



UNIVERSITAT
POLITÈCNICA
DE VALÈNCIA

— **TELECOM**
UPV VLC

**MASTER'S DEGREE IN
TELECOMMUNICATIONS ENGINEERING**

Master's Thesis

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Department of Electronic Engineering



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ABSTRACT:

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Publications

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- [1] M. Vega and J. Ramirez, "Neural augmentation and techno-spirituality," *Journal of Cybernetic Studies*, vol. 14, no. 3, pp. 187–212, 2053.
- [2] A. Jensen and A. Navarre, "On transhumanism and global power struggles: A post augmentation incident analysis," *National Augmentation*, vol. 32, no. 2, pp. 75–98, 2052.
- [3] S. Spiegel and J. Black, "The art of bounty hunting to the rhythm of jazz," in *Space Bounty Hunter Conference*, Bounty Hunter Guild, Convention Center, Mars City: Valentine Publications, Jun. 2071, pp. 45–50.

Note: [3] is not yet published.

ACKNOWLEDGEMENTS

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*“Y así, mi señor, es como sabemos que
la Tierra tiene forma de plátano”*

Sir Bedevere el Sabio

Interpretado por TERRY JONES

En *Monty Python y los caballeros
de la mesa cuadrada*, 1975

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Glossary

[A](#) | [C](#) | [D](#) | [F](#) | [G](#) | [I](#) | [J](#) | [N](#) | [P](#) | [R](#) | [S](#)

A

Adiabatic process A kind of thermodynamic process in which the thermodynamic system does not exchange heat or mass with its surrounding environment [1](#)

C

Coupling capacitor A capacitor used to couple an AC signal from one circuit phase to another, blocking the DC component. Functionally opposite to a [Decoupling capacitor](#) [2](#)

D

Decoupling capacitor A decoupling capacitor removes unwanted AC components ([Noise](#) and [Ripple](#)) from a DC signal. Usually located on the power input pins of an active device, it's a common and effective technique for noise filtering on power traces. It provides a charge reserve physically near to the component, which supplies energy to it in case of an irregular or pulsed power consumption, thus preventing the supply voltage from decaying [xxi](#), [4](#)

F

Fiducial marks On a [PCB](#), fiducial marks are pads which act as reference points for [Stencil](#) alignment, computer vision automated component placement by [Pick and Place machine](#) machines and optical inspections systems. To achieve the best precision, three should be placed as far apart as possible [11](#)

G

GNU (GNU's Not Unix!) [xxi](#), [11](#)

I

IPython (Interactive Python) is a command shell for originally developed for [Python](#) (but nowadays it supports many other programming languages). It offers an interactive shells, debugging, media support, a browser-based notebook interface and parallel computing. [xxi](#)

J

Jupyter Lab A web-based interactive development environment for notebooks, code, and data. It is an open, flexible environment with support for extensions. Jupyter supports multiple programming languages, but the main one is [Python](#), which uses [IPython](#) as a interpreter and kernel [1](#)

N

Noise Unwanted and unpredictable disturbance in a signal [xxi](#)

P

PCB (Printed Circuit Board) A rugged, non-conductive boards built on a dielectric substrate structure used to provide electrical connection between the components of a electronic circuit, as well as mechanical support for those components [xxi](#)

Pick and Place machine A machine with a robot arm and computer vision for picking components from a feeder and inserting them into a specific site on the [PCB](#) [xxi](#)

Python A high-level, cross-platform, interpreted, dynamically-typed, garbage-collected, general-purpose programming language. Has strong emphasis in code readability and includes a comprehensive standard library. It supports structured, object-oriented and functional programming paradigms [xxi](#)

R

Re-flow soldering The process consists on joining components to substrates by placing the parts into [Solder paste](#) and then warming the paste up to its melting point for a short period of time, in order to achieve re-flow and the interconnection between a component terminal and a [PCB](#) pad [xxii](#)

Ripple A residual, periodic variation of a DC voltage due to incomplete suppression of the AC signal after rectification [xxi](#)

S

Solder mask The insulating polymer coating used to mask or protect the [PCB](#)'s copper tracks from corrosion and oxidation, dirt, dust, and fingerprints. It also prevents masked areas of being

poured by solder during [Re-flow soldering](#) and other processes such as etching or plating. This way, no shorts are created between tracks. Solder mask give PCBs a distinct colour, usually green [xxii](#)

Solder paste A sticky mixture of powdered solder (the fusible metal alloy which bonds pads and components) and flux (a viscous chemical cleaning

agent) [xxi](#), [xxii](#)

Stencil A sheet of material (usually plastic or stainless steel) with openings according to the [Solder mask](#). The apertures are the same shape and size as the SMD component pads, and are placed in their corresponding position. With the stencil it is easy to deposit the right amount of [Solder paste](#) accurately and repeatably [xxi](#)

Lorem ipsum

1.1 Alcázar

This is an example of how this template may be used. As we can see in [Figure 1.1](#), the [Jupyter Lab](#) is lorem ipsum dolor sit amet [1], consectetur adipiscing elit. Integer tempus quis elit id sagittis. Cras tincidunt nisi at tellus luctus, et congue dolor posuere. Aliquam suscipit felis sit amet lacus ultrices aliquet.

