Senior Design Project Guidelines
School of Engineering
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1 Introduction

The Senior Design Project (SDP) courses (I & II) offer students the opportunity to practice their technical knowledge and skills acquired over their course of study at the American University of Ras Al Khaimah (AURAK) by conceiving, designing, and implementing a design project, and considering all aspects of engineering/computing design, non-technical as well as technical, and presenting the results in both oral and written format. Senior Design Projects can be single discipline or multidisciplinary projects that may include students from at least two different engineering programs.

The main purpose of the SDP is to integrate various aspects of the knowledge acquire in earlier course and to demonstrate academic skills and professional analysis, in addition to design and implementation skills. It gives students the opportunity to conduct in-depth work on a substantial problem to show individual creativity and originality, to apply where appropriate knowledge, skills and techniques taught throughout the degree program to further oral and written communication skills, and to practice critical thinking, problem-solving, management and other transferable skills. The management and execution of the project are the student responsibility with the guidance of the SDP supervisor.

Choosing of a project area should be based on certain technical aspects to reflect the focus of the degree, personal interests in addition to the ability of the academic staff to support students throughout the project. Projects vary widely based on the problem addressed on the project and the products or deliver at the end. While the main product of some projects is a piece of software or hardware, other projects produce a systems model or design, and yet others may address some research hypothesis using a theoretical or experimental approach. In brief, the better defined the problem that project addresses, the further through the systems lifecycle you should expect to progress in the course of project.

1.1 The Educational Objectives of the SDP courses

The educational objectives of the Senior Design Project courses are as follows:

- Plan and manage a technical project from specification to implementation.
- Formulate project problem, project specification and action plan.
- Design an advanced engineering or/and computing project, non-technical as well as technical.
• Manage project design constraints such as shifting requirements and time constraints.
• Propose design alternatives, compare them and recommend an optimum design.
• Communicate effectively the results of the completed project to technical as well as non-technical audiences.
• Perform technical writing (e.g., specifications, proposals, reports, online documents, etc.).
• Work effectively in a team.

1.2 Senior Design Project Outcomes (ABET Criteria)

**Outcome 2:** An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

**Outcome 3:** An ability to communicate effectively with a range of audiences.

**Outcome 4:** An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

**Outcome 5:** An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

**Outcome 6:** An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

**Outcome 7:** An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
2 Roles and Responsibilities

This section describes the formation of the SDP team, roles and responsibilities of the key individuals and committees that are involved in the instruction and administration of SDP courses.

2.1 Formation of SDP teams

Formation of SDP teams is subjected to the following requirements:

- SDPs should be conducted by two to four students. The size and composition of the team should properly match the nature and complexity of the project. It is strongly discouraged to have a team of more than 4 students.
- SDP teams may be formed by students from a single engineering program or students from two or more engineering programs.
- Single-discipline design group is advised by one faculty member from the relevant discipline
- Multidisciplinary design group may include students from at least two engineering programs and is advised by two faculty members each from a different engineering program.

2.2 SDP Supervisor

The SDP supervisor plays a key role in supporting students in conducting their SDPs successfully. He/she is a faculty member of the students’ program. The supervisor assists the students on developing and finalizing their SDP proposal. Students will have regular meetings with their supervisors seeking their guidance on all aspects of the SDP steps. In areas outside his/her expertise the supervisor can ask students to consult with other faculty or with external professionals. The supervisor will help students drafting and finalizing their SDP-I and SDP-II report. He/She is responsible for assessing the students’ progress during SDP-I semester and determine based on this if the student can continue to the SDP-II.

During the SDP-II semester the supervisor continues with his/her role in advising students in carrying out the SDP tasks and in preparing the SDP-II report, presentation and poster. The supervisor will evaluate the student performance in SDP-II based on the individual contribution of the student, final SDP-II, presentation and poster.
2.3 Department Chair

The department chair plays a central role in overseeing that SDPs within the department and ensuring that they are carried out according to schedule and following SDP guidelines. He/she will coordinate with the organizer of the AURAK Engineering Design and Research Day to schedule the presentations of SDPs and placement of posters. The department chair is usually assigned the role of the SDP coordinator for the SDPs conducted with the given program under his/her department.

2.4 SDP Examining Committee

The SDP Examining Committee (EC) is chaired by the SDP supervisor and includes two members: a faculty from the same SDP program and an external examiner preferably a practicing engineer with professional industrial experience. In the event that an external examiner could not be secured, the third member can be selected from another program in the School of Engineering. The SDP supervisor is responsible for forming the SDP Examining Committee and submit the names of the members of the committee to the department chair. Any reservations to the makeup of the SDP Examining Committee should be resolved first at the level of the department chair. Further disagreements can be then referred to the Program SDP Committee.

