



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
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Faculty of Engineering, Built Environment and Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en Inligtingtegnologie

School of Engineering

Department of Mechanical and Aeronautical Engineering

MRN 412/MRN 422 Research Project

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Table of Contents

1	Introduction	1
1.1	Departmental study guide.....	1
1.2	Study goal.....	1
1.3	Scope	1
2	General.....	2
2.1	Module Organizer.....	2
2.2	Topics	2
2.3	Topic Allocation and supervisor meetings	2
2.4	Research Project.....	3
2.4.1	Research Project Proposal (RPP).....	3
2.4.2	RPP Compliance Matrix.....	3
2.4.3	Deadline Dates and Times for Handing In.....	4
2.4.4	Progress Meetings	4
2.5	Role of Supervisors.....	5
2.6	Finances.....	5
2.7	Damage to Equipment, Theft	5
2.8	Cleaning and Dismantling.....	6
2.9	Workshop	6
2.10	Indemnity	7
2.11	Safety and the Environment.....	7
2.12	Other General Research Project Rules	7
3	Research Project Examination	8
3.1	Examination for MRN 412	8
3.2	Examination for MRN 422	8
3.2.1	External Evaluation	9
3.2.2	Poster requirement.....	9
3.3	Supplementary Examination	9
4	Contents of Research Project Proposal and Reports	9
4.1	Research Project Proposal.....	9
4.2	Progress Reports	10
4.2.1	General.....	10
4.2.2	Gantt Chart	12
4.3	Final Reports.....	12
4.3.1	Submission of Final Report for MRN412	12
4.3.2	Content of the Final Report for MRN412	12
4.3.3	Submission of Final Report for MRN422.....	13
4.3.4	Structure of Final Report for MRN422	13
4.3.5	Content and formatting of the final report for MRN422	14
4.3.6	Editorial Considerations	16

1 Introduction

1.1 Departmental study guide

This study guide is a crucial part of the general study guide of the Department. In the study guide of the Department, information is given on the mission and vision of the department, general administration and regulations (professionalism and integrity, course related information and formal communication, workshop use and safety, grievances, support services, plagiarism, class representative duties, sick test and sick exam guidelines, vacation work, appeal process and adjustment of marks, university regulations, frequently asked questions), ECSA Graduate Attributes, ECSA knowledge areas, CDIO, new curriculum and assessment of cognitive levels. It is expected that you are very familiar with the content of the Departmental Study Guide. It is available in English and Afrikaans on the Department's website at

English: https://www.up.ac.za/media/shared/120/Noticeboard/2020/departmental-studyguide-eng-2020_version21jan2020-002.zp185016.pdf

Afrikaans: https://www.up.ac.za/media/shared/120/Noticeboard/2020/departementele-studiegids-af-2020_weergawe21-jan2020-002.zp185015.pdf

1.2 Study goal

After completing this module, the student should be able to complete an engineering Research Project as typically experienced in practice. This will require that the student:

- Executes an investigation within a pre-defined budget and time limit;
- Applies the knowledge the student has acquired thus far in order to solve the problem that is presented to the student;
- Acquires, by the student's own effort and initiative, new theoretical or empirical knowledge required to master the task;
- Communicates the outcome of the Research Project to engineering audiences and to the community in general.

1.3 Scope

During the year, approximately 400 hours (MRN 412 and 422 together) is set aside for the Research Project modules. This is the equivalent of more than 50 full working days. The effort and scope of the work done must reflect this amount of time. It should also be noted that both modules must be done in the same year and on the same topic.

The following is expected from students:

- To execute an engineering Research Project, consisting of **both** theoretical and experimental investigations.
- To plan the Research Project properly keeping in mind the financial constraints, available equipment and software, and the available time and target dates.
- To compile and submit progress reports, and to hand in a final report for MRN 412 at the end of the first semester, thereby reporting progress as typically done in industry. The progress in the first semester must be of such a standard that the candidate can pass the module MRN 412 to be able to progress with the second semester module MRN 422.
- To produce a properly written final report for MRN422 on the Research Project.
- To present and defend your research during an oral examination on the project.

It must be emphasised that a pure theoretical investigation, and/or the writing of a computer program alone, does not fulfill the requirements of the module. However, if the investigation

requires a fair amount of computer study and/or simulation and certain aspects are verified experimentally, it is acceptable.

The various Engineering Council of South Africa (ECSA) Graduate Attributes addressed in this module are discussed in detail in the Departmental study guide, however a brief summary of the relevant applicable Graduate attributes is provided in Appendix A.

2 General

2.1 Module Organizer

The module is organised and administrated by:

Prof. S Kok

Office : Engineering I, room 9-21

Tel. Office : (012) 420-5809

E-Mail : schalk.kok@up.ac.za

All the lecturers in the department are involved as supervisors of the Research Projects and each has a fixed quota of students allocated to him/her. In case of problems that cannot be solved with the student's own supervisor the Module Organizer must be consulted.

2.2 Topics

A list of topics, including short project descriptions, is collected from all supervisors. This list is divided into the following four Research Groups:

- Clean energy research group (CERG),
- Centre for Asset Integrity Management (C-AIM),
- Vehicle Dynamics Group (VDG) and
- Aeronautical Research Group.

The respective Heads of the Research Groups reviews the list before it is posted on the web page together with the Study Guide at the end of the academic year. Students must examine the list, do a selection of at least 20 research projects and then rank the topics on the Project Assignment Website. **If a student failed MRN the previous year, he/she may not select a topic from the same supervisor.** If students require more information on a particular topic they are welcome to discuss it with the particular supervisor that proposed the topic before the ranking is done.

