

Outer Cover

**T.C**.

KARADENIZ TECHNICAL UNIVERSITY

Of Technology Faculty

Department of Electronics and Communication Engineering

Engineering Design and Graduation Project Template File

(Engineering Design / Graduation Project)

Student No Name Surname

Student No Name Surname

Student No Name Surname

Consultant Title Name Surname

January 2023

TRABZON



Inside Cover

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**UNDERGRADUATE GRADUATION PROJECT APPROVAL FORM**

The undergraduate graduation project titled "....................................................................................." prepared by ............. ..................... under the direction of ................................. has been examined by us and accepted as an Undergraduate Graduation Project in terms of its scope and quality.

|  |  |  |
| --- | --- | --- |
| Counselor | : | Title Name and Surname |
| Jury Member 1 | : | Title Name and Surname |
| Jury Member 2 | : | Title Name and Surname |
| Head of Department | : | Title Name and Surname |

**PREFACE**

This guide has been prepared to help the preparation of the Graduation Study book to be prepared by the students of Karadeniz Technical University Of Technology Faculty Electronics and Communication Engineering Department. Careful reading and application of this guide will enable our students to prepare a good thesis.

In the preface, the instructor who advised the Graduation Study should be thanked, and other instructors, technicians and other employees should be thanked if they have been helpful. Thanks should be given to fellow students and other people who have been helpful. Thanks should also be given to the Head of the Department for allowing the use of departmental facilities for the Graduation Studies, and to the Dean of Of Technology Faculty and the Rectorate of KTU for their support.

I would also like to thank my family members for their support during my education.

June 2021

The names and surnames of the students in the group are written one below the other.

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**SUMMARY**

This guide has been prepared in order to ensure unity in the written presentations of the graduation studies to be prepared in the Department of Electronics and Communication Engineering of Of Technology Faculty.

## While preparing the project report, it should be taken into consideration that the summary, introduction and conclusion sections are the most read sections. These three sections give the reader general information about the subject. For this reason, the project topic and important results should be clearly written in these sections.

## When writing the abstract, it should be kept in mind that the aim is to give the reader a general idea about the project. The first paragraph of the abstract should define the project topic. In the other paragraphs, the content and objectives of the project should be explained and the methods and results should be mentioned.

Since the abstract describes a finished project, the passive voice should be used in the narrative, such as "done, completed, implemented".

**SYMBOLS AND ABBREVIATIONS**

**INDEX OF FIGURES**

**INDEX OF CHARTS**

1. **INTRODUCTION**

**1.1. General Information**

In the introduction section, a general description of the study is given, the subject, purpose, scope of the study, method and stages are summarized. It is elaborated by giving subheadings and more detailed explanations are made. For example, under the subheading **1.1.**

* A general description of the work done should be given
* Explain why this topic was chosen
* As a result of this upheaval, the innovations to be provided to the relevant subject should be mentioned.
* Information on how and why this subject or practice is used today should be given.

**1.2. Literature Review**

Information about similar research, studies and practices conducted by others on this subject is given by citing references.

* In this *section,* at least 5 publications from *IEEE Xplore Digital library*, TÜBİTAK Turkish Journal of Electrical Engineering & Computer Sciences, YÖK Thesis Library, International or national refereed journals and KTÜ Thesis Library must be cited. At least 2 of these references must be in English.

**1.3. Authenticity**

If the study to be conducted is different from similar ones, it is explained. If it is a repetition of a previous work, this is stated. Originality is not required in Undergraduate Design and Graduation Projects. However, originality and innovative aspects are always preferred. It should not be forgotten that a project written to provide financial support must have an innovative aspect and a unique value.

In Design and Graduation Projects, even if a previous work is repeated, there must be structural and dimensional differences and every stage from design to realization must be done by the students working on the project. These structural and design differences should be explained in this section.

**1.4. Method**

Under this heading, it should be briefly explained which methods and how they will be used in all stages of the Design and Graduation project (idea generation, literature review, design, simulation and realization). Details should be given under the headings of the relevant sections.

**1.5. Widespread Impact**

What will be the benefits when the study or project is completed? What problem will it solve on a national and international basis or locally? Which aspects will attract attention? What effects will it have on employment, production, economy, health, environment and social aspects? Does it have the potential for publication? Where can it be published?