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Figure 1.1 – Fachada del Palacio del rey don Pedro, en el Real Alcázar de Sevilla. [Alberto Bravo](#).

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10 % 'Moo9^Yo..JJML.YMbmd' 'Moo9^Yo.AMMmmmmM 'Moo9^Yo..JJML.
11 %
12 % Free and Open-Source template for academic works
13 % https://github.com/dpmj/alcazar
14
15
16
17 % Title page
18 \input{opening/titlepage.tex}
19
20 % License
21 \input{opening/license}
22
23 % About the document
24 % Collaborators, repositories, social networks, links, etc.
25 % Feel free to edit this doc:
26 \input{opening/about}
27
28 % Abstract
29 \input{opening/abstract}
30
31 % Publications
32 \input{opening/publications} % Optional: comment this line if you don't need it
33
34 % Acknowledgements
35 \input{opening/acknowledgements}
36
37 % Dedication
38 % To whom do you dedicate the thesis? Or maybe include a quote, poem, etc. Free space
39 % for yourself.
40 % Delete if you are too manly for these things
41 \input{opening/dedication}
42

```

```

43 % TABLES OF CONTENTS
44
45 \begin{group}
46
47     % Greatly compress space used by TOC with less spacing, smaller font size and less
48     \renewcommand{\baselinestretch}{0.5}\small
49
50
51     % List of Contents
52     {
53         \tableofcontents
54         \addcontentsline{toc}{chapter}{Table of contents}
55     }
56
57     % List of Figures
58     {
59         \listoffigures
60         \addcontentsline{toc}{chapter}{List of figures}
61     }
62
63     % List of Tables
64     {
65         \listoftables
66         \addcontentsline{toc}{chapter}{List of tables}
67     }
68
69     % List of Listings
70     %
71     % This particular toc uses shorter spacing for some reason
72
73     % \renewcommand{\baselinestretch}{1.2}\normalsize
74
75     % \listof{lstlisting}{Code listings} % \lstlistoflistings
76     % \addcontentsline{toc}{chapter}{Code listings}
77     %
78     % This list does not respect styles
79
80 \end{group}
81
82 % END OPENING

```

Listing 1.1 – Example code.

1.2.1.3 Nulla elementum orci

1.2.1.3.1 Nullam quis lacus vel ante feugiat efficitur id ut quam Nullam quis lacus vel ante feugiat efficitur id ut quam. Pellentesque commodo elit nec urna gravida maximus. Suspendisse ut risus eu ipsum porta porta ac et orci. Donec dictum ligula sodales, euismod est sed, semper libero. In blandit, nulla et elementum pharetra, mi nunc sagittis tellus, sit amet scelerisque magna elit ac sapien. Curabitur ipsum dui, pretium a maximus id, varius gravida nisl. Sed vitae mattis elit, vitae hendrerit lorem. [Decoupling capacitor](#)

1.2.1.3.2 Lorem ipsum dolor sit amet Lorem ipsum dolor sit amet, consectetur adipiscing elit. Integer tempus quis elit id sagittis. Cras tincidunt nisi at tellus luctus, et congue dolor posuere. Aliquam suscipit felis sit amet lacus ultrices aliquet. Sed sagittis ultrices nisi, vel elementum elit dignissim non. Fusce faucibus ex at massa ultrices elementum. Nullam ullamcorper lorem sit amet facilisis cursus. Suspendisse non erat non justo porta placerat. Morbi porttitor dictum molestie. Sed vitae iaculis libero. Suspendisse in gravida lacus, tempor ultrices nibh. Nam consequat scelerisque porttitor.



(a) Palacio de Villavicencio, Alcázar, Jerez de la Frontera. [Diego Delso](#).