2.3 Topic Allocation and supervisor meetings

Only finalists are eligible to register for MRN412/422. Therefore, all potential finalists are invited via e-mail at the end of the third academic year to rank the student's top 20 preferred topics. This will be taken into account when the students are allocated to the various supervisors. Although the Department will try to accommodate the preferred choice of the student, it is not always possible.

Students are allocated to supervisors on the basis of:

- The individual workload of supervisors.
- The student's list of preferred topics.
- Requests from bursary providers.
- Allocation by module lecturer or Head of Department.

A list of the research projects allocated to each student is made available towards the end of the third academic year. **Once the list is placed on ClickUp the allocations are final.** The supervisor still reserves the right to negotiate a different project for a student, should special circumstances arise. Some students (typically those that failed Research Project the previous year) are only allocated topics at the start of the current academic year. Please note that there are some external

supervisors not employed by the University that offer their time and service to the University. In the case of external supervisors, the students must make sure that they contact the respective external supervisors to make the initial appointments.

During the course of the year the student must interact on a regular basis (preferably weekly) with the supervisor to discuss progress on the Research Project and to inform the supervisor of difficulties encountered and possible slippages on the schedule or to suggest modifications to the Research Project Proposal (RPP) (discussed in Section 4.1). Both the student and the supervisor must agree on changes to the RPP and any such changes and other resolutions must be summarized in a Project Journal. This summary must be signed off at each interaction between the student and the supervisor. After each meeting your Meeting Log Card should be signed by both the student and supervisor. The agreed changes must then be inserted in a revised RPP and its revision number incremented. An example of the Meeting Log Card is shown in Appendix B. Students must also have the Meeting Log Card signed by the relevant facility supervisor each time they use the departmental laboratory or the facilities of a bursary donor.

2.4 Research Project

2.4.1 Research Project Proposal (RPP)

Students must arrange two meetings with the supervisor to which they were allocated. The latest dates of these meetings are shown in paragraph 2.4.3. However, since the allocations are now already finalized in the last month of the preceding academic year, these meetings can take place much sooner. This provides the opportunity to students to start their literature surveys during the end-of-year recess.

During the first appointment the supervisor must explain the topic to the student. For the next appointment the student must write an RPP that describes how the student interprets the Research Project and which also includes the complete Research Project execution plan. The contents and importance of the RPP are discussed in paragraph 4.1.

During the second appointment the RPP must be presented to the supervisor for approval. It is important that during this meeting, the student determines what the minimum requirements of the supervisor are. Students can also present their own ideas about the execution of the Research Project in the RPP and negotiate these with the supervisor. The RPP should be seen as a document in which the student and the supervisor enter into a contract about the contents, scope and scheduling of the work to be done. If necessary, the RPP must be revised until both parties are satisfied that it reflects the requirements of the Research Project correctly. The agreed version of the RPP must be signed off by both student and supervisor and indicated as **revision 0**. If later-on changes to the RPP are agreed between the student and supervisor, the RPP must be modified and the revision number incremented.

2.4.2 RPP Compliance Matrix

The RPP shall also show a commitment by the student to fulfill the ECSA Graduate Attributes. The RPP shall explicitly communicate how the student aims to achieve the objectives AND ECSA Graduate attributes (GA); especially GA 4. The ECSA Graduate Attributes are listed in Appendix A.

The External Examiner has not been involved in the project from the start and it is therefore necessary to provide assurance to the external examiner that the final report conforms to the various clauses in the RPP. This assurance must be provided in a compliance matrix included at the start of the report, immediately after the Executive Summary. This section will be titled: **“Research Project Proposal Compliance Matrix”** (See Appendix C for an example).

2.4.3 Deadline Dates and Times for Handing In

The deadline dates and times to follow are hard cut-off times and no responsible student should do planning according to this schedule. Allowance should be made for all possible delays in the production and delivery of the reports to the end-point by planning for hand-in a few days ahead of these dates.

All work must be handed in as communicated during the semester.

2.4.3.1 First semester MRN 412/Second semester MRN 422 for students completing the Research Project in 1 year

Publication of allocation list	21-11-2019
Introductory lecture	04-02-2020
Arrange 2 appointments with Supervisor, 2 nd appointment should be before	14-02-2020
Handing in of RPP	21-02-2020
Compulsory progress report MRN 412 (minimum 10 pages)	06-04-2020
Final report MRN 412 (maximum 30 pages)	20-05-2020
Supervisors to submit MRN 412 grades to course administrator	17-06-2020
Submission date for handing in the rectified report for students that received a supplementary exam for MRN 412.	13-07-2020
Compulsory progress report MRN 422 (minimum 20 pages)	07-09-2020
Final report MRN 422 (maximum 50 pages)	28-10-2020
Presentation and oral examination	Not available yet

2.4.3.2 First semester MRN 412 and MRN 422 for students completing the Research Project in 6 months

Publication of allocation list	21-11-2019
Introductory lecture	04-02-2020
Arrange 2 appointments with Supervisor, 2 nd appointment should be before	14-02-2020
Handing in of RPP	17-02-2020
Compulsory progress report MRN 412 (minimum 10 pages)	02-03-2020
Final report MRN 412 (maximum 30 pages)	20-03-2020
Supervisors to submit MRN 412 grades to course administrator	01-04-2020
Compulsory progress report MRN 422 (minimum 20 pages)	28-04-2020
Final report MRN 422 (maximum 50 pages)	25-05-2020
Presentation and oral examination	Not available yet

2.4.4 Progress Meetings

Students must meet supervisors **at least** ten times evenly spread across the semester. It is recommended that a set of monthly or bi-weekly fixed appointments initially be made with the supervisor. Ad hoc additional appointments can then be made when required.

