**YEDITEPE UNIVERSITY**

**FACULTY OF ENGINEERING**

**YOUR THESIS TITLE**

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**GRADUATION PROJECT REPORT**

Department of Electrical and Electronics Engineering

**Supervisor**

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ISTANBUL, year

**YEDITEPE UNIVERSITY**

**FACULTY OF ENGINEERING**

**Your Thesis Title**

**by**

**Name**

**January 15, 2019, Istanbul**

**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**

**YEDITEPE UNIVERSITY**

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# ACKNOWLEDGEMENTS

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**January, 2019**

**Name Surname**

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# ABSTRACT

Truss optimization has been an attractive area for researchers in recent years. Researchers are interested in this issue to find out how they can reduce the weight and cost while the structure satisfied with the physical constraints. To accomplish these requirements, the trial-and-error method cannot be used because lots of trials will be required. Therefore, optimization methods should be used to find an optimum structure.

# LIST OF SYMBOLS

**Cd:** coefficient of derivative control

# ABBREVIATIONS

**ADC:** Analog Digital Converter

**ANN:** Artificial Neural Network

**DAC:** Digital Analog Converter

**HVAC:** Heating, Ventilating and Air Conditioning

**NG:** Negative

**PID:** Proportional Integral Derivative

# LIST OF FIGURES

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# INTRODUCTION

The introduction should include general information about the physics/math/or whatever behind your problem. Statement of the problem and need for the study (What is your motivation for this thesis? Define the problem clearly and give the importance of the problem?). Subproblems (Mention about your secondary motivations)

All equations, figures, and tables used in the report MUST be referred in the text.

A sample equation:

|  |  |
| --- | --- |
|  | (1.1) |



**Figure 1.1** A sample figure

**Table 1.1** A sample table

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Expression | Values | Description |
| vR | 5268[m/s] | 5268 m/s | Rayleigh wave velocity |
| f0 | 100[MHz] | 1.0000E8 Hz | Target frequency |
| lambda0 | vR/f0 | 5.2680E-5 m | Target wavelength |
| w0 | lambda0/4 | 1.3170E-5 m | Electrode width |
| h0 | 5\*lambda0 | 2.6340E-4 m | Electrode length |
| gap\_port | 10\*lambda0 | 5.2680E-4 m | Horizontal gap between ports |
| gap\_term | lambda0 | 5.2680E-5 m | Vertical gap between terminals |
| N0 | 3 | 3 | Number of electrodes |
| pitch | 4\*w0 | 5.2680E-5 m | Pitch of electrodes |
| gap\_vert | (3+2)\*lambda0 | 2.6340E-4 m | Distance of electrode from substrate wall along vertical direction |
| gap\_horiz | (3+2)\*lambda0 | 2.6340E-4 m | Distance of electrode from substrate wall along horizontal direction |
| t0 | 2\*lambda0 | 1.0536E-4 m | Substrate thickness |
| N\_cyc | 20 | 20 | Number of cycles to simulate |
| h\_max | lambda0/5 | 1.0536E-5 m | Maximum mesh size |
| CFL | 0.2 | 0.2 | CFL number |
| tstep | CFL\*h\_max/vR | 4.0000E-10 s | Maximum solver time step |
| V0 | 10[V] | 10 V | Input voltage magnitude |
| eta0 | 0.001 | 0.001 | Mechanical loss factor |
| pz\_thick | 1 [um] | 1.0000E-6 m | Piezoelectric material thickness |
| gap\_depth | 5 [um] | 5.0000E-6 m | Depth of rectangular gap |

## Thesis Content

The content should include the following sections.

# RESEARCH OBJECTIVE

The general information about the physics/math/or whatever behind your problem. Statement of the Problem and Need for the Study (What is your motivation for this thesis? Define the sub-problem clearly and give the importance of the problem?). Sub-problems (Mention about your secondary motivations)

This part should be DETAILED version of the introduction.

# LITERATURE REVIEW

The studies about your thesis, who did try to solve similar problems? What are their results? Which parts of these results are unsatisfactory? The contribution of your study? (Maybe your study is just a replica of some previous works. Please refer to the previous work and just inform the reader about this).

# DESIGN

## Realistic Constraints and Conditions

In this subsection, you must include factors such as economic, environmental issues, social and political issues, ethical, health, safety, manufacturability, sustainability, and cost analysis following the nature of the design.

**Economy:** In this context, the cost of the components used in the project should be discussed. Also, the economic contribution of the project output should be mentioned. (e.g., The domestic-foreign market shares of the relevant field or the project output.)