**1.6. Standards**

The standards to be followed and complied with in the study should be listed in this section with their numbers and standard names. For example, if you need standards on X, when you type "Standards in X" in Google search engine, you will see many standards related to that subject. Examine these and list the appropriate ones here. Especially search for TSE, IEC and IEEE Standards.

**1.7. Work Schedule**

A work plan is placed at the end of the introduction under this heading. This work plan is organized as a work-time chart. It briefly summarizes who will take part in the work packages defined in the work-time graph and what will be done. What will be achieved when each work package is completed is briefly explained in a few sentences.

The tasks in the work packages are shared so that each student in the team is the leader in at least one work package. The student in charge of a work package monitors the work of the other students and ensures that the work package is completed in the planned time with the planned result.

In case there is a disruption in the operations to be performed in the work packages, a B plan should be created and a B plan should be attached to each work package to ensure that progress is not interrupted. A B plan is not required for work packages where it is certain that there will be no disruption. However, a plan B should be created for situations where disruption may occur and the project should be completed within the specified time. A sample Work-Time chart is given in Table 1.1.

Schedule 1.1. Work-Time Schedule

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **IP No** | **Name and Purpose of the Work Package** | **Worked by whom** | **Time Interval** | **Contribution to the Project** |
| 1 | Creating the project idea, literature research and revealing the original idea | Student 1 (L)Student 2Student 3 | October 2020 | The project idea is created and originality is supported by literature research. The formation of the original idea also clarifies what will be done in the next steps. |
| 2 | Determination of the methods to be applied and related theoretical studies. Proceeding to the design phase | Student 2 (L)Student 3Student 1 | October-November 2020 | The methods to be applied are supported by theoretical explanations. Continuation of the design depends on the adequacy of theoretical knowledge. |
| 3 | Completion of design calculations and drawings, financial analysis and budgeting, and investigation of legal responsibilities  | Student 3 (L)Student 1Student 2 | November-December 2020 | Design calculations and technical drawings of the project are made. Connection diagrams are created according to the dimensions of the components such as table, case, box etc. Connection diagrams are the working indicator of the prototype.  |
| 4 | Creating the simulation model, performing simulations, evaluating the results and writing the Engineering Design book | Student 1 (L)Student 2Student 3 | December 2020 - January 2021 | The simulation model of the designed system is created and simulated with package programs or software to be developed. Simulation is important as it will provide prior knowledge of whether the prototype will work or not. |
| 5 | Final exams and Engineering Design presentations, | Student 2 (L)Student 3Student 1 | January 2021 | The prepared Engineering Design is evaluated by the jury during the presentations. Since Engineering Design is a prerequisite for the Graduation Project, it is important to successfully complete the presentations. |

Schedule 1.1. Work-Time Schedule (Continued)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **IP No** | **Name and Purpose of the Work Package** | **Worked by whom** | **Time Interval** | **Contribution to the Project** |
| 6 | Ordering the necessary materials for prototype production and starting prototype production | Student 3 (L)Student 1Student 2 | January-February 2021 | Procurement of the materials to be used in the project is an important stage. If the materials cannot be provided, the project cannot be realized. |
| 7 | Creation of electrical-electronic circuits required for prototype manufacturing in accordance with the design | Student 1 (L)Student 2Student 3 | February-March-April 2021 | Correct connection of the connection diaphragms of the system to be realized is important as it will ensure the continuation of the project. |
| 8 | Completion of prototype assemblies and tests, evaluation of test results | Student 2 (L)Student 3Student 1 | March May 2021 | Completion of the assembly works is necessary for the tests to be carried out. Test results are also important as an indicator of whether the work has achieved its purpose. |
| 9 | Writing and submission of the Graduation Project book,  | Student 3 (L)Student 1Student 2 | May-June 2021 | Writing and describing the work done in a suitable format is important as it is the final report of the project. A poorly prepared project book may prevent the completion of the project. |
| 10 | Final exams, Graduation Project Exhibition and presentations and completion of the project | Student 1 (L)Student 2Student 1 | June 2021 | The prototype made in the Graduation Project Exhibition is exhibited in working condition and evaluated by the Jury. A passing score is required. |