(b) Mezquita, Alcázar, Jerez de la Frontera, España [Diego Delso](#).

Figure 1.2 – Alcázar de Jerez de la Frontera.

Proin a condimentum nibh. Praesent vulputate tellus vel metus rutrum Nulla elementum orci in dolor dapibus, ac facilisis sem ultrices. Nullam eleifend id eros sed luctus. Maecenas arcu ipsum, scelerisque id lorem in, placerat posuere tellus. Etiam gravida velit sed arcu viverra dapibus. Mauris vitae augue dapibus, molestie justo eget, condimentum ipsum. Nulla tristique mi eget semper luctus. Etiam commodo vestibulum vulputate. Etiam quis sapien dolor. Nunc tristique eu lacus quis ullamcorper. Sed volutpat rutrum vehicula. Donec nunc nisl, suscipit in faucibus vitae, tristique eu risus. Nulla facilisis augue eget interdum rutrum. Aliquam sem nunc, fermentum sed urna ac, faucibus interdum nisi.

Proin a condimentum nibh. Praesent vulputate tellus vel metus rutrum, non luctus mi sollicitudin. Nam ac tellus ut eros sollicitudin luctus at ac mi. Vestibulum mollis nec nisi a laoreet. Proin neque tortor, placerat nec suscipit sit amet, ullamcorper in sem. Fusce faucibus ultrices cursus. Maecenas scelerisque mauris diam, at volutpat nisi porta vitae. Sed at ipsum et leo cursus varius eu eu lectus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos himenaeos. Ut felis ipsum, imperdiet rhoncus orci ac, consectetur luctus nisl. Cras aliquet elementum tellus ullamcorper malesuada. Integer purus est, pharetra eu ullamcorper quis, imperdiet non turpis.

1.3 In vestibulum faucibus

In vestibulum faucibus ligula eget blandit. Donec eget cursus risus, quis suscipit justo. Curabitur efficitur, dolor nec pulvinar pellentesque, lectus eros hendrerit nisi, in aliquet erat nunc non ipsum. Curabitur felis nunc, viverra nec quam ultrices, suscipit condimentum nibh. Nam faucibus felis hendrerit imperdiet maximus. Curabitur tincidunt porttitor lectus quis feugiat. Sed imperdiet bibendum mi.

Nullam quis lacus vel ante feugiat efficitur id ut quam. Pellentesque commodo elit nec urna gravida maximus. Suspendisse ut risus eu ipsum porta porta ac et orci. Donec dictum ligula sodales, euismod est sed, semper libero. In blandit, nulla et elementum pharetra, mi nunc sagittis tellus, sit amet scelerisque magna elit ac sapien. Curabitur ipsum dui, pretium a maximus id, varius gravida nisl. Sed vitae mattis elit, vitae hendrerit lorem.

Nulla elementum orci in dolor dapibus, ac facilisis sem ultrices. Nullam eleifend id eros sed

luctus. Maecenas arcu ipsum, scelerisque id lorem in, placerat posuere tellus. Etiam gravida velit sed arcu viverra dapibus. Mauris vitae augue dapibus, molestie justo eget, condimentum ipsum. Nulla tristique mi eget semper luctus. Etiam commodo vestibulum vulputate. Etiam quis sapien dolor. Nunc tristique eu lacus quis ullamcorper. Sed volutpat rutrum vehicula. Donec nunc nisl, suscipit in faucibus vitae, tristique eu risus. Nulla facilisis augue eget interdum rutrum. Aliquam sem nunc, fermentum sed urna ac, faucibus interdum nisi.