**Cost Analysis:** The purpose of cost analysis is to show the labor, raw material component, required machinery and equipment, service procurement, and processing costs incurred within the project. (e.g., BOM list implementation)

**Environmental Issues:** These studies include reducing energy consumption in stages such as processing and production work used to realize the project output, reducing harmful substances thrown into the environment, reducing harmful gas emissions to the environment by using alternative and renewable energies, and selecting alternative materials for materials with recycling issues in nature. (e.g., Selection of RoHS compliant PCB boards)

**Sustainability:** Studies on how long a material determined for a certain product design will last, if it will become worthless after use, such as trash or waste, or whether it can be reprocessed into the same or a different product. (e.g., Recycled raw materials are used to make plastic-like containers.)

**Manufacturability:** Manufacturability is the process that starts with the selection of material, production method, and which stages it should go through for a design to be manufacturable. (e.g., Process selection and use of appropriate processes in integrated circuit-based projects, to design based on the constraints of the relevant production company if printed circuit board production will be made.)

**Ethical:** Evaluation of the studies to be carried out in terms of engineering ethics. (e.g., Examination of the tests (especially in the projects related to health or KVKK) to be carried out in the project, if any.)

**Health:** Examination of whether the methods and materials to be used in the project are harmful for human health. (e.g., The use of RoHS or REACH certified components)

**Safety:** An evaluation of the materials selected for the project in terms of engineering safety criteria, an evaluation to be made in terms of occupational safety as to whether the methods to be used in the project cause any occupational accidents. (e.g., All Lithium (Li-ion, Li-polymer) batteries shall be purchased with and stored, when not in use, in a fire and explosion-proof battery bag.)

**Social and Political:** Evaluations to be made in terms of social and political values of our country, strategic and social interests in areas such as the military and defense industry where social and political factors are important. (ex. Projects carried out in line with the needs of the defense industry)

## Cost of the Design

In this subsection, you must include the cost of your design in detail following the concept of the design. You can provide the price of each component that you used in your project.

## Engineering Standards

In this subsection, you must provide and discuss the engineering standards used in your design.

You may find some of the sample standards in the following links:

Bluetooth standards: <http://www.informit.com/articles/article.aspx?p=23760&seqNum=3>

Wireless standards:

<https://ieeexplore.ieee.org/browse/standards/get-program/page/series?id=68>

Microprocessor standards: <http://grouper.ieee.org/groups/msc/>

For software standards: <https://webstore.ansi.org/industry/software>

## Details of the Design

In this subsection, you must provide a detailed explanation of your design.

# METHODS

Design (implementation/simulation studies), The experimental setups/the algorithms/the HW designs must be mentioned in detail. The logic behind the study must be explained.

# RESULTS AND DISCUSSION

Present the results of your study. Comment about the results: Are they satisfactory enough to solve your problem mentioned in chapter 1? Use these results to comment on your study: Which part of your study is not good enough and why? Discuss the satisfactory/unsatisfactory parts.

# CONCLUSION

Summary of your work: The important points of the study (from each chapter) should be mentioned, your contribution should be emphasized. The important points of the discussion section should be written and related results should be referred to.

# REFERENCES

|  |  |
| --- | --- |
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\*\*\* All references MUST be given in IEEE format.

# APPENDICES

## Appendix A

**Matlab Code for Numerical Solution of Rayleigh-Lamb Frequency Equations**

clc,clear all

VpMatrix=[0];

i=1;

d = 0.1e-6 % Thickness of the thin AlN plate

h = d/2;

f = 1e8; % Target frequency of SAW device

Vl = 10287.28; % Longitudinal wave velocity

Vs = 5867; % Shear wave or tangential wave velocity

w=2\*pi\*f; % Angular frequency

SignChange=2;

for d = 0.1e-6:1e-6:52.36e-6

h = d/2;

SignChange=2;

for Vp = 1:1:6000; % Phase velocity

k = w/Vp;

p = sqrt((w/Vl)^2-k^2);

q = sqrt((w/Vs)^2-k^2);

% Lamb's equation for antisymmetric modes

lambAsym = real(q\*tan(q\*h) + ((q^2-k^2)^2\*tan(p\*h))/(4\*k^2\*p));

if SignChange~=sign(lambAsym) && sign(lambAsym)~=0 &&...

SignChange ~=2;

SignChange=sign(lambAsym);

disp('kök');

break

end

Vp

if SignChange == 2

SignChange=sign(lambAsym);

end

end

VpMatrix(i)=Vp;

i=i+1;

end

dMatrix = 0.1e-6:1e-6:52.36e-6;

plot(dMatrix,VpMatrix)