Table 1.2. Risk analysis and plan B

|  |  |  |
| --- | --- | --- |
| **IP No** | **Contribution to the Project** | **Risk Analysis** |
| 1 | The project idea is created and originality is supported by literature research. The formation of the original idea also clarifies what will be done in the next steps. | Original value is recommended in undergraduate projects, and re-projecting an existing idea can be implemented as plan B. |
| 2 | The methods to be applied are supported by theoretical explanations. Continuation of the design depends on the adequacy of theoretical knowledge. | If there is a lack of information on the subject, it can be overcome by conducting additional studies. |
| 3 | Design calculations and technical drawings of the project are made. Connection diagrams are created according to the dimensions of the components such as table, case, box etc. Connection diagrams are the working indicator of the prototype.  | The connection diagrams of the study will be drawn using technical drawing programs. In the absence of licensed drawing programs, open source programs will be used. |
| 4 | The simulation model of the designed system is created and simulated with package programs or software to be developed. Simulation is important as it will provide prior knowledge of whether the prototype will work or not. | The simulation of the project will be done using package programs. If licensed simulation software is not available, open source software or students' own software can be used. |
| 5 | The prepared Engineering Design is evaluated by the jury during the presentations. Since Engineering Design is a prerequisite for the Graduation Project, it is important to successfully complete the presentations. | The project book must be prepared and presented in accordance with the spelling rules. If this work package cannot be completed, the project will be considered unsuccessful. Therefore, it must be done accordingly. |
| 6 | Procurement of the materials to be used in the project is an important stage. If the materials cannot be provided, the project cannot be realized. | If the necessary materials are not available from local vendors, they can be ordered online.  |
| 7 | Correct connection of the connection diaphragms of the system to be realized is important as it will ensure the continuation of the project. | No disruption is expected in this work package. However, support can be obtained from the technical staff in the department when necessary. |
| 8 | Completion of the assembly works is necessary for the tests to be carried out. Test results are also important as an indicator of whether the work has achieved its purpose. | Prototype assembly is done by project students. If necessary, support is also received from the technical staff of the department. Measuring tool support can also be obtained from the department.  |
| 9 | It is important that the work done is written and explained in the appropriate format as it is the final report of the project. A poorly prepared project book may prevent the completion of the project. | The project book must be prepared and presented in accordance with the spelling rules. If this work package cannot be completed, the project will be considered unsuccessful. Therefore, it must be done accordingly. |
| 10 | The prototype made in the Graduation Project Exhibition is exhibited in working condition and evaluated by the Jury. A passing score is required. | It is mandatory to attend the Graduation Project exhibition and exhibit the prototype. This work package must be realized. |

1.8. Work Packages Organization and Work Management

The first 5 work packages are related to Engineering Design and the last 5 work packages are related to the Capstone Project. The students who take part in the project should take turns to lead these work packages and warn the other students in charge of that work package to complete the work package they are responsible for on time. Each student has to take a leadership role in at least one work package and take responsibility for ensuring that it is completed by telling the other students what they need to do.

Under this sub-heading, it should be given in detail who will lead which work package and who among the other students in that work package will do which work and in how much time.

**2. THEORETICAL BACKGROUND**

**2.1. General Information**

In the theoretical background section, a brief information about the topic can be given. This information should be limited to the subject and the part used in the study. For example, if the speed control of a direct current motor is being done, the DA motor and how its speed can be controlled should be briefly mentioned for a few pages and how this speed control process is done in the study should be expressed with mathematical equations. The chapters of books related to DC motors should never be transferred to the graduation book with copy-paste logic. **NO GRADUATION PROJECT THAT DOES NOT EXPLAIN THE THEORY WILL NOT BE ACCEPTED.**

2.1. Under the sub-heading General Information, a general framework of the project and what will be done and how it will be done is briefly described, followed by theoretical information about each sub-section in detail under other sub-headings. This information is usually classical theoretical information in book form and does not require referencing. However, when a theorem, formula, algorithm, method, etc. developed by a specific person is used, the source must be cited.

The topic may consist of one or more parts. In this case, theoretical information about that part should be given by using a title for each sub-topic. While giving the theoretical information, only the result equations related to the subject studied should be given, not how the equations are obtained and their proofs. For example, if "*A Grid Connected Wind Energy System*" is chosen as the topic of study, the main sub-headings will be the *wind turbine, the electric generator, the power electronics elements that will provide the interconnection* and the *grid*. If a study on "*Wireless Robot Control*" is being carried out, then the *equations of motion of the robot, motors that provide robot motion, wireless data transmission*, and *control* issues can be used as subheadings as follows.