2.5 School of Engineering (SOE) SDP Committee

The SOE SDP committee is commonly formed by a representative from all the engineering programs and chaired by one of the SOE faculty. The objective of the committee is to support the role of the SDP coordinator including preparatory meeting with students, review of SDP proposals, and examine the quality of the final SDP report in addition to, liaising with the organizer of the AURAK Engineering Design and Research Day to schedule SDP presentations and posters. They will also look into any issues that may arise during the development of SDP including disputes over assessments, conflict among students, etc.

2.6 The AURAK Engineering Design and Research Day

The AURAK Engineering Design and Research Day (EDRD) is a yearly event organized by the School of Engineering at the end of the Academic Year. The event requires that students who are registered in SDP-II and ungraduated research project courses to present their projects both orally and in a poster format. Faculty, Examining Committee, students, parents and audience from the professional community will attend the event. The main objective of this event is to provide
students with a forum to display their work, hone in their professional skills, and get acknowledgment for their achievements. During Q and A session, SDP examining committees will assess students on their presentations and posters.
3 Stages and Timeline of the SDP

Senior Design Projects (SDP) at AURAK’s School of Engineering are conducted over two consecutive courses: Senior Design Project-I (SDP-I) and Senior Design Project-II (SDP-II). The process is composed of a sequence of activities that start in the semester preceding registration of SDP-I and ends with the completion of the semester of SDP-II. These activities are described in the following sections and summarized in Table 1.

The first step is to announce the collection of pre-proposals (minimum one and maximum three) from the faculty members. The maximum number of students should be five with a minimum of two to induce teamwork and enable proper task distribution. Supervisors need to submit their proposals for department approval using the project proposal form Appendix 6.1.2. The project proposals are expected to achieve the goals of SDP by:

- Proposing projects that are up to date
- Comply with ABET requirements for environmental, economic and ethical issues
- Selecting projects that are related to community and industrial needs
- Proposing multidisciplinary projects where applicable
- Proposing a clear project tasks milestone

Once all the project proposals are collected, they need to be analyzed by the concerned department to verify design component and ABET requirements for final approval. This step is needed to guarantee suitability, level of quality and ABET requirements adherence and it will give the whole department a rounded overview and awareness regarding different project conducted within the department. The timeline of these activities is described in Table 1.

The next logical step is to prepare and orient the students for Project I and Project II. Two separate workshops should be conducted in the School of Engineering to facilitate the senior design project standard and its requirements.
<table>
<thead>
<tr>
<th>Stage</th>
<th>Activities</th>
<th>Notes</th>
</tr>
</thead>
</table>
| Submission of SDP pre-proposal form 11th Week of the semester preceding the SDP-I semester | • Faculty will prepare SDP pre-proposal. The pre-proposal is a draft proposal that will be finalized in the SDP-I proposal form.  
• Faculty will submit the SDP pre-proposal to the department chair. | The SDP pre-proposal should be approved and signed by the department chair. |

**SDP-I Semester**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Activities</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration in SDP-I course (early registration or registration period)</td>
<td>• Final year students should register in SDP-I course.</td>
<td>Students should register in the SDP-I section of the selected SDP supervisor.</td>
</tr>
<tr>
<td>Developing SDP Proposal 1st Week of SDP-I semester</td>
<td>• Students will start developing SDP proposal with support from supervisor.</td>
<td>Students should seek their supervisor advice in developing the SDP proposal.</td>
</tr>
<tr>
<td>SDP-I Workshop 3rd week of the SDP-I semester</td>
<td>• Students should attend the 1st SDP workshop.</td>
<td>Items covered are shown in the sections below (section 3.5)</td>
</tr>
</tbody>
</table>
| Submission of SDP Proposal 4th Week of SDP-I semester | • Students will submit the SDP proposal to supervisor for approval.  
• Supervisors will submit a copy of the approved SDP proposals to department chair. | SDP proposal should be signed by supervisor. |
| Regular meetings with supervisor Throughout the semester | • Students should meet regularly with their supervisors | Meetings with supervisors are preferably held on a weekly basis and at minimum on a biweekly basis. |
| Submission of Draft SDP-I report 13th week of the SDP-I semester | • Students submit a draft SDP-I report to their supervisors for review and feedback. | Students are expected to continuously seek their supervisors’ feedback in preparing SDP-I report. |
| Submission of Final SDP-I report 15th week of the SDP-I semester | • Students submit the final SDP-I report to their supervisors for assessment. | The SDP-I report along with the logbook will be used by the supervisor to assess the progress in the SDP-I semester. The results from the assessment must be satisfactory before the students can proceed to the next stage of SDP-II. |
### SDP-II Semester