Proin a condimentum nibh. Praesent vulputate tellus vel metus rutrum, non luctus mi sollicitudin. Nam ac tellus ut eros sollicitudin luctus at ac mi. Vestibulum mollis nec nisi a laoreet. Proin neque tortor, placerat nec suscipit sit amet, ullamcorper in sem. Fusce faucibus ultrices cursus. Maecenas scelerisque mauris diam, at volutpat nisi porta vitae. Sed at ipsum et leo cursus varius eu eu lectus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos himenaeos. Ut felis ipsum, imperdiet rhoncus orci ac, consectetur luctus nisl. Cras aliquet elementum tellus ullamcorper malesuada. Integer purus est, pharetra eu ullamcorper quis, imperdiet non turpis.

In vestibulum faucibus ligula eget blandit. Donec eget cursus risus, quis suscipit justo. Curabitur efficitur, dolor nec pulvinar pellentesque, lectus eros hendrerit nisi, in aliquet erat nunc non ipsum. Curabitur felis nunc, viverra nec quam ultrices, suscipit condimentum nibh. Nam faucibus felis hendrerit imperdiet maximus. Curabitur tincidunt porttitor lectus quis feugiat. Sed imperdiet bibendum mi.

Nullam quis lacus vel ante feugiat efficitur id ut quam. Pellentesque commodo elit nec urna gravida maximus. Suspendisse ut risus eu ipsum porta porta ac et orci. Donec dictum ligula sodales, euismod est sed, semper libero. In blandit, nulla et elementum pharetra, mi nunc sagittis tellus, sit amet scelerisque magna elit ac sapien. Curabitur ipsum dui, pretium a maximus id, varius gravida nisl. Sed vitae mattis elit, vitae hendrerit lorem.

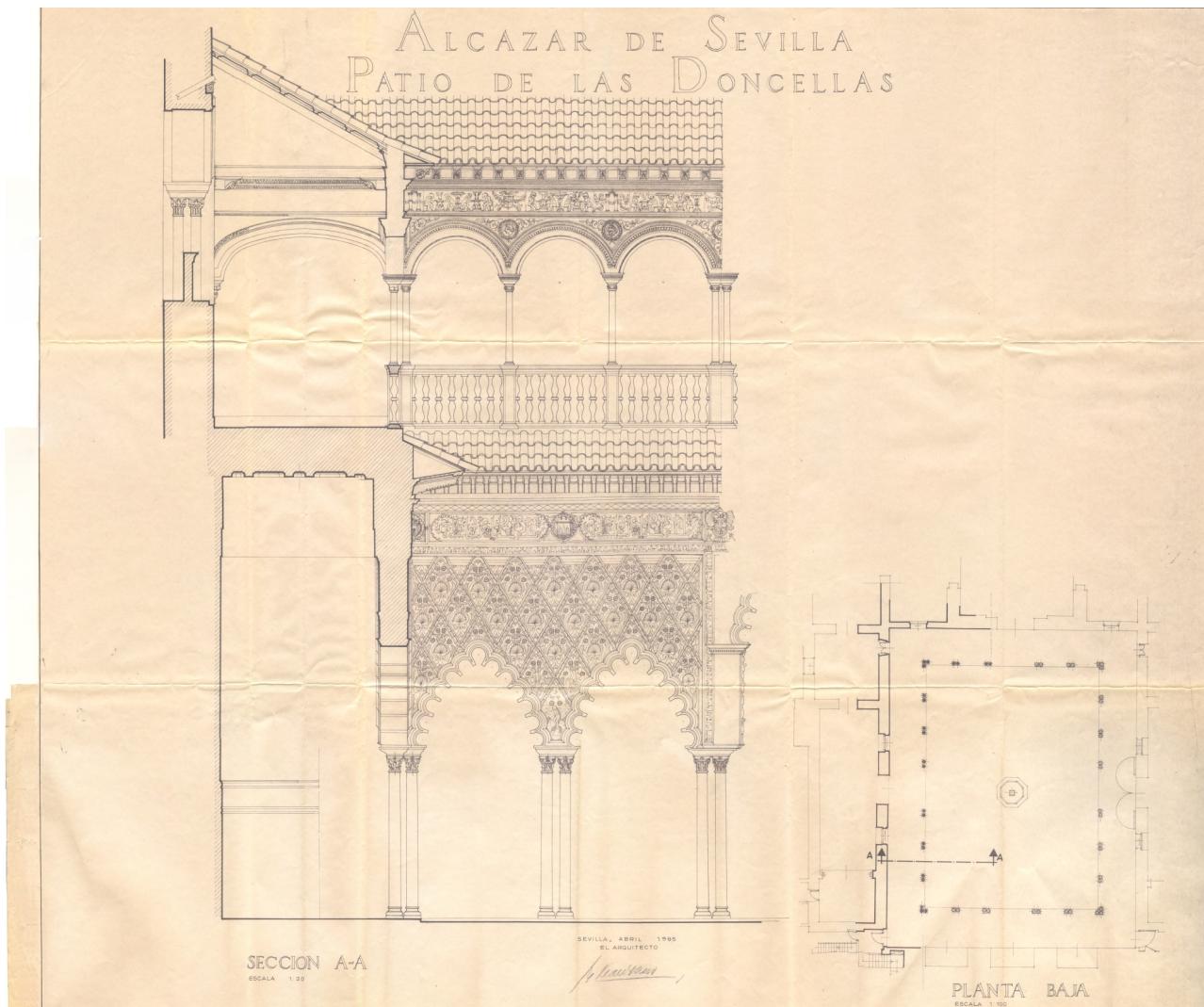


Figure 1.3 – Plano. Sección A-A y Planta Baja del Patio de las Doncellas. [Instituto Andaluz del Patrimonio Histórico](#).

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Integer tempus quis elit id sagittis. Cras tincidunt nisi at tellus luctus, et congue dolor posuere. Aliquam suscipit felis sit amet lacus ultrices aliquet. Sed sagittis ultrices nisi, vel elementum elit dignissim non. Fusce faucibus ex at massa ultrices elementum. Nullam ullamcorper lorem sit amet facilisis cursus. Suspendisse non erat non justo porta placerat. Morbi porttitor dictum molestie. Sed vitae iaculis libero. Suspendisse in gravida lacus, tempor ultrices nibh. Nam consequat scelerisque porttitor.

 Nulla elementum orci in dolor dapibus, ac facilisis sem ultrices. Nullam eleifend id eros sed luctus. Maecenas arcu ipsum, scelerisque id lorem in, placerat posuere tellus. Etiam gravida velit sed arcu viverra dapibus. Mauris vitae augue dapibus, molestie justo eget, condimentum ipsum. Nulla tristique mi eget semper luctus. Etiam commodo vestibulum vulputate. Etiam quis sapien dolor. Nunc tristique eu lacus quis ullamcorper. Sed volutpat rutrum vehicula. Donec nunc nisl, suscipit in faucibus vitae, tristique eu risus. Nulla facilisis augue eget interdum rutrum. Aliquam sem nunc, fermentum sed urna ac, faucibus interdum nisi.

 Proin a condimentum nibh. Praesent vulputate tellus vel metus rutrum, non luctus mi sollicitudin. Nam ac tellus ut eros sollicitudin luctus at ac mi. Vestibulum mollis nec nisi a laoreet. Proin neque tortor, placerat nec suscipit sit amet, ullamcorper in sem. Fusce faucibus ultrices cursus. Maecenas scelerisque mauris diam, at volutpat nisi porta vitae. Sed at ipsum et leo cursus varius eu eu lectus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos himenaeos. Ut felis ipsum, imperdiet rhoncus orci ac, consectetur luctus nisl. Cras aliquet elementum tellus ullamcorper malesuada. Integer purus est, pharetra eu ullamcorper quis, imperdiet non turpis.