In order to aid proper management of the **Research Project** the student must have a dedicated **Project Journal** where interim progress on the project is summarized and where problems are listed for discussion with the supervisor. The outcome of each meeting is then written-up as minutes in the journal, signed off and dated by both the supervisor and the student. The Project Journal does not replace the Meeting Log Card but serves to provide the detail behind the entries on the Meeting Log Card. The RPP (see paragraph 2.4.1) should be updated according to decisions made. This update is noted in the Project Journal and the RPP should therefore be in total compliance with the Project Journal. The Project Journal must be in the form of an A4 permanently bound manuscript book.

2.5 Role of Supervisors

Supervisors participate in an advisory capacity. Except for initially proposing the topic, supervisors must not be expected to take the initiative with any part of the Research Project. Supervisors are also not responsible for the project management. ***The input from supervisors is limited to aiding in the solution of encountered problems and making critical comments on statements and concepts that the student submits on own initiative.***

The tasks of the supervisors participating in the Research Projects are:

1. To ensure that each student undertakes a meaningful project, which can be completed in the allotted time, within the financial constraints and with the available equipment and software.
2. To ensure that the student initially understands the subject and scope of the project; and that this is correctly reflected in the RPP.
3. To provide advice on request.
4. To make suggestions on the progress of the Research Project.
5. To assist the student with the planning of the documentation. To provide critical (high level but not detailed) commentary on draft reports.
6. To judge the progress, enthusiasm and quality of the student's efforts.

2.6 Finances

Each supervisor participating in the Research Projects receives a budget of R500 per allocated student. Some projects are fully funded with external funding and this information has been made known when the projects were made available for selection. If no information was given then the budget is R500. Supervisors can divide this budget as they see fit amongst the projects they lead. Supervisors who prefer to work together in groups can pool their individual allocations. However, the money may only be used directly for the purposes of the Research Projects.

Every student must initially draw up a budget for his/her project as part of the RPP. Students may not procure any items against this budget without the written approval of the supervisor. All expenses must be motivated and accounted for and all invoices and other documentation must be kept in order to provide an audit trail. Expenses made by the student can only be claimed back from the University if original tax invoices are provided. Students are also expected to keep an up to date record of expenses. The laboratory staff will sign all withdrawals from campus stores. The University does not pay for the traveling expenses of students.

If a student overspends on his initially approved budget, without written permission by the supervisor, the student will be liable for the amount exceeding the budget. Students are also liable for all expenses not approved by the supervisor, and all expenses where the required documentary proof cannot be supplied. The University will bill students for these liabilities in the usual manner.

2.7 Damage to Equipment, Theft

The University accepts that normal wear and tear of equipment and buildings will occur. Students will be held liable for the following:

1. Deliberate damage to equipment and buildings.
2. Damage caused by negligence of the student or if the student fails to follow the instructions of the supervisor or instructors.
3. Damage caused while the student was using equipment without the required prior consent.
4. Damage caused when a student uses equipment that should only be used under supervision without supervision.
5. Loss, due to theft, of equipment in use by the student where the student failed to take reasonable precautions.

6. Assets, including laptop computers and measuring equipment, removed from campus without the required removal permits.

2.8 Cleaning and Dismantling

The laboratory instructor allocates each student space in a specific laboratory for practical work. No additional space may be occupied without the approval of the instructor. Each student is responsible for regular cleaning of their allocated space. **After completion of the module students are responsible for dismantling the equipment and cleaning of the laboratory space where they were working.** If students fail to clean up, they will be personally liable for the cost of cleaning up.

Each student has to submit the form included in Appendix D. This form states whether or not the equipment must be dismantled. The supervisor signs this form and indicates if dismantling is required. If dismantling is required, the supervisor will fill in the name of the laboratory instructor/technician that will monitor if this dismantling occurred or not. Once all equipment is dismantled, the laboratory technician will sign the form. There are two opportunities to submit this dismantling form. The first opportunity is to submit the form with the final report. The second opportunity is to submit the dismantling form during the oral examination. Students who are awarded a supplementary exam to obtain additional experimental data have to submit an additional dismantling form when they submit their corrected report.

2.9 Workshop

Most Research Projects will require some manufacturing of test setups or specimens. There are two possibilities for using the workshop namely the “self-service” route and the “manufacturing” route.

The self-service route allows students to do their own manufacturing. The procedure for using this route is as follows:

- I. Schedule a training appointment with one of the workshop instructors. The training session will take about two hours and will be focused on safe use of the workshop and the relevant equipment including lathes and milling machines. After completion of the training session you will write a test to make sure that you understand and remember the safety rules.
- II. Once you successfully completed the training, you will be issued with a workshop access card signed by the instructor. No work will be allowed in the workshop without this card.
- III. All machines and tool cupboards are locked. When you want to work on a machine, the instructor will exchange the keys to the machine and tools for your workshop access card. The instructor will complete a tool and machine check with you after which you can use the equipment.
- IV. Use the machine in accordance with the rules, keeping your own safety, as well as those around you, in mind at all times. Please ask for assistance as and when required. The instructors are there to help you produce quality results in a safe and efficient way.
- V. Upon completion of your work, put back all tools in the appropriate places and clean your work area.
- VI. The instructor will repeat the tool and machine check with you and exchange your workshop access card for the keys of the machine.
- VII. Please leave the equipment and tools in the state you would like to find it the next time.

The manufacturing route allows the student to have parts manufactured by the instructors. The procedure for using this route is as follows:

- I. Prepare high quality manufacturing drawings according to proper engineering standards. These drawings should include all dimensions, tolerances, material specifications and any additional information that will enable the instructors to manufacture the components to specification without any additional correspondence. Please discuss your design and drawings with the instructors to make sure that it can be done.