<table>
<thead>
<tr>
<th>Registration for SDP-II course</th>
<th>Students passed SDP-I successfully should register in SDP-II course.</th>
<th>Students should register with same supervisor of SDP-I.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(early registration or registration period)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular meetings with supervisor</td>
<td>Students should meet regularly with their supervisors</td>
<td>Meetings with supervisors are preferably held on a weekly basis and at minimum on a biweekly basis.</td>
</tr>
<tr>
<td>Throughout the semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDP-II Workshop</td>
<td>Students should attend the 2nd SDP workshop.</td>
<td>Items covered are shown in the sections below (section 3.5)</td>
</tr>
<tr>
<td>5th week of the SDP-II semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submission of Draft SDP-II report</td>
<td>Students submit a draft SDP-II report to their supervisors for review and feedback.</td>
<td>Students are expected to continuously seek their supervisors’ feedback in preparing SDP-II report.</td>
</tr>
<tr>
<td>11th week of the SDP-II semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submission of Final SDP-II report</td>
<td>Students submit the final SDP-II report to their supervisors for review and feedback.</td>
<td>The SDP will be assessed by the examining committee during presentation and poster sessions.</td>
</tr>
<tr>
<td>14th week of the SDP-II semester</td>
<td>Supervisor submit the final draft of the SDP-II report to the examination committee.</td>
<td></td>
</tr>
<tr>
<td>Final Presentation</td>
<td>Students are required to present their SDP both orally and in a poster format.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supervisors requested to coordinate with the department chair to schedule presentation sessions.</td>
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</tbody>
</table>

#### 3.1 Preparation Stage

Students are expected to explore different topics for their SDP in the semester preceding registering in SDP-I. To facilitate this process the department chair will hold a meeting with all prospective SDP students in the end of the semester preceding registration of the SDP-I. The meeting – which could be held over one or more sessions- will provide an opportunity for students to explore and discuss potential SDP topics with faculty. Prior to the meeting students are encouraged to review literature, discuss with their faculty and peers and explore different topics for SDPs. They are encouraged to be innovative and to seek out solutions for challenging problems.
3.2 Supervisors Selection
Students should approach faculty who presented the SDP pre-proposal to discuss potential SDP work. They can then decide in details their interest in certain SDP topic with the supervisor. Students are still, however, required to register the SDP courses through AURAK registration system.

3.3 Registration of SDP Courses
Students are required to register SDP courses as they do for their other courses. They should register in the section assigned to their supervisor. Students must complete 90 credit hours or more (Senior Standing) to be eligible for registering of SDP-I courses.

3.4 Maintaining Regular Meeting with Supervisor
Students are expected to consult with their supervisors on a regular basis preferably on a weekly basis or at minimum on a bi-weekly basis. Supervisors will maintain a record of these meetings by filling the logbook form, which including minutes of meeting, project planning and progress, pertinent issues, concerns, data sources, tasks for the next meeting etc. The project logbook form (Appendix 6.1.1) is an important record of the student work and progress where the supervisor and department chair will use it to assess students’ performance and their capacity to proceed to SDP-II.

3.5 SDP Workshops
The School of Engineering will hold two workshops to help students in carrying out SDP tasks. The first workshop is held in the 3rd week of the SDP-I semester, while the second workshop is held in the 5th week of the SDP-II semester.

The 1st workshop will introduce students the SDP guidelines highlighting their responsibilities, timeline of events and the rubric used in assessing their performance. It will also provide them with training on project management tools including the use of Gantt charts, milestones, task management, and on how to manage time and work as a team.

The 2nd workshop will focus on training students on preparing their SDP-II report, presentation and posters. It will cover the writing of abstract, discussion and conclusion sections of the report. It will discuss techniques for preparing and delivering oral presentations and design of highly effective posters. It will also discuss the rubrics used in assessing students’ performance.
3.6 Submission of SDP Proposal
Students shall start working on developing and finalizing their SDP proposal during the first weeks of the SDP-I semester. They should submit their final SDP proposal by the 5th week of the SDP-I semester. They should use the SDP proposal form available in Appendix 6.1.2. It is important for students to clearly describe their project and indicate how they plan to meet key ABET requirements including describing the project design components, using applicable Standards, presenting constraints that will be considered in the project. The supervisor needs to approve and sign the SDP proposal and signed copy must be sent to the department chair.

3.7 Preparation and Submission of SDP-I Report
The students should work on preparing the SDP-I report throughout the SDP-I semester. The report should follow the format and content of the SDP-I template provided by the SOE SDP committee. Students should consult their supervisor in preparing the SDP-I report. A draft of the report should be submitted to the supervisor by the 13th week of the SDP-I semester. The supervisor will provide feedback to students within a week. Students will work on editing and refining the report and submit the supervisor a final copy for review by the 15th week of the SDP-I semester. The SDP-I report along with the logbook will be used by the supervisor to assess the progress in the SDP-I semester and to plan for the SDP-II.