 In vestibulum faucibus ligula eget blandit. Donec eget cursus risus, quis suscipit justo. Curabitur efficitur, dolor nec pulvinar pellentesque, lectus eros hendrerit nisi, in aliquet erat nunc non ipsum. Curabitur felis nunc, viverra nec quam ultrices, suscipit condimentum nibh. Nam faucibus felis hendrerit imperdiet maximus. Curabitur tincidunt porttitor lectus quis feugiat. Sed imperdiet bibendum mi.

 Nullam quis lacus vel ante feugiat efficitur id ut quam. Pellentesque commodo elit nec urna gravida maximus. Suspendisse ut risus eu ipsum porta porta ac et orci. Donec dictum ligula sodales, euismod est sed, semper libero. In blandit, nulla et elementum pharetra, mi nunc sagittis tellus, sit amet scelerisque magna elit ac sapien. Curabitur ipsum dui, pretium a maximus id, varius gravida nisl. Sed vitae mattis elit, vitae hendrerit lorem.

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APPENDIX A

Proin a condimentum nibh

A.1 Praesent vulputate tellus vel metus rutrum

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Integer tempus quis elit id sagittis. Cras tincidunt nisi at tellus luctus, et congue dolor posuere. Aliquam suscipit felis sit amet lacus ultrices aliquet. Sed sagittis ultrices nisi, vel elementum elit dignissim non. Fusce faucibus ex at massa ultrices elementum. Nullam ullamcorper lorem sit amet facilisis cursus. Suspendisse non erat non justo porta placerat. Morbi porttitor dictum molestie. Sed vitae iaculis libero. Suspendisse in gravida lacus, tempor ultrices nibh. Nam consequat scelerisque porttitor [6], [7].

A.1.1 Faucibus interdum nisi

Nulla elementum orci in dolor dapibus, ac facilisis sem ultrices. Nullam eleifend id eros sed luctus. Maecenas arcu ipsum, scelerisque id lorem in, placerat posuere tellus [8]. Etiam gravida velit sed arcu viverra dapibus. Mauris vitae augue dapibus, molestie justo eget, condimentum ipsum. Nulla tristique mi eget semper luctus. Etiam commodo vestibulum vulputate. Etiam quis sapien dolor. Nunc tristique eu lacus quis ullamcorper. Sed volutpat rutrum vehicula. Donec nunc nisl, suscipit in faucibus vitae, tristique eu risus. [GNU](#) nulla facilisis augue eget interdum rutrum. Aliquam sem nunc, fermentum sed urna ac, faucibus interdum nisi.

A.1.2 Praesent vulputate tellus vel metus rutrum

Proin a condimentum nibh. Praesent vulputate tellus vel metus rutrum, non luctus mi sollicitudin. Nam ac tellus ut eros sollicitudin luctus at ac mi. Vestibulum mollis nec nisi a laoreet. Proin neque tortor, placerat nec suscipit sit amet, ullamcorper in sem. Fusce faucibus ultrices cursus. Maecenas scelerisque mauris diam, at volutpat nisi porta vitae.

Sed at ipsum et leo cursus varius eu eu lectus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos himenaeos.

Ut felis ipsum, imperdiet rhoncus orci ac, consectetur luctus nisl. Cras aliquet elementum tellus ullamcorper malesuada. Integer purus est, pharetra eu ullamcorper quis, imperdiet non turpis. [9]

In vestibulum faucibus ligula eget blandit. Donec eget cursus risus, quis suscipit justo. Curabitur efficitur, dolor nec pulvinar pellentesque, lectus eros hendrerit nisi, in aliquet erat nunc non ipsum. Curabitur felis nunc, viverra nec quam ultrices, suscipit condimentum nibh. Nam faucibus felis hendrerit imperdiet maximus. Curabitur tincidunt porttitor lectus quis feugiat. Sed imperdiet bibendum mi.