- II. Obtain your supervisor's signature on all your drawings. No parts will be manufactured without the approval of your supervisor.
- III. Procure the necessary materials.
- IV. Hand in your drawings, contact details and material at the workshop. Manufacturing will be performed on a first-come-first-serve basis. The instructors will give you an estimated time for completion of your work.

Both these routes require proper planning and time allowance from your side since both the equipment and staff are limited. Unforeseen circumstances such as power cuts, equipment failures and strikes may seriously affect schedules.

ANY STUDENT THAT IS NOT WORKING ACCORDING TO THE RULES AS LAID OUT IN THE DEPARTMENTAL STUDY GUIDE WILL BE BARRED FROM WORKING IN THE WORKSHOP. THE WORKSHOPS ARE OPERATED IN COMPLIANCE WITH THE OPERATIONAL HEALTH AND SAFETY ACT (OHS Act).

2.10 Indemnity

The University accepts no responsibility for any injury, damage or loss of property during the use of machine tools or other equipment in the workshops, or in any University laboratory, or any other location on the University grounds.

2.11 Safety and the Environment

The action of an engineering student doing experiments may have an influence on personal safety, safety of fellow students and may also affect the environment. Care must therefore be taken to ensure safe operation with no uncontrolled releases of harmful substances into the environment.

2.12 Other General Research Project Rules

All Research Project activities must be undertaken in collaboration with the supervisor or instructors. Please note the following:

- It is the duty of the student to search for literature and equipment for the project. The supervisor will only assist by giving advice and guidance. Please note that, in this module, attention will specifically be paid to the ability of the student to work independently.
- Students must make their own arrangements for purchasing, building and manufacturing of the necessary equipment and measuring systems for the execution of the experiment. An administrative system for procurement of material and equipment is in force at the University. Always adhere to the stipulations of this system. The supervisor must approve all purchases.
- Students are **only allowed to work in the laboratories if supervision is available from the laboratory instructors/staff. Students are not normally allowed into the workshops after hours.** If the student wants to work in the laboratories, arrangements for such work must be made with the relevant technical assistants. If, at any stage approval is granted for a student to work in the laboratories after normal working hours, it will only be on the condition that they must be accompanied by a competent person that can assist in the case of an accident and/or emergency and who can also immediately phone Security Services at (012) 420 2310. **This safety measure may NOT be violated for any reason.**
- Under no circumstance may other laboratory exhibits or apparatus be taken apart to obtain parts or instrumentation. Disciplinary action will be instituted against students who commit this offence.
- It is the duty of the student to dismantle their equipment after the conclusion of the project and final examination. Re-usable material must be stored and scrap material must be

disposed of. This must be done in collaboration with the supervisor. See Appendix D for the dismantling form.

- All safety regulations must be adhered to at all times and the necessary protective equipment must be used when working in the laboratories or workshops.
- Students are seriously cautioned against dishonesty and plagiarism. See the University of Pretoria policy on plagiarism.

3 Research Project Examination

3.1 Examination for MRN 412

At the end of the first semester, the supervisor will evaluate the MRN 412 final report. **A final mark of 50% is required to pass MRN 412 and a sub minimum of 50% for both Graduate Attributes 6 and 9 must be achieved (refer to Appendix E).** External examiners are appointed for MRN412, but only 15 graded reports are selected randomly and checked for fairness and consistency by the externals.

If the final mark is i) between 40% and 49%, or ii) 50% and above but one of the outcomes is failed, the student qualifies for a supplementary exam. The supervisor will provide the student with a list of required corrections/improvements, and the updated report must be submitted at the start of the second semester. The corrected/improved sections of the updated report are assessed using the same criteria as the original report: superficial effort to address each of the required corrections will result in a fail.

If the MRN 412 mark is less than 40%, the student does not pass MRN 412 and may therefore not proceed to MRN 422. Students that pass MRN 412 with a mark greater than 50% have to retrieve their graded reports at the start of the second semester. It is expected that the errors in the MRN412 report that were pointed out by the study leader are corrected in the compulsory progress report for MRN422.

It must be noted that students will have to provide proof at this stage that they can do independent learning and that they can communicate effectively in writing on the progress made with the research project up to this stage. The report produced must be in the same format as the final report although it will obviously contain less material. It will however be required that certain parts of the final report be included almost in their final form. This report must show that the student understands the work to be carried out, and is capable of synthesizing a feasible research project using the applicable information derived from the literature study.

The evaluation sheet that is used for MRN412 is attached as Appendix E. This evaluation sheet should be used as a guide to plan the various outcomes to be reached during the first semester and to judge the amount of effort to be expended on each.

3.2 Examination for MRN 422

The first requirement for examination is to submit a written report, as described in Section 4.3.2. An oral examination, in the presence of an external examiner, will take place and the work of the candidate will be evaluated according to the evaluation sheet shown in Appendix F. The final report must contain both the information from the MRN 412 module as well as the results of the additional investigations, numerical simulations, experiments and data analyses performed in the MRN 422 module. The work must also be summarized on a poster (designed for A1 size but printed on A3 paper) that demonstrates that the candidate can communicate effectively using this format.

3.2.1 External Evaluation

It must be emphasized that the external examiners will be judging a full year's hard work of the student with only the paper copy of the report at their disposal. The report is a reflection of the work done over the entire duration of the Research Project and it is possible that high-quality technical work will end up with a poor mark (even a supplementary examination or a fail), because it was not documented in a high-quality report. The judgment of the external examiner is very important in this regard. The person who reads the report usually knows less of the specific topic than the writer. Therefore, the writer of the report must lead the reader by clearly explaining how and where their work fits into the particular field of engineering science.