3.8 Registration in SDP-II
Students who have successfully complete the SDP-I are required to register in SDP-II course following the registration procedures in AURAK. Those who fail to get a satisfactory assessment are required to re-register in SDP-I.

3.9 Preparation and Submission of SDP-II Report
As in the SDP-I semester students are expected to maintain regular contact with their supervisors. Students should be working on developing the SDP-II report following the SDP-II report template. Students are expected to submit a draft of SDP-II report to their supervisors by the 12th week of the SPD-II semester for reviewing and feedback. Students will incorporate feedback from supervisors and submit to the final report by 14th week of the semester for final assessments.

3.10 Preparation of Presentation and Poster
Students will work on developing a presentation and poster to be presented in front of the examination committee, supervisor, department chair and general audiences. Students will be expected to make a 15-minute presentation to an examination committee and audience. They are
also expected to prepare a poster which will be displayed during the Engineering Design and Research Day event. Both the presentation and poster will be graded, and their grades will be part of the overall grade of the SDP course.
4 SDP Report structure

This guide is meant to help students produce high quality senior design project report that
document and presents the project work concisely and effectively. The senior design project report
should contain various materials relevant to the work undertaken in the project; it should be
organized into a logical framework; and it should be supported by written material that follows
well-established academic conventions in a consistent fashion.
The manuscript of the senior design project must have a professional and technical appearance; it
must have standardized features and be attractively reproduced. Introductory material, text, and
appendices must all be clearly and consistently prepared and must meet ABET and SOE
requirements. In this section, engineering technical report format is presented to shed light and to
provide an overview regarding the structure of the SDP reports.

4.1 Overview

In general, reports are written for many objectives, such as

- To transmit information to supervisor: to show that the writer is thoroughly acquainted
  with the material, the information, and/or the procedures; therefore, be thorough and
  complete; be concise.
- To transmit information to decision makers: experts and technicians, executives, and
  laypeople.

Before one starts writing a report, he/she should wonder and ponder on the following questions:

- Who will read the report?
- In what context will they be reading?
- What do they want to know?
- How should the report be structured?
- What questions will your readers want your communication to answer?
- What additional information do your readers need?
- What information do you need to gather through research?
- Finally, the following remarks should be in mind while writing a technical report.
- There is no universally agreed-upon format.
- You should follow the format for your course or your company.
- You must follow the guidelines and examples provided by the Project Committee to help
  you.

4.2 Report Formats

Report format is basically a plan of organization, a means of structuring material and a framework
for arranging information. Engineers use specific report format for the following reasons:
• To present report as clearly and as concisely as possible to one reader or to a variety of audiences
• To signal the type of information being presented
• To enhance the presentation

4.2.1 General Report Format Guidelines

When one writes an engineering report, he/she will want to make it easy to read and understand. Here are some guidelines to apply to any engineering report.

• **Use lists:** Whenever you can, help your reader by using lists. Give your lists visual emphasis by bullets.
• **Use headings and subheadings:** Use headings and subheadings to guide the reader through the organization of the report and list them in the table of contents. Each section should have a clear topic statement to let the reader know what will be included in the section.
• **Use clear typefaces, such as Times New Roman or Arial:** Avoid using more than one typeface in a document. Bold section headings for emphasis.
• **Use white space to enhance your information:** Dense blocks of text are difficult to read and will make it more difficult for your readers to find the information they need.

4.2.2 Other Guidelines for Writing Reports

Additional guidelines that are useful and more directed towards the structure of the report include the following:

• Write the body of the report first before writing the abstract: Most report writers prefer to save the mechanical elements, such as the title page and the table of contents, for the last step.
• Maintain consistent structure: Once one determines the structure that will be used, then he/she needs to keep using it consistently throughout the report. This will make it easier for the readers to understand the written report.
• Choose carefully the voice, mood, and tense: These depend on the rhetorical situation. Consider the expectations of the report readers and their needs.

4.3 Organization of the Report

There are many types of reports engineers are confronted with to write throughout their career. Some of these reports engineers write in academic settings, while others in industry and government environments. Writing academic report needs to be both a “narrative” (telling the story of your project) and an “argument” (providing a logical justification of the steps you have undertaken to solve certain problem). Nevertheless, all technical reports have similar organization, which maybe enlisted by the following W.H questions.

• WHAT was done (the problem being worked)?
• HOW it was done (the procedures used)?
• WHAT are the achieved results?
• WHAT conclusions can be drawn?
• WHAT recommendations can be made?