Nullam quis lacus vel ante feugiat efficitur id ut quam. Pellentesque commodo elit nec urna gravida maximus. Suspendisse ut risus eu ipsum porta porta ac et orci. Donec dictum ligula sodales, euismod est sed, semper libero [Fiducial marks](#).



Figure A.1 – Alcázar de los reyes cristianos, Córdoba. [Ahura klik.](#)

In blandit, nulla et elementum pharetra, mi nunc sagittis tellus, sit amet scelerisque magna elit ac sapien. Curabitur ipsum dui, pretium a maximus id, varius gravida nisl. Sed vitae mattis elit, vitae hendrerit lorem [10].

A.1.2.1 **Lorem ipsum dolor sit amet, consectetur adipiscing elit**

Integer tempus quis elit id sagittis. Cras tincidunt nisi at tellus luctus, et congue dolor posuere. Aliquam suscipit felis sit amet lacus ultrices aliquet. Sed sagittis ultrices nisi, vel elementum elit dignissim non.

A.1.2.2 **Fusce faucibus ex at massa ultrices elementum**

Nullam ullamcorper lorem sit amet facilisis cursus. Suspendisse non erat non justo porta placerat. Morbi porttitor dictum molestie. Sed vitae iaculis libero. Suspendisse in gravida lacus, tempor ultrices nibh. Nam consequat scelerisque porttitor.

A.2 Nulla elementum orci in dolor dapibus

Nulla elementum orci in dolor dapibus, ac facilisis sem ultrices. Nullam eleifend id eros sed luctus. Maecenas arcu ipsum, scelerisque id lorem in, placerat posuere tellus. Etiam gravida velit sed arcu viverra dapibus. Mauris vitae augue dapibus, molestie justo eget, condimentum ipsum. Nulla tristique mi eget semper luctus. Etiam commodo vestibulum vulputate. Etiam quis sapien dolor. Nunc tristique eu lacus quis ullamcorper. Sed volutpat rutrum vehicula. Donec nunc nisl, suscipit in faucibus vitae, tristique eu risus. Nulla facilisis augue eget interdum rutrum. Aliquam sem nunc, fermentum sed urna ac, faucibus interdum nisi.

A.2.1 Non luctus mi sollicitudin

Nam ac tellus ut eros sollicitudin luctus at ac mi. Vestibulum mollis nec nisi a laoreet. Proin neque tortor, placerat nec suscipit sit amet, ullamcorper in sem. Fusce faucibus ultrices cursus. Maecenas scelerisque mauris diam, at volutpat nisi porta vitae. Sed at ipsum et leo cursus varius eu eu lectus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos himenaeos. Ut felis ipsum, imperdiet rhoncus orci ac, consectetur luctus nisl. Cras aliquet elementum tellus ullamcorper malesuada. Integer purus est, pharetra eu ullamcorper quis, imperdiet non turpis.

In vestibulum faucibus ligula eget blandit. Donec eget cursus risus, quis suscipit justo. Curabitur efficitur, dolor nec pulvinar pellentesque, lectus eros hendrerit nisi, in aliquet erat nunc non ipsum. Curabitur felis nunc, viverra nec quam ultrices, suscipit condimentum nibh. Nam faucibus felis hendrerit imperdiet maximus. Curabitur tincidunt porttitor lectus quis feugiat. Sed imperdiet bibendum mi.

A.2.1.1 Nullam quis lacus vel ante feugiat

Nullam quis lacus vel ante feugiat efficitur id ut quam. Pellentesque commodo elit nec urna gravida maximus. Suspendisse ut risus eu ipsum porta porta ac et orci. Donec dictum ligula

sodales, euismod est sed, semper libero. In blandit, nulla et elementum pharetra, mi nunc sagittis tellus, sit amet scelerisque magna elit ac sapien. Curabitur ipsum dui, pretium a maximus id, varius gravida nisl. Sed vitae mattis elit, vitae hendrerit lorem.