The RPP and the RPP Compliance Matrix are included in the report to aid any person reading the report by showing in an abbreviated form what the contract was and how the work that was done complied with the requirements of the contract.

During the oral examination the examiners will give feedback to the student on the quality and contents of the final report.

3.2.2 Poster requirement

During the oral examination, the students should also present a poster that summarizes the entire project. All posters must be prepared in A1 size and in a portrait orientation but printed on A3 paper and folded in half. The examiners will attach the poster to the completed grade sheet. The evaluation sheet in Appendix F contains sections that specifically apply to the poster.

3.3 Supplementary Examination

If the examination results indicate that a supplementary examination is required, the examiners will inform the student in writing what the required corrections/improvements are (see Appendix G). In some cases, too much time will be needed to document the corrections and then it might be sent by e-mail. The date on which the consultation with the supervisor can commence and deadline date when the report for the supplementary examination must be submitted to the internal and external examiners will also be indicated on this form. A single bound copy of the improved report must be hand-delivered to the internal examiner, and both examiners must be e-mailed electronic versions, in PDF format, of the original report, the suggested corrections, as well as the improved report. The corrected sections of the report are assessed using the same criteria as the original report: superficial effort to address each of the corrections will result in a fail. It is the responsibility of the student to arrange access to laboratories, in cases where additional experimental work is required. This might prove challenging since most laboratories close from late December till early January.

4 Contents of Research Project Proposal and Reports

4.1 Research Project Proposal

The RPP states the understanding by the student of the problem underlying the topic of the Research Project and presents the proposed method of solution. It also presents the project plan. The RPP must contain the following:

- A statement that gives a clear description of the problem that is to be investigated. The problem statement may not contain vague and uncertain statements—it must be specific. If necessary it can be revised later. Rather say: "The following two aspects of . . . will be investigated: . . . in the following three ways . . ." instead of "The project consists of an investigation into . . ."

- Background is required to explain the problem and to put it into perspective. Ensure that an uninformed person will be able to understand that the Research Project is sensible and not trivial.
- The goal and importance of the problem must be stated in a few sentences. What goal is to be achieved? Why is it relevant? Who will benefit?
- The scope must be stated clearly. In a limited number of hours only some of the aspects can be investigated in depth. What aspects are specifically included and what excluded? Students must ensure that agreement is reached between them and their supervisors on the scope of the study.
- The plan of the study gives the division of labour, a schedule of tasks to be completed and the budget. A convenient way to plan the project is in the form of the Gantt chart (see Section 4.2.2). The plan may be modified to take into account changes in circumstances and new information that may become available. **Remember, the deadlines are fixed. The only way to finish on time is to plan carefully taking into consideration the availability of resources.**
 - Each project is unique and requires different planning. The typical progress at the end of MRN 412 could range across the following examples:
 - Experimental investigations: Students must plan to finish most of the background study and theoretical investigation at the end of the first semester. In the second semester there is only enough time to complete the practical part of the Research Project and to write the final report.
 - Numerical investigations: Students must plan to finish most of the background study and experimental measurements by the end of the first semester. In the second semester there is only enough time to do the numerical investigations and to write the final report.

A number of software packages do exist that can aid in the planning and management of a project. Additional training in the use of specialist software as well as special equipment in the laboratories will be provided. Dates will be posted.

Supervisors will evaluate the final version of the RPP and pay specific attention to:

- The completeness,
- The intelligibility and accuracy of information and planning,
- The correct use of language,
- The diligence and independence of the student.

4.2 Progress Reports

4.2.1 General

The purpose of the progress reports is to monitor that the student is making good progress. One compulsory progress report is required for each of MRN412 and MRN422. If you do not submit a progress report of sufficient length, your study leader may recommend to the course coordinator that you fail the module. The progress report consists of:

Part I

- Page 1: An executive summary page, with the first 3 lines containing the project title, student name and supervisor name respectively. The rest of this page contains an Executive Summary, which focuses on the technical progress to date.

- Page 2: An RPP Compliance Matrix which indicates which of the RPP objectives have been achieved already
- Page 3: A project plan in the form of a Gantt chart (see Section 4.2.2). The Gantt chart must include the planned and actual timelines, such that lead and lag times are easily visible.
- Page 4: Reflect on the difference between the originally planned timelines, and the actual timelines. If progress lags behind the envisaged status in the plan, the plan warns that problems are being experienced and re-planning may be required.

Part II

- Include the final report to date (page 5 till the end)
 - The following is expected for the MRN 412 progress report, and Part II must be **at least 10 pages in length** when using an **11pt font** of your choice with **single line spacing** and **2.5cm margins**.
 - Introduction
 - Background and previous work, supported by literature
 - Problem statement, following from the background and previous work
 - Overview of remaining sections in the report
 - Literature survey
 - Summary of relevant theory
 - Summary and critical discussion of relevant literature
 - Limited to 10 pages to force student to focus on **relevant** theory and literature
 - Detailed Research Proposal
 - Any additional completed work
 - Reflection on the way ahead
 - The following is expected for the MRN 422 progress report, and Part II must be **at least 20 pages in length** when using an **11pt font** of your choice with **single line spacing** and **2.5cm margins**.
 - Start with the corrected MRN 412 final report
 - Delete the “Detailed Research Proposal” section (what has been planned), and replace it with what has been done. This should result in:
 - Introduction
 - Background and previous work, supported by literature
 - Problem statement, following from the background and previous work
 - Overview of remaining sections in the report
 - Literature survey
 - Summary of relevant theory
 - Summary and critical discussion of relevant literature
 - Limited to 10 pages to force student to focus on **relevant** theory and literature
 - Numerical simulation or theoretical work completed to date
 - Experimental work completed to date
 - Reflection on the way ahead

Part I of the Progress Report (Executive Summary, RPP Compliance Matrix, Project Plan and Reflection) must be included as an Appendix in the final report. Progress reports are submitted electronically on ClickUP, and your supervisor will provide feedback.