4.3.1 Structuring the Project Report

This section discusses the main parts of the SDP report in the order in which one will usually proceed. The scientific report consist of main three parts which are:

- The Abstract
- The Report Body
- Reference and Appendix

4.3.1.1 Abstract

The abstract is a brief summary of the report contents it is also a crucial part of your report as it may be the only section read by people at the executive or managerial level who must make decisions based on what they read in your abstract. The abstract should very concisely summarize the whole report: why it was written, what was discovered or developed, and what is claimed to be the significance of the effort. The abstract does not include figures or tables, and only the most significant numerical values or results should be given and should not be vague or obtuse in its content. When you include specific content, it is important to remember these readers are looking for the information they need to make decisions.

The abstract is an overview that provides the reader with the main points and results, though it is not merely a listing of what the report contains. It is a summary of the essence of a report. For this reason, it should be crafted to present the most complete and compelling information possible.

A good technical abstract should include the following.

- Why the work was done (the basic problem), the specific purpose or objective, and the scope of the work if that is relevant.
- How the work was done, the methods or means of investigation
- What was found—the major results, conclusions, and recommendations

4.3.1.2 The Report Body

The body of the report shows what was done, how it was done, what is the achievable, and what conclusions and recommendations can be drawn. All technical Engineering reports consist of main pillars or building blocks. These building blocks form the report, give it flow and make complete or coherent. The report body (one of the reports largest building blocks) consists of the following elements.

1. Introduction
A quick overview of the report body main elements is presented in the following sections. A full understanding of these ingredients is necessary and needed while writing the report.

I. Introduction

A good introduction should tell the reader what the project is about without assuming special knowledge and without introducing any specific material that might obscure the overview. It should anticipate and combine main point described in more detail in the rest of the report. It should also enthuse the reader about the project to encourage them to read the whole report. Normally it should include such things as:

- Problems that gave rise to the investigation.
- The aim (s) or the objective (s) of the project.
- The scope of the project.
- The approach used in carrying out the project.

- **Problem definition:** A problem is a statement about an area of concern, a condition to be improved upon, a difficulty to be eliminated, or a troubling question that exists in theory or in practice that points to the need for meaningful understanding and deliberate investigation. Although the problem could be an open ended, a specific objective should be stipulated. The problem definition is the responsibility of the program and/or the project supervisor. Problems could be initiated by faculty who should seek department approval before the end of the semester preceding the offering of the project.

- **Objective definition:** Project objective describes the status, which should be achieved at the end of the project. Project objectives must be measurable and contain key performance indicators that will be used to assess a project's success. These indicators will often encompass areas such as budget, quality, and time to completion.

- **Scope definition:** A project scope statement is a useful tool to outline the project’s deliverables and identify the constraints, assumptions and key success factors. The well-
written scope statement clearly defines the boundaries of a project. Before the project begins, the project team and the project supervisor need to agree to the scope statement before project execution.

II Literature review/ Background

A compulsory part of the work which is used to help students broaden their knowledge in the field of study. This section includes the theory or previous work on which the idea of the project is based on if that information has not been included in the introduction. It should explain why the project is addressing the problem described in the report, indicate an awareness of other work relevant to this problem and show clearly that the problem has not been completely solved or further improvement is require in this area. This section may describe such things as:

- The wider context of the project;
- The problem that has been identified;
- Likely stakeholders within the problem area;
- Any theory associated with the problem area;
- Any constraints on the approach to be adopted;
- Existing solutions relevant to the problem area, and why these are unsuitable or insufficient in this particular case;
- Methods and tools that your solution may be based on or use to solve the problem; and so on.

III Methods / procedures:

The methodology describes the broad philosophical underpinning to your chosen project methods, including whether you are using qualitative or quantitative methods, or a mixture of both, and why. Methodology is the systematic, theoretical analysis of the methods applied to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge. This section describes the major pieces of equipment used and recaps the essential step of what was done. In scholarly articles, a complete account of the procedures is important. However, general readers of technical reports are not interested in a detailed methodology. This is another instance in which it is necessary to think about who will be using your document and tailor it according to their experience, needs, and situation.
This section must include a detail description about the following:

- System Design and Components

- Simulation and/or Experimental Test

- Design Specifications, Standards and Constraints
  The purpose of the design specification sections is to give the reader a clear picture of the system you plan to create, in terms of the dimensions and capability required. A specification should tell the reader what the system is required to do. The design then gives the top-level details of how the system or the designed process meets the requirement. It will also identify constraints on the solution that are important in guiding decision making throughout the development process. Any project should be designed under certain constraints to ensure validity, applicability and sustainability of the proposed solution. The preferred solution should be validated by performing an economical study describing the profitability of the product following an economical calculation of capital and operational costs.

