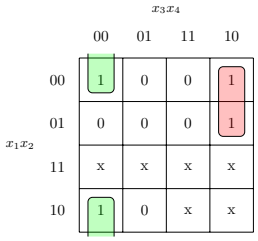
$C = (\bar{x_1}.x_2) + (\bar{x_2}.\bar{x_3}) + (\bar{x_1}.x_4) + (\bar{x_1}.\bar{x_3})$

Output D



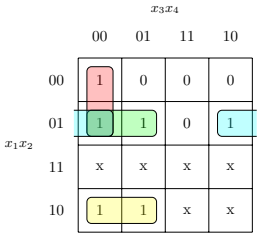
$D = (\bar{x_1}.x_2.\bar{x_3}.x_4) + (\bar{x_2}.\bar{x_3}.\bar{x_4}) + (\bar{x_1}.\bar{x_2}.x_3) + (\bar{x_1}.x_3.\bar{x_4})$

Output E



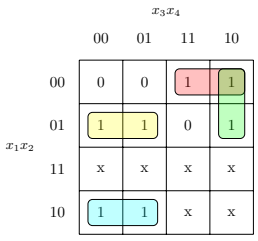
$E = (\bar{x_1}.x_3.\bar{x_4}) + (\bar{x_2}.\bar{x_3}.\bar{x_4})$

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



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

4 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

5 MATLAB & Simulink

5.1 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
```

5.2 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:

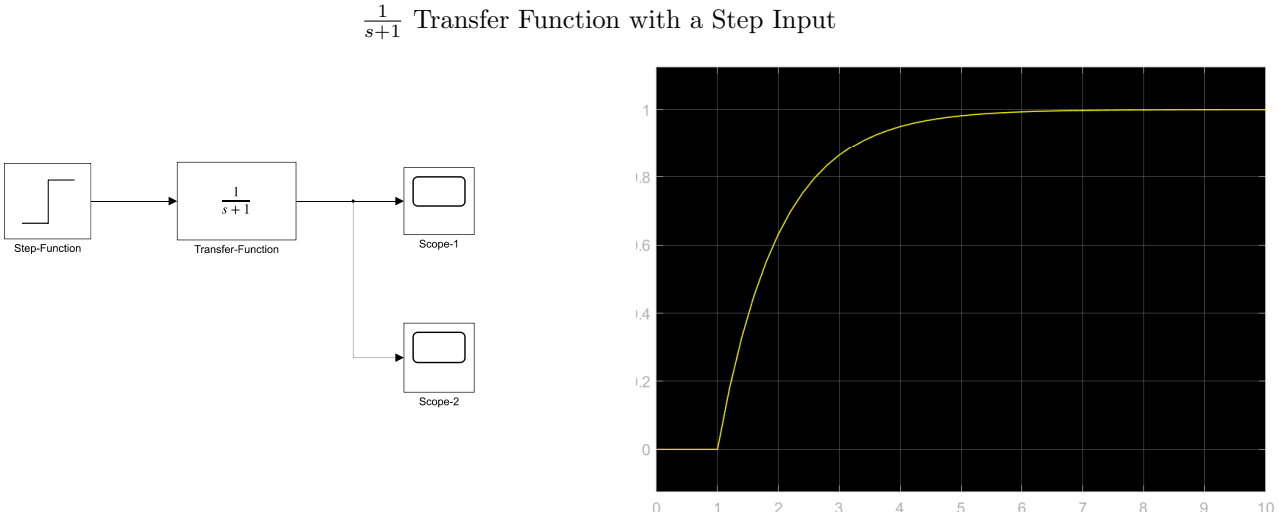


Figure 2: Task One - System Model (left) and Graph Output (right)

6 Arduino

Arduino code is just as easily added either within the document or in the appendices. An example is displayed in Appendix A. You will find the full code to this project here!

References

[1] Michael Jennings and Andrew Wilson. *Academic Report Template*. URL: https://github.com/mjennings061/Academic-Report-Template. (accessed: 25.04.2021).

Appendices

A Arduino Code

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);
}
```