4.2.2 Gantt Chart

A well-proven method for planning a project is with the aid of a *Gantt chart* that indicates the logical sequence of the various tasks that are required to complete the project. An example of a Gantt chart is given in Appendix H. The chart indicates the milestones and predetermined dates. The important milestones that need to be provided are the date of the semester examination as well as the date when the final report must be handed in. These dates are fixed.

The tasks are identified and scheduled as required by the milestones. The planning process is executed backwards, starting with the milestones. A final report requires tasks such as writing, editing, proofreading and activities normally not mentioned i.e., printing, copying and binding. The contents of the report are based on tasks such as the planning and execution of an experiment. Planning an experiment requires obtaining theoretical knowledge and getting background information. An experiment also requires obtaining the required resources such as equipment and materials well in advance. The expected delivery delays are indicated on the Gantt chart so that the effect of late delivery can be determined clearly.

4.3 Final Reports

4.3.1 Submission of Final Report for MRN412

Submit 1 bound copy of the final report (venue, dates and times will be communicated) and a single PDF file of the complete final report (including all appendices) on the course ClickUP page. The final submission date is listed in Section 2.4.3.

4.3.2 Content of the Final Report for MRN412

A typical MRN412 report will contain the following sections:

- Cover page
- Executive summary (start numbering using Roman numerals i, ii, etc.)
- RPP Compliance Matrix (indicate which objectives in the RPP have been achieved)
- Table of contents
- Introduction (restart numbering using Arabic numerals 1, 2, ... etc.)
 - Background and previous work, supported by literature
 - Problem statement, following from the background and previous work
 - Overview of remaining sections in the report
 - Typically, 1 to 2 pages in length
- Literature survey
 - Summary of relevant theory
 - Summary and critical discussion of relevant literature
 - Limited to 10 pages to force student to focus on **relevant** theory and literature
- Detailed Research Proposal (NOT to be confused with the RPP generated at the start of the semester)
 - Synthesis of a feasible research proposal, consistent with the problem statement and the literature.
 - Compile a detailed step-by-step description of how you will solve the research question. The level of detail expected in this “Detailed Project Proposal” is such that another final year student should be able to take this list and complete your project by simply executing your steps one by one. For example, for the experimental component your steps should include what you measure, where you measure, with what you measure and how much you measure. Similarly, for numerical simulations, your steps should include what you are simulating, using what software, what answers you will extract, and how many simulations you will perform.
 - Include and justify the Scope of Work.

- This section demonstrates that the planning required for MRN 422 is completed.
- Typically, 2 to 5 pages in length
- Progress to date
 - This section documents the actual work completed to date, starting at step 1 in your own “Detailed Research Proposal” up to the step you managed to complete.
 - For topics that primarily require experimental investigation, it is anticipated that you would include the completed analytical or numerical work.
 - For topics that primarily require numerical simulation, it is anticipated that you would include the completed experimental work.
 - Typically, 10 to 20 pages.
- Reflection on work to be done to complete MRN422 (the remaining steps in you “Detailed Research Proposal”)
- Appendix
 - RPP
 - Part I of the MRN 412 Progress Report (see Section 4.2)
 - Other Appendices that might be required

4.3.3 Submission of Final Report for MRN422

Submit 2 bound copies of the final report (venue, dates and times will be communicated), and a single PDF file of the complete final report (including all appendices) on the course ClickUP page. The final submission date is listed in Section 2.4.3. One hardcopy is sent to the external examiner to evaluate.

THE DEADLINE WILL NOT BE EXTENDED AND NO LATE REPORTS WILL BE ACCEPTED.

Since one of the values of the Department is punctuality it is appropriate at this stage to repeat the comment that was used before:

“At this stage it must be emphasized that these deadline dates and times are hard cut-off times and no responsible student should do planning according to this schedule. Allowance should be made for all possible delays in the production and delivery of the reports to the end-point by planning for hand-in a few days (preferably one week) ahead of these dates”.

The final report must contain the RPP, Meeting Log Card and Part 1 of the MRN422 progress report in the Appendices. If these documents are not included or should there be any indication that the interaction with the supervisor was not as prescribed, entry to the oral examination may be refused and consequently the student will fail the module.

4.3.4 Structure of Final Report for MRN422

The contents of each sub-division of the final report are summarized in paragraph 4.3.5. This structure of the report is the final check that should be done before the report is handed in.

Section	Refer to paragraph	Checked
Cover page	4.3.5	
Executive summary	4.3.5	
RPP Compliance Matrix	4.3.5	
Acknowledgements	4.3.5	
Table of contents	4.3.5	
List of Symbols	4.3.5	
1. Introduction	4.3.5	

2, 3, 4, ... Main Report, including sections such as Literature survey, Experimental Investigation, Numerical Simulation etc.	4.3.5	
5. Conclusions and Recommendations	4.3.5	
6. References	4.3.5	
Appendices		
A. Research Project Proposal (RPP)	2.4.2, 4.1	
B. Part I of the MRN 422 progress report	4.2	
C. Meeting Log Card	2.3	
D, E, ... Other Appendices, if required		

4.3.5 Content and formatting of the final report for MRN422

The objective is to report on the Research Project in a concise way without using unnecessary repetitions and saying what needs to be said in as few words as possible without reducing the quality of the communication. This implies that you have to optimize the number of words used to describe the research that was carried out, the results obtained, the conclusions reached and recommendations to note.