- Design Alternatives
  A project alternative is another combination of the project costs, schedules, resources, and risks that allow achieving the same results as compared to the project base-line or final deliverable. It is one or more ways to produce the project and address the business need while using the same resource base yet operating in a new project environment and facing new working conditions. The design could be optimize to meet specific standers or requirement. Optimization is finding an alternative with the most cost effective or highest achievable performance under the given constraints, by maximizing desired factors and minimizing undesired ones. In comparison, maximization means trying to attain the highest or maximum result or outcome without regard to cost or expense.

IV Results and Discussion
This section presents the data or the products of the study, test, or project and includes tables and/or graphs and a detailed interpretation of what the data show. When interpreting your data, be sure to
consider your reader, what their situation is and how the data you have collected will pertain to them. In addition, the discussion part should explain what the results show, analyzes uncertainties, notes significant trends, compares results with theory, evaluates limitations or the chance for faulty interpretation, or discusses assumptions. The discussion section is a very important section of the report which describe to what extent you achieved your goals. It is important to remember that when you are discussing the results, you must be specific and present a scientific reason. Avoid vague statements such as “the results were very promising.”

This section also gives you an opportunity to present a critical appraisal of the project as a whole. This could include, for example, whether the methodology you have chosen, steps for designing system or the programming language used were appropriate.

V Conclusions and Recommendation:
Conclusions are often confused with results. The conclusions section should be a summary of the aims of project and a restatement of its main results. An effective set of conclusions should not introduce new material. Instead it should briefly draw out, summaries, combine and reiterate the main points that have been made in the body of the project report and present opinions based on them.

Be sure to spend some time thinking carefully about your conclusions. Avoid such obvious statements as “X doesn’t work well under difficult conditions.” be sure to also consider how your conclusions will be received by your readers, and as well as by your shadow readers—those to whom the report is not addressed but will still read and be influenced by your report.

The recommendations are the direction or actions that you think must be taken or additional work that is needing to expand the knowledge obtained in your report. In this part of your report, it is essential to understand your reader. At this point you are asking the reader to think or do something about the information you have presented. In order to achieve your purposes and have your reader do what you want, consider how they will react to your recommendations and phrase your words in a way to best achieve your purposes.

4.3.1.3 References and Appendix

- References
In the section of the Literature review/ Background we said that you should relate your work to that of other people. Other work explicitly cited should be listed in the Reference section and referred to in the text using some kind of key. It is important that you give proper credit to all work that is not strictly your own, and that you do not violate copyright restrictions. When you refer to these published works in the text of your report, the following formats should be followed:

**Journal paper:**


**Book:**


**Report:**


**Conference paper:**


- **Appendix**

This section include information that is not essential to explain your findings, but that supports your analysis (especially repetitive or lengthy information), validates your conclusions or pursues a related point. An appendix is like a storage warehouse, the place to put material that needs to be included in the report but is not essential. Putting material (such as raw data, processed data, analytical procedures, details of equipment, etc.) at the end keeps the report from being buried in a mass of detail but keeps all that detail available if needed by any of your various readers. Each appendix is numbered or lettered consecutively and given a title.

**4.3.2 Mechanical Elements of Reports**

The mechanical elements of your report are largely included to make sure your information is useful and accessible for your readers. It is especially important to incorporate the HATS methodology (Headings, Access, Typography, Spacing) when designing your mechanical
elements, as that will make your documents easier to read, and it will give your documents a professional appearance. A brief overview of the report’s mechanical elements is presented in subsequent sections with some hints and brief discussions.

4.3.2.1 Preliminaries

I Title or Cover Page

The title or cover page includes the title, the name of the person authorizing the report, the name of the author(s), the name and address of the institution issuing the report, and the date.

II Letters of Approval

These letters of approval bound into the report immediately after the cover page. The letters include the supervisors’ approval sheet and Examining Committee (EC) evaluation sheets.

III Acknowledgments

The acknowledgments section includes material which is irrelevant to the actual report but is required for the record or for acknowledgment purposes. The acknowledgments may include, for example, the names of people who made technical contributions, notices of permission to use copyrighted materials, and so on.

IV Table of contents

The table of contents contains a guide to the contents of the whole report. It lists the preliminary pages such as the letter of transmittal and the acknowledgements, and it includes all headings and subheadings used in the report, exactly as they appear in the report.

The table of contents also includes the page numbers for all parts. Use lower case roman numerals (i, ii, iii, etc.) for all preliminary pages and Arabic numerals (1, 2, 3, etc.) for all pages in the body of the report, starting with page 1 for the introduction of the body.

V Lists of tables and figures

In some situations, especially if the report contains only a few figures and tables, all of the figures and tables, with their complete titles, are listed in the table of contents. In that format, tables and figures are listed separately even though they are mixed together in the report.