In *a Grid-Connected Wind Energy System*

**2.2. Wind Turbine**

By giving information about wind turbines, the mechanical moment or mechanical power equations produced by the turbine depending on the wind speed are written and explained.

**2.3. Electricity Generator**

The types of generators used in wind energy systems are briefly mentioned. The electric generator to be used in the project and why it is chosen is mentioned and how this generator converts the mechanical energy applied to the shaft of the generator into electrical energy is briefly explained and the relevant equations are given. How the power and voltage control will be done is explained.

**2.4. Power Electronics Components**

Power electronics circuits and elements used in wind energy systems are mentioned. Elements such as rectifier, inverter, frequency inverter and chopper that will be used in the study are mentioned and theoretical information about the working principles of each of them is given briefly.

**2.5. Control Methods**

If the design for the control of turbine, generator and power electronics circuit elements is to be made in the study, brief information is given about the control methods and theories that are considered to be used or used.

In *Wireless Robot Control*

**2.6. Robots and Their Movements**

Information is given about the movement flexibility of robots. Moving parts and equations of motion are written and explained.

**2.7. Robot Drive Motors**

How robots are moved is explained. The types of drive motors used are explained and the moment and speed equations produced by these motors to drive robots are given. How they are controlled is explained.

**2.8. Wireless Data Communication**

Information about wireless data communication used in robots is given. The wireless data communication that will be used in the study is explained, related theoretical information is given. The data communication protocols used, if any, are explained.

**2.9. Microprocessors**

If a microprocessor will be used in the study, general information about microprocessors is given and the microprocessor to be used is explained. Putting a photo of the microprocessor does not mean explaining it. It is necessary to explain how it works. Inputs, outputs, processor, speed, software features, how it is programmed should be explained.

**2.10. Control Methods**

Information is given about the control methods used in the control of the robot. The theory of these methods is briefly explained.

**2.11. Wired-Wireless Communication**

Necessary technical information, communication protocols, distance, frequency, communication power, energy, wavelength, etc. should be calculated according to the type of communication and their relationship with the project should be explained.

**2.12. Biomedical Applications**

Those who work on this subject should explain the necessary theoretical knowledge, image and signal processing techniques under this section.

**2.13. Human-Machine Interaction**

Those who work on this subject should explain the necessary theoretical knowledge under this section.

**2.14. Intelligent Systems**

Developers of smart devices or systems should explain in this section how this smartness is achieved.

**2.15. Other**

Theoretical information on other topics not listed here but used in the project should be given in this section.

**NOTE: Catalog information, product introduction information should not be used in this section. Use of such information may result in the project being deemed unsuccessful.**

**3. DESIGN**

**3.1. General Information**

In the design section, the calculations made in the study must be explained based on the relevant theories and theorems. Depending on the theoretical background of the project, necessary calculations and drawings, if any, should be made. The numerical values used in the calculations should be given in tables, and the calculation results should be shown either in tables or figures. In design drawings, there should be a title (letterhead) on the drawing paper, and there should be information about when the drawing was made, by whom and by whom, under whose supervision and within the scope of which project. All dimensioning measurements must be given numerically in the design drawings. At the end of the design section, all the details of the work to be done should be revealed, a list of materials to be used and purchased should be listed and **a preliminary cost calculation should be made.** In addition, legal problems that may arise during the realization of the project and its subsequent use should be investigated and resolved.

Design-related sections may have the following sub-headings.

**3.2. Dimensioning**

Sizing of the materials to be used such as table, box, mounting bed, etc. is made. Taking into account the dimensions and spacing of the elements to be placed in them, parts such as the outer box and mounting bed to be used are dimensioned.

**3.3. System Components and Selections**

The subsystem components to be used and how they are selected can be explained in this section. Giving photographs of the selected components does not mean that they are explained. It should not be forgotten that this report is a Design Project Report or a Graduation Project Thesis Book. It is not a product catalog. The elements used should be explained not by photographs, but by emphasizing their technical features and why and how they are used in the project. How they were selected should also be explained.

**3.4. Applied Methods**

The methods applied at different stages of the study should be explained in this section. Circuit design methods, control methods, digital analysis methods, communication methods, whatever application methods are specific to the subject should be explained here.