Writing optimum length reports requires a lot of good planning and in most cases more time than would be the case if there were no restrictions. A concise optimized report is more valuable since it says what needs to be said in less space and therefore will take less time of the reader to study and understand its contents.

As a result, the final report will also be testing the ability of the student to write an optimized document and a restriction is placed on the number of pages allocated to the technical content. This restriction is set at **50 pages** and it includes the Introduction, the Main Report with its figures, graphs and tables up to but excluding the references. Use an **11pt font** of your choice with **single line spacing** and **2.5cm margins**. If your report exceeds 50 pages, the examiners will only grade the first 50 pages starting from the Introduction.

Cover Page

On the cover page the title, as agreed with the supervisor, is given. Underneath the title the initials and surname of the author, student number, supervisor, the year and the Department are provided.

Executive summary (page i)

The Executive Summary is included to enable a reader to obtain all the important information contained in the report in a concise **one-page summary**. It should contain as a minimum:

- The purpose of the work that was done;
- The procedures that were applied;
- A verbal description of the results obtained;
- The conclusion reached and if applicable,
- Recommendations.

RPP Compliance Matrix (page ii)

To ease the evaluation of the correlation between the requirements as stated in the RPP and the delivered “product” in the form of the Project Report, a Compliance Matrix is included to explicitly link the agreed requirements to the delivered results in the Research Report. This aids the External Examiner to evaluate the work, since the external examiners were not involved in the project from the beginning as was the supervisor. The format to be used for the compliance matrix is shown in Appendix C in this report.

Acknowledgements (page iii)

It is fitting to acknowledge people who made a direct contribution to the Research Project.

Table of Contents (page iv)

The purpose of this section is to allow the reader to see at a glance the structure and layout of the report. It is important that this bird's eye-view is not cluttered with unnecessary sub-divisions and detail. The table of contents must give the page numbers where each division appears.

List of Symbols (page v)

All symbols and unfamiliar abbreviations that are used in the text must be clearly defined and explained in this section. The order in which the symbols are listed is usually:

- English letters and symbols
- Greek symbols
- Superscripts
- Subscripts
- Acronyms and abbreviations

SI-units of all symbols must be provided as part of the definition. Up to this point in the report, page numbers are Roman Numerals (i, ii, iii, iv, v, vi, vii etc.).

Introduction (page 1)

The technical content starts here and the page numbering from here is Arabic (1, 2, 3 etc.), starting from 1. In the introduction, the purpose of the study is explained. The following questions must be dealt with in some detail:

- Give the background
- What is the problem?
- Why was work conducted in this field?
- What work did others previously do in this area?
- What did the author do i.e. what was the objective and contribution of this study?

The last paragraph of the introduction must briefly summarize the rest of the report. The contents of each major section of the rest of the report are stated briefly. The reason is to help the reader understand the structure of the report and to serve as a transition point into the rest of the report.

Main Content

The main content should not exceed three or four chapters. Typically the first chapter will discuss a theoretical analysis, the second an experimental procedure and the third the results which were obtained. Topics that require extensive numerical simulations may present this in a separate chapter. It is important to discuss the assumptions and restrictions of the theory and measurements in a separate paragraph.

Only the relevant theory, which is directly applicable to the particular study, must be presented. Details of calculations and experimental work must be added in Appendices. The report itself must be logical, easy to read and understand. Important results must be presented in graphical format rather than in tables, where possible. Discuss only one idea per paragraph. Paragraphs should follow a logical flow.

It is also good practice to give a short summary of the conclusions of each chapter at the end of the chapter. The writer must fully interpret the results for the reader.

Conclusions

Note that most readers are only interested in the executive summary, the introduction, and the conclusion. The most important methods, problems, results and conclusions are therefore briefly mentioned at the end of the report. The conclusion should not contain new information, or new statements, which have not been thoroughly discussed elsewhere.

At the end of the report the final conclusions are discussed. Shortcomings are pointed out and suggestions for future work are made. Discuss the question: Did the project succeed?

Recommendations

Any research effort must conclude with some recommendations of how to go further. Typically this will include suggestions to refine, improve, optimize or even to utilize the results in other applications.

References

At the end of the report a list of references must be given. The source of all statements contained in the report must be traceable. All ideas from sources other than of the author, i.e. from the literature, the supervisor or from a co-working team member, must be acknowledged explicitly. The IEEE referencing style, the Harvard reference system or another acceptable reference system as used in engineering ISI journals must be used.

Appendices

Research Project Proposal

The latest revision of the RPP is included as Appendix A.

Progress Reports

Include Part 1 of the MRN422 Progress Report as Appendix B. This enables the External Examiner to gauge the student's progress.

Meeting Log Card

Include the signed Meeting Log Card as Appendix C.

Other Appendices

All the detail of theory, calculations, and results that are not necessary for clarity in the main report must be included in appendices. Please make sure that the information that is supplied here is correct and complete so that enquiries at a later stage can be answered with confidence.

Do not include unnecessary "padding" in this section to increase the apparent length of the report. Nevertheless, it is important to preserve in the appendices relevant material, which was acquired with some effort, and will be required for future continuation of the work. Material that is available in the library must not be included but should be referenced properly. This includes excerpts from catalogs or equipment specification that may infringe on copyright.

4.3.6 Editorial Considerations

Correct Language

Students must ensure the final report is carefully edited, uses proper grammar and contains no spelling mistakes. If necessary, students must have the report edited on their own expense. Students preparing the report in their second language should ensure the language in the report is of acceptable quality.