In most situations, tables and figures are listed on separate pages, with the figures and their complete titles listed on one page and the tables and their complete titles listed on a separate page. If you follow this format, list the headings for each page in the table of contents.
4.3.2.2 Graphics

Graphics are all the tables and figures used in a report as visual aids for the reader. They are useful, important parts of a report and must be accurate. They should also be clear so the reader can interpret them easily. Tables are all lists of data presented in rows and columns. Place the numbers and titles above the tables. While for the figures or any other visual presentations the numbers and titles should be placed below.

When tables or figures are discussed in the text, cite their numbers and the pages on which they appear. Either number them consecutively through the report or number them according to the section in which they appear (2.1, 2.2, 2.3, etc.). Put all units in the tables, and don’t make the tables too long. If necessary, break them up into several short tabulations. This will help your tables be more visually appealing and will encourage your readers to look at them.

Popular Engineering types of illustrations found in technical reports include the following.

- Line graphs—for representing continuous processes
- Bar graphs—for representing absolutes
- Pie graphs—for showing percentages
- Flow charts—for illustrating stages in a process
- Schematics—the same as flow charts, but usually used for illustrating more abstract concepts

4.3.2.3 Mathematical Equations

All the mathematical equations, correlations, expressions…etc. must be typed neatly in a scientific equation editor such as latex or MS Word equation editor. Below are some hints and tips that are useful in using the MS Word equation editor.

Example: Written mathematical expressions such as “F=m*a” is not acceptable and must be written in the equation editor and it must be given an equation number and the variables must be defined.

\[ F = m \cdot a \]  

Where \( F \) is the exciting force (N), \( m \) is the objects point concentrated mass (Kg) and \( a \) is the objects induced acceleration (m/s\(^2\))
4.3.3 Report Typography

The manuscript of the senior design project should be prepared to meet ABET and departmental requirements and must have a professional and technical appearance; it must have standardized features and should be attractively reproduced. Introductory material, text, and appendices must all be clearly and consistently prepared and must meet the following subsequent sections specifications.

All the requirements stated in this guideline and report template must be met and adhered to the stated specifications and requirements. Consequently, the coordinator will withdraw the violated project from the presentations and file an incomplete grade for the project team members.

I. **Typeface:** Type size should be 12-point. Do not use script, or ornamental fonts, use Times New Roman. Print must be letter quality or near letter quality with dark black characters that are consistently clear, crisp, and easily read. Accent marks and other hand annotations must be done neatly in black ink.

II. **Margins:** Left, Right, Upper, and Lower Margins: 1 inch each (setting: Normal)

III. **Spacing:** One and a half spacing is required in the main body of the manuscript except where conventional usage calls for single spacing; e.g., footnotes, indented quotations, tables, etc.

IV. **Size:** All copies must be on white, A4 or letter-size paper. Note that double-sided copies may be submitted.

V. **Pagination:** Each page of the manuscript, including all blank pages, and pages with photographs, table, figures, maps, and computer program printouts should be assigned a number. Consistent placement of pagination, at least one inch from the paper’s edge, should be used throughout the manuscript. The following pagination plan may be used:

- For the preliminary pages, use small Roman numerals (i, ii, iii, iv, etc.). The title page does not have a number but counts as page i; the following page is ii and so on.
- For the remainder of the manuscript use continuous pagination for text, illustrations, appendices, and bibliography- use Arabic numbers (1, 2, 3, etc.).
- Figures, tables and other illustrations should be titled as well as numbered (example- Figure 1 “The title of the figure.”).
VI. **Large Photographs, Maps, and Charts:** Large maps and charts should be avoided. Where necessary, they must be folded to A4 paper size; they should be in pockets in the bound reports.

VII. **Reproducing the Report:** Final copies of the report must be submitted in clear and attractive format. Review each copy for evenness and clarity of type, missing pages and misaligned text…etc.

VIII. **Front Page:** check the Senior Design Project Template.

IX. **Final Report copies:** Four hard cover bounded copies (one for the supervisor, one for the department, one for the School, and one for the Library) with original signed supervisor forms should be submitted to the department chair. One soft copy of the project should also be submitted. This should be inserted in an envelope attached to the back cover of the department copy.
5 Assessment of Senior Design Projects

5.1 Assessment tools and distribution of grades

Student performance in SDP courses is assessed via several tools as shown in Figure 1. The SDP supervisor takes lead in assessing students’ performance early during the SDP I and SDP II stage by evaluating their SDP report, logbooks and assess their individual efforts and teamwork through regular meetings. The supervisor grades are based on the Supervisor’s direct interaction with the students; hence his inside information judgment is vital. At the end of Senior Design Project II, Supervisors should fill out Senior Design Project II Supervisor Evaluation Form (Appendix 6.1.4).