**3.5. Software**

If software has been developed in the study, the flow chart of this software should be given here and necessary explanations should be made. Do not give the code of the software here. If the thesis advisor wants the software code to be included, then it can be added as a separate appendix in the appendices section.

If there is a software package used for the simulation of the study, that software can also be briefly mentioned here. Do not describe the simulation study here. The next section is already directly for simulation studies.

**3.6. Bill of Materials and Economic Analysis**

The complete list of materials to be used in the study is given in this section. In a table similar to the one in Table 3.1, the name of the material, where and why it will be used, unit price and how many quantities are required are written. The prices of all materials are added together to form the overall budget and compared with the project budget. What kind of evaluations and choices are made to create a material list that fits the budget is also explained here. The positive and negative effects of the price and quality of the materials to be used on the project are evaluated and written here.

Table 3.1. Material List

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name of the material | Intended use | Unit price (TL) | Number | Price (TL) |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| TOTAL |  |

**3.7. Legal Dimension**

Legal problems that may be encountered during the realization of the project depending on its subject matter should be evaluated under this heading. Legal problems that may be encountered after the project is completed should also be included here. Regulations and legislation related to the subject of the project are also included here. The web address **mevzuat.gov.tr** may be useful in this regard.

**4. SIMULATION STUDIES**

**4.1. General Information**

Each study must be simulated. Simulation studies are the part that can be done within the scope of the Design Project. Simulation software can be developed by the students doing the study or package programs can be used. How the modeling to be used in the simulation study is done should be explained and the mathematical model equations should be given based on the work done in the previous sections. If a ready-made package program is used, it should be explained how the study was used in this package program, how it was modeled for this package program, and which data were used in the simulation. Simulation results should be given in the *Results* section.

Possible sub-headings that could be used in this section could be as follows.

**4.2. Simulation Software**

Information about the simulation software developed or to be used in the study is given. The software is briefly introduced and how it will be used in this study is explained.

**4.2. System Modeling**

Explain how the system to be simulated is modeled and give the model equations or model shape. Necessary explanations are made and how the model works is explained.

**4.3. Simulation**

Simulation diagrams and how the simulation is performed are explained in this section.

**5. EXPERIMENTAL STUDIES**

**(This section is not included in the Engineering Design Project).**

**5.1. General Information**

Experimental Studies are given under this heading. Since the Design Project does not include this section, the Design Project Final Report also does not include this section. This section is included in the Graduation Project Book.

In this section, it should be explained how the set-up or the practical work was realized. Information about the difficulties and conveniences experienced during this realization, how the practical work works, and how someone else can use it should be given. It should be stated which safety precautions were taken in the practical work within the standards. All necessary markings should be made on the work and warnings, if any, should be placed. These markings and warnings must be on the practical work and must also be included in this section of the booklet. If there are more safety warnings, it can also be organized as a separate section. In this section, **connection diagrams, printed circuit drawings and photographs of the system should be given. A clear connection diagram must be drawn and placed. A photograph is not a connection diagram.**

In the General Information sub-heading, what will be mentioned in this section is briefly explained, followed by the details. The details are described under the following sub-headings. For example, if the Wind Energy System example used in Chapter 2 is taken as an example, the other sub-headings can be as follows.

**5.2. Combining Wind Turbine and Generator System**

After briefly introducing the wind turbine and generator used in the study, it is explained how they are combined. The technical specifications of the turbine and generator should be explained and how they are used in this study should be explained. Photographs of them separately and/or combined can also be used. However, it is correct that the technical drawing and the combination diagram are given in Chapter 3 where the design is explained. The content of this subheading should be organized according to the subject and scope of the project. The subject given here is only an example.

**5.3. Realization of Interface Elements**

The interface elements used in combining the different systems in the study and how they are used and how they are practically realized should be explained in this section. The title may change according to the subject and scope of the study. For example, in the study on Wind Energy Systems, how the intermediate power electronics elements (rectifier, inverter, chopper, etc.) that connect the generator to the grid or loads are realized and installed can be explained in this section. If necessary, new subheadings such as 5.3.1., 5.3.2. can be opened and the realization of different intermediate elements can be explained in detail. For example, if we take the study titled Wind Energy System again, these 2nd sub-headings can be as follows.

5.3.1. Inverter and Driver circuits

5.3.2. Control of the Inverter

5.3.3. Loads

When talking about the components in the intermediate elements used in this section, their technical features should be explained. For example, when describing a diode used, the characteristics of this diode should be explained through its operating curve.