```

1  """
2  Some interesting python code
3  Blah Blah Blah
4  """
5
6  import numpy as np
7  from matplotlib import pyplot as plt
8  from numpy.polynomial import Polynomial as Poly
9
10 plt.rcParams["font.family"] = "Libertinus Serif"
11 plt.rcParams['font.size'] = 14
12 plt.rcParams['mathtext.fontset'] = 'custom'
13 plt.rcParams['mathtext.rm'] = 'Libertinus Serif'
14 plt.rcParams['mathtext.it'] = 'Libertinus Serif:italic'
15 plt.rcParams['mathtext.bf'] = 'Libertinus Serif:bold'
16
17 R510 = 508.3 # Ohms
18 V5 = 5.018 # Volts
19
20 # Open files
21
22 nmos_vgs, nmos_vr = np.loadtxt('nmos_ids_vgs.csv', delimiter='\t', unpack=True, skiprows=1)
23 nmos_sim_vgs, nmos_sim_ids = np.loadtxt('CIC_P0_NMOS_ids_vgs_5.txt', delimiter='\t', unpack=True, skiprows=1)
24
25 # Do thingies
26
27 nmos_ids = nmos_vr / R510 # Current in resistor
28 p = Poly.fit(nmos_vgs, nmos_ids, 1) # Tendency line
29 print(f"f(x) = {p:unicode}")
30
31 # Plot stuff
32
33 fig0, ax0 = plt.subplots(figsize=[12, 6])
34 x = np.linspace(0, 6, 100)
35
36 plt.plot(nmos_vgs, nmos_ids, linestyle='none', marker=".", label='Experimental')
37 plt.plot(nmos_sim_vgs, nmos_sim_ids, linestyle='dashdot', label='Simulation')
38 plt.plot(x, p(x), linestyle='dashed', label='Tendency')
39
40 ax0.grid(True, which='major', color="#DDDDDD", linestyle='-', linewidth=0.6)
41 ax0.grid(True, which='minor', color="#DDDDDD", linestyle=':', linewidth=0.6)
42 ax0.minorticks_on()
43
44 ax0.legend()
45
46 plt.title(r'NMOS, curve $I_{DS} / V_{GS}$')
47 plt.xlabel(r'$V_{GS}$ (V)')
48 plt.ylabel(r'$I_{DS}$ (A)')
49
50 plt.xlim([0, 6])
51
52 # Dont forget to save
53
54 plt.savefig("nmos_vgs_ids.pdf")

```

Listing A.1 – Some Python Code [11]

A.2.1.1.1 Sed sagittis ultrices nisi Lorem ipsum dolor sit amet, consectetur adipiscing elit. Integer tempus quis elit id sagittis. Cras tincidunt nisi at tellus luctus, et congue dolor posuere. Aliquam suscipit felis sit amet lacus ultrices aliquet. Sed sagittis ultrices nisi, vel elementum elit dignissim non. Fusce faucibus ex at massa ultrices elementum. Nullam ullamcorper lorem sit amet facilisis cursus. Suspendisse non erat non justo porta placerat. Morbi porttitor dictum mo-

lestie. Sed vitae iaculis libero. Suspendisse in gravida lacus, tempor ultrices nibh. Nam consequat scelerisque porttitor.

Nulla elementum orci in dolor dapibus, ac facilisis sem ultrices. Nullam eleifend id eros sed luctus. Maecenas arcu ipsum, scelerisque id lorem in, placerat posuere tellus.

Etiam gravida velit sed arcu viverra dapibus. Mauris vitae augue dapibus, molestie justo eget, condimentum ipsum. Nulla tristique mi eget semper luctus.

Table A.1 – Example of a long landscape table.

| Nº | EDT | Nombre de tarea | Trabajo | Duración | Predecesoras | Comienzo | Fin | Recursos |
|-----------|----------|---|----------------|-------------------|---------------------|---------------------|---------------------|---|
| 1 | 1 | Dirección del proyecto | 4 días | 4 días | | lun 03/07/23 | jue 06/07/23 | |
| 2 | 1.1 | Reunión inicial de planificación con el cliente | 3 días | 3 días | | lun 03/07/23 | mié 05/07/23 | Ana Torres;Carla Aguilar;Diego Ortiz;Lucía Castro;Martina Martínez;Pablo Gómez;Rodrigo García |
| 3 | 1.2 | Reparto de tareas a los trabajadores | 1 día | 1 día | 1.1 | jue 06/07/23 | jue 06/07/23 | Ana Torres |
| 4 | 2 | Estudio de la viabilidad del despliegue | 27 días | 9,67 días | | vie 07/07/23 | jue 20/07/23 | |