Equations

Refer to a prescribed textbook to remind yourself how to include equations in a technical report. Any equation appears within a sentence. To check if you introduced the equation properly, pretend that the equation is written out in words (although we use formal mathematical notation). If your sentence reads naturally, you did it correctly. Number the equation with a number in parentheses, aligned to the right margin. All equations are numbered, in sequence, whether the equation will be referred to later in the report or not. If you introduce the equation for the first time, do not refer to the equation number and make sure that you immediately define every symbol in the equation. If in a later part of the report you refer back to an equation, refer to it using the equation number.

Figures and Tables

Figures and tables must be numbered in sequence. All figures and tables must be supplied with a caption that briefly explains the contents. The caption is usually placed immediately below a figure, or immediately above a table. Abbreviations and symbols appearing in the figure or table must be defined in the caption. It must be possible to comprehend the figure or table by reading the caption without referring to the main text. However, the main text **must** also contain a full discussion of all figures and tables. If a figure or table appears in the report, but the reader is not expressly instructed when to refer to it, it is as if the figure or table does not exist. A disciplined reader only looks at figures and tables once instructed by the author to do so. The use of colours in graphs to distinguish between parameters should be used with utmost care since when printed in black and white the distinction could be lost. Rather use different markers and line types, combined with different colours.

Appendix A

Applicable ECSA Graduate Attributes

The Detailed Research Proposal shall be structured to contain a section where it will be explicitly shown how the student aims to achieve the objectives as stated in the RPP (Research Project Proposal) AND the ECSA Graduate Attributes. For the Research Project modules MRN412/422 the ECSA Graduate Attributes are as follows:

Graduate Attribute 4: Investigations, experiments and data analysis (MRN422)

The student will demonstrate competence to design and conduct investigations and experiments. Typically, students will have to show:

- How they plan to and eventually conducted the investigations and experiments;
- How they plan to and eventually conducted a literature search and how the material was evaluated;
- How they plan to do and eventually did the required analyses;
- How they plan to select and eventually selected and used the appropriate equipment or software;
- How they plan to evaluate the data from the experiments;
- How they plan to draw conclusions from the evidence provided by the data obtained;
- How they will compile the results of the investigation in a technical report.

Graduate Attribute 6: Professional and technical communication (MRN412 and MRN422)

The student will demonstrate competence to communicate effectively, both orally and in writing with engineering audiences and the general community at large. Typically, students will have to show:

- How they plan to structure the report and eventually compile the report;
- How they will enhance the quality of the report by other means such as visual aids and physical demonstrations on display hardware.

Exit level outcome 9: Independent learning ability (MRN412)

The student will demonstrate competence to engage in independent learning through well-developed learning skills. Typically, students will have to show:

- How they plan to operate and eventually operate in ill-defined contexts which require taking personal initiatives and responsibility for the work done;
- How they plan to and eventually source and evaluate the information that was acquired outside the formal curricula of the courses taken and in so doing demonstrate a capability of new thinking.

Meetings with the Supervisor are to be scheduled and during these meetings the RPP (Research Project Proposal) needs to be evaluated to ensure that the completed and planned uncompleted work is aligned and are still within the requirements in the original project description. All modifications to the RPP agreed to during the meetings are to be entered into the report card and signed off by the student and Supervisor. This is part of quality assurance to be applied to ensure a proper "paper trail" of the modifications agreed to during the execution of the Research Project. In the end all measures are to ensure total alignment between the RPP and the Research Project report.

Appendix B

UNIVERSITY OF PRETORIA
DEPARTMENT OF MECHANICAL AND AERONAUTICAL ENGINEERING

RESEARCH PROJECT MRN 412/422

MEETING LOG CARD

Student name and surname: _____ Student number: _____

Supervisor title and surname: _____ Year: _____

Research Project Title: _____

Date	Student signature	Supervisor signature	Comments
			Initial discussion
			Research Project Proposal discussion

ADDITIONAL COMMENTS:

Appendix C

Research Project Proposal Compliance Matrix Format (Example)

Requirement	Proposal		Project Report	
	Section	Page	Section	Page
Perform theoretical prediction of convection heat transfer coefficient on the structure wall	1.6	2	4.1	15
Perform a three-dimensional prediction of room air temperature distribution	1.8	3	4.2	18
Design and build a 1/10 th scale model of the structure	2.2	3	4.4	23
Measure the convection heat transfer coefficient	3.4	4	5.6	30
Measure the temperature distribution at positions 10cm from the wall and at the centre of the room	3.5	4	5.7	35
Compare the theoretical prediction of the convection heat transfer coefficient on the structure wall with measurements	4.3	5	6.3	40
Compare the spatial temperature distribution in room with theoretical predictions	4.4	5	6.6	44
Discuss results and draw conclusions	5.2	6	7.5	47
Make recommendations for future improvements	5.3	6	7.6	50

Appendix D

UNIVERSITY OF PRETORIA
DEPARTMENT OF MECHANICAL AND AERONAUTICAL ENGINEERING

RESEARCH PROJECT MRN 412/422

DISMANTLING REQUIREMENT

Student name and surname: _____

Student number: _____

Year: _____

Research Project Title: _____

The experimental equipment has to be dismantled: Yes / No

Supervisor Name

Supervisor Signature

If yes, the following technician will confirm that the experimental equipment has been dismantled:

Technician name

Technician Signature

Date dismantled

Appendix E
UNIVERSITY OF PRETORIA
DEPARTMENT OF MECHANICAL AND AERONAUTICAL ENGINEERING
RESEARCH PROJECT MRN 412
EVALUATION SHEET

	EXAM
	SUPPLEMENTARY EXAM

Student initials & last name:		Study leader:	
Student number:		Date:	
Short title:			

ECSA Graduate Attributes 6 and 9 are evaluated and these must be passed with a sub minimum of 50% for graduate attribute