**5.4. Tests Performed**

After the realization of the designed system is completed, it should be tested whether it works in accordance with the production (construction) purpose and how these tests are performed should be explained in this section. The conditions under which the tests were carried out under which special conditions, the acceptances made, etc. should be given here. Connection diagrams of the test system, if any, should be given and explained. Listing, drawing and interpretation of the results should be given in the next section, not in this section.

**6. CONCLUSIONS**

**6.1. General Explanations**

The results section should include the outputs and their explanations that show whether the intended goal of the study has been achieved or not. A photograph of a practical or experimental study is not a result. The results are graphs, figures, charts, etc. that show whether the study worked according to the purpose of the study. In other words, numerical values or visual graphics. If you are doing a motor speed control, the result of this is not a photo of the motor, but speed-time graphs that show whether that motor is running at the reference speeds you give. If you have done an RF-based communication project, the result of this is not a photo of the RF circuit, but a chart or graph of the measurement results showing how far it can communicate in open or blocked areas. All figures, graphs and charts showing the results should be referred to and explained in the text.

**The axes of the graphs must be written with their units. Please refer to the Engineering Design or Graduation Project Writing Guide for graph format.**

Possible sub-headings of the results section could be as follows.

**6.2. Simulation Results**

The results of simulation studies conducted within the scope of Engineering Design are included in this subheading. The data obtained should be given with charts or graphs and it should be explained whether the designed system meets the targeted objectives or not. Simulation results should be interpreted and expectations from experimental studies should be given.

**6.3. Experiment Results**

The test and measurement results obtained from the practical studies should be given in this sub-heading and it should be explained whether the designed system meets the targeted objectives or not. Experimental results should be compared with simulation results and their similarities and differences should be explained and the reasons for the differences, if any, should be explained. **A photograph of the system is not a result.** Such a photograph can be placed. But this is not the result. **The result is to show whether the system fulfills the reason for which it was built.** For this reason, the numerical data obtained by conducting tests should be explained and discussed with graphs and charts.

**7. EVALUATIONS**

Comments and Evaluation is the last section. Here, the achievements of the study should be interpreted and evaluated. These evaluations can also include what can be done about this study in the future.

It should be explained which problems the work will solve or which processes will be facilitated. Who will be the customers of the prototype produced in this study should be explained.

Differences between the budget calculated during design and the actual budget should be emphasized.

**8. SOURCES**

The main body of the thesis book ends with a list of references. References are written according to the rules described in the Design/Finishing Book Writing Guide. According to Nu rules;

1. First and middle names of authors are abbreviated and surnames are spelled out. Only the first letters are capitalized.
2. After the names of the authors are listed, a comma is inserted and the title of the relevant article, book or paper is written in quotation marks.

After the title, the following spelling rules are followed according to the type of the source.

1. If the source is a journal, a comma is placed after the title and the name, issue, section number, year of publication, and the numbers of the beginning and end pages of the journal in which the article and the article were published are written.
2. If the source in question is a symposium or conference, a comma is placed after the title and the name of the symposium or conference in which the article or paper was published is written. Then the year and place of organization, the year of publication and the numbers of the beginning and end pages of the article are written.
3. If the source is a book, the name of the publisher, the year of publication and the edition of the book are given.
4. If the source in question is a thesis, a comma is placed after the title and the thesis (Graduation Project, Master's thesis or Doctoral Thesis) is given. The name of the university and department where the thesis was done. The year of publication of the thesis is written.
5. If a web page is cited, the name of the web page and the working link address are given.

**Examples**

**Authored Book**

1. M. Buresch, "*Photovoltaic Energy Systems Design and Installation",* McGraw-Hill, New York, 1983.
2. I. Boldea and Syed A. Nasar, "*Linear Electric Actuators and Generators*", Cambridge University Press, 1997.

**Edited Book**

1. J. Breckling, Ed., "*The Analysis of Directional Time Series: Applications to Wind Speed and Direction"*, Lecture Notes in Statistics. Berlin, Germany: Springer, 1989, vol. 61.
2. A. A. Author1, B. B. Author2 and C. C. Author3, "Title of chapter or article", *Name of the edited book*, A. A. Editor1 and B. B. Editor2 (Eds.), Publisher, Location, Year.