| 5 | 2.1 | Estudio de la orografía | 5 días | 1,67 días | 1.2 | vie 07/07/23 | lun 10/07/23 | Rodrigo García;Paloma Cuesta;Ramón García |
| 6 | 2.2 | Estudio del emplazamiento de las antenas del radioenlace y balance de potencias | 4 días | 1,33 días | 2.1 | mié 12/07/23 | jue 13/07/23 | Rodrigo García;Paloma Cuesta;Ramón García |
| 7 | 2.3 | Estudio del emplazamiento de las estaciones base y radio de cobertura | 4 días | 1,33 días | 2.1 | jue 13/07/23 | vie 14/07/23 | Rodrigo García;Paloma Cuesta;Ramón García |
| 8 | 2.4 | Estudio de la magnitud del tráfico | 3 días | 1 día | 1.2 | lun 10/07/23 | mar 11/07/23 | Rodrigo García;Paloma Cuesta;Ramón García |
| 9 | 2.5 | Revisión de la normativa | 2 días | 0,67 días | 1.2 | mar 11/07/23 | mié 12/07/23 | Rodrigo García;Paloma Cuesta;Ramón García |
| 10 | 2.6 | Establecimiento de los requisitos técnicos | 5 días | 1,67 días | 2.1;2.2;2.3;2.4;2.5 | lun 17/07/23 | mar 18/07/23 | Rodrigo García;Paloma Cuesta;Ramón García |
| 11 | 2.7 | Establecimiento de un presupuesto temprano | 4 días | 2 días | 2.6 | mar 18/07/23 | jue 20/07/23 | Ana Torres;Rodrigo García |
| 12 | 3 | Diseño del despliegue | 41 días | 14 días | | jue 20/07/23 | mié 09/08/23 | |
| 13 | 3.1 | Diseño de la red | 29 días | 9,67 días | | jue 20/07/23 | jue 03/08/23 | |
| 14 | 3.1.1 | Diseño de las estaciones base de telefonía | 7 días | 9,67 días | | jue 20/07/23 | jue 03/08/23 | |
| 15 | 3.1.1.1 | Elección del emplazamiento físico | 5 días | 1,67 días | 2 | jue 20/07/23 | lun 24/07/23 | Rodrigo García;Paloma Cuesta;Ramón García |
| 16 | 3.1.1.2 | Diseño de la sectorización y el apuntado | 2 días | 0,67 días | 3.1.1.1 | mié 02/08/23 | jue 03/08/23 | Rodrigo García;Paloma Cuesta;Ramón García |
| 17 | 3.1.2 | Diseño de las estaciones base del radioenlace | 7 días | 2,33 días | | lun 24/07/23 | mié 26/07/23 | |
| 18 | 3.1.2.1 | Elección del emplazamiento físico | 5 días | 1,67 días | 2 | lun 24/07/23 | mar 25/07/23 | Rodrigo García;Paloma Cuesta;Ramón García |
| 19 | 3.1.2.2 | Diseño del apuntado | 2 días | 0,67 días | 3.1.2.1 | mié 26/07/23 | mié 26/07/23 | Rodrigo García;Paloma Cuesta;Ramón García |
| 20 | 3.1.3 | Diseño de la topología de red | 10 días | 3,33 días | 2 | mié 26/07/23 | lun 31/07/23 | Rodrigo García;Paloma Cuesta;Ramón García |
| 21 | 3.1.4 | Diseño de la gestión y separación del tráfico | 5 días | 1,67 días | 2 | mar 01/08/23 | mié 02/08/23 | Rodrigo García;Paloma Cuesta;Ramón García |
| 22 | 3.2 | Elección de equipos y componentes | 10 días | 3,33 días | | jue 03/08/23 | mar 08/08/23 | |
| 23 | 3.2.1 | Elección de los equipos de RF | 5 días | 1,67 días | 3.1 | jue 03/08/23 | vie 04/08/23 | Rodrigo García;Paloma Cuesta;Ramón García |
| 24 | 3.2.2 | Elección de los equipos de red | 5 días | 1,67 días | 3.1 | lun 07/08/23 | mar 08/08/23 | Rodrigo García;Paloma Cuesta;Ramón García |
| 25 | 3.3 | Elaboración del presupuesto base | 2 días | 1 día | 3.1;3.2 | mar 08/08/23 | mié 09/08/23 | Rodrigo García;Ana Torres |
| 26 | 4 | Despliegue físico | 38 días | 15,83 días | | mié 09/08/23 | jue 31/08/23 | |
| 27 | 4.1 | Reunión de materiales | 4 días | 2 días | 3 | mié 09/08/23 | vie 11/08/23 | Diego Ortiz;Martina Martínez |
| 28 | 4.2 | Construcción | 15 días | 7,5 días | | vie 11/08/23 | mié 23/08/23 | |
| 29 | 4.2.1 | Estaciones de telefonía | 5 días | 2,5 días | 4.1 | vie 11/08/23 | mié 16/08/23 | Diego Ortiz;Martina Martínez |

Thank you for reading this Master's Thesis.