The next grade portion belongs to the coordinator. The coordinator grade is to be used to manage the students and to direct them to accomplish needed items that are necessary for the Project’s Process Flow. Hence, the 5% grade is to be used to award the students on items on their report in Senior Design Project II, which are related to task distribution, Gantt chart, Milestones, and Logbook. The grade is based on the poster structure and content. 10% of the grade is assigned to Senior Design Project Audience who attend SDP II presentations. For this purpose, 2 forms were prepared; poster evaluation form and presentation evaluation form.

The engineering technical content and students’ comprehension of the project should be verified by the Examining Committee. The Examining Committee (EC) members should read the projects’ manuscript before attending the students’ presentations; also, each member should fill out the EC Evaluation form. An EC member evaluator should scrutinize and verify the submitted report for technical sound and get familiar with the project’s deliverables. Also, the EC members should leave their comments, concerns, and corrections on the project manuscript using either RED or GREEN ink pens. The coordinator should after presentations pass the required changes for the students for corrections in the final manuscript report, which is submitted to the coordinator for ABET record keeping. In case of student’s failure to do the changes, their grade will not be released unless the changes are performed.

In the presentations, the EC members should evaluate the students’ soft skills, comprehension, inspect hardware/software if applies and deliverables of the project’s outcomes. The EC committee is also asked to evaluate the posters which will be collected.
5.2 Assessment Rubrics

Using rubrics in assessment is a proven method to reduce subjectivity and enhance transparency of the assessment process. It also makes it clear to students how their performance will be evaluated. This would provide them with clear targets that they can work towards achieving. Developing rubrics is a challenging process as it requires clear definition of the different levels of performance articulated in measurable terms. The AURAK Engineering School has decided to adopt the rubrics approach for all its SDP assessment tools. The assessment rubrics for the SDP are shown in Appendix 6.2.
Appendix A
Forms
A.1. Project LogBook Form

Project LogBook Form

Directions: The project’s LogBook is used to track down all the weekly meetings between the supervisor and members of the team. The meetings minutes must be documented, so please fill out all the required fields by hand and have it signed by the supervisor then return to Senior Design Project Coordinator within one week.

Project’s Meeting Minutes

Project Title: ____________________________  Supervisor: ____________________________

Student Attendees  Student ID

1. ____________________________  __________________
2. ____________________________  __________________
3. ____________________________  __________________
4. ____________________________  __________________

Meeting No:____  Date:______________  Start Time:_________
Finish:____________

Items discussed in meeting (list briefly)

1. ____________________________________________
2. ____________________________________________
3. ____________________________________________
4. ____________________________________________

Achievements from last time

a. ____________________________________________
b. ____________________________________________

Obstacles or Problems encountered

a. ____________________________________________
b. ____________________________________________

For Supervisor Usage ONLY

- Did the Team maintain progress according to Gantt chart and Milestones?  Yes ☐  No ☐
- Supervisor’s estimation of percentage of progress relative to Gantt chart:  ____%

Supervisor’s Remarks (you may list tasks for next meeting)

___________________________________________________________________________________
___________________________________________________________________________________
___________________________________________________________________________________

___________________________________________________________________________________
___________________________________________________________________________________

___________________________________________________________________________________

___________________________________________________________________________________
A.2. SDP Proposal Form

Project Proposal Form

Spring 2017

Directions: The supervisor needs to provide a brief summary of his proposed project. Please fill out the Abstract. Then print out this form and return to the coordinator. Please do not alter or modify this template form. Thanks.

Project Description

Project Title:  

Supervisor:  

Department Approval □
A.3. Project Handover Form

Project Handover Form

Directions: The projects handover form maybe used to transfer students to another supervisor. Please fill out all the required fields.

Project Related Information (Must be filled out by Advisor)

<table>
<thead>
<tr>
<th>Project Title:</th>
<th>Supervisor:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Student Name</th>
<th>Student ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td></td>
</tr>
</tbody>
</table>

Please answer all the following questions

- Did supervisor fill out grading form G-01? [Yes] [No]
- Did students submit their short progress report, please attach? [Yes] [No]
- Is the project sponsored or funded? [Yes] [No]
  Who is the sponsor? ________________________________
  How much? ________________________________________
- Recommended takeover supervisor: __________________________

Please provide short summary of project progress and achievements (may use additional pages if needed)

___________________________________________________________________________________
___________________________________________________________________________________

For Project Committee Usage (Do not write below this line)

- Does recommended supervisor’s specialty match the project topic? [Yes] [No]

PC Comments

___________________________________________________________________________________
___________________________________________________________________________________

Department Approval □