**Magazine**

1. L.A. Zadeh, "Fuzzy sets", *Information and Control*, 8, 1965, pp. 338-353.
2. W.Z. Fam and M.K. Balachander, "Dynamic Performance of a DC Shunt Motor Connected to a Photovoltaic Array", *IEEE Trans. Energy Conversion, Vol. EC-3*, No.3, September 1988, pp.613-617.

If the number of authors is more than 3:

1. M. DeYong et al., "Fuzzy and adaptive control simulations for a walking machine", *IEEE Control Systems*, Volume:12, Issue:3, June 1992, pp. 43-50.
2. A. Author et al., "Title of the article", *Name of the journal*, Section Number if any, Issue Number, Publication date, Pages: 65-72.

**Symposium or Conference**

1. İ. H. Altaş, "A Fuzzy Logic Controlled Tracking System For Moving Targets", *12th IEEE International Symposium on Intelligent Control, ISIC'97,* July 16-18, 1997, Istanbul, Turkey, pp. 43-48.

**Patent**

1. R. E. Sorace, V. S. Reinhardt, and S. A. Vaughn, "High-speed digital-to-RF converter," U.S. Patent 5 668 842, Sept. 16, 1997.

**Web page**

1. International Energy Agency, "Electricity and Heat for 2011", website. [Online]. (www.iea.org/statistics/statisticssearch/report/?country=TURKEY=&product=electricityandheat&year=Select), Available as of June 22, 2014.
2. E-Legislation, "Electricity Internal Facilities Regulation", General Directorate of Legislation Development and Publication, Legislation Information System, Web [Online].

(http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=7.5.10391&sourceXmlSearch=&MevzuatIliski=0), Accessed on June 22, 2014.

**Data Sheet**

1. *FLEXChip Signal Processor (MC68175/D)*, Motorola, 1996.
2. "PDCA12-70 data sheet," Opto Speed SA, Mezzovico, Switzerland.

**Thesis**

1. A. Karnik, "Performance of TCP congestion control with rate feedback: TCP/ABR and rate adaptive TCP/IP," M. Eng. Thesis, Indian Institute of Science, Bangalore, India, Jan. 1999.

**Technical Report**

1. J. Padhye, V. Firoiu, and D. Towsley, "A stochastic model of TCP Reno congestion avoidance and control," Univ. of Massachusetts, Amherst, MA, CMPSCI Tech. Rep. 99-02, 1999.

**Standard**

1. *Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification*, IEEE Std. 802.11, 1997.

**APPENDICES**

Explanations about the work such as ethical forms, data sheets, product description, software list and theory details are given in the appendices section.

The main annexes to be included are listed below.

1. IEEE Code of Ethics (Turkish) and IEEE Code of Ethics (English)
2. Constraints Form

In this form, the realization and implementation constraints related to the study, its effects on health, environment and safety in universal and social dimensions, and its legal consequences should be listed.

1. Interdisciplinary Study

The experiences gained in interdisciplinary workshops or courses organized by the Head of the Department and which are compulsory to attend should be included and explained here. **This section is compulsory. The project of those who do not participate in the aforementioned studies will not be accepted.**

In addition, during the design/finishing studies, it should be explained how the activities carried out by others outside the department or by working together with others were carried out and how they were carried out. How much time is allocated to these out-of-department activities and the professions of the people contacted should be given.

1. Other Annexes

Attachments such as datasheets, product descriptions, software list and theory detail are listed starting with Attachment 5. As more appendices are added, the appendix numbers below need to be updated.

1. Resumes
2. Engineering Design Submission Requirements Form

After the necessary markings are made on this form, it is signed, scanned and attached. Those who cannot answer all the questions on this form as YES cannot submit the Engineering Design. If the submission conditions are met, the form is attached to the Engineering Design book. It remains where it is after the graduation project is written.

1. Graduation Project Submission Requirements Form

After the necessary markings are made on this form, it is signed and scanned and added to the Graduation Project book. Those who cannot answer all the questions on this form as YES cannot submit the Graduation Project. If the submission conditions are met, this form is added to the Graduation Project book after the Engineering Design Conditions Form. This form is not added during the Engineering Design phase.

1. TUBITAK project closure form

After the 2209/B etc. projects supported by TUBITAK are completed, the closure form signed by the advisor and students should be attached to the Graduation Project as the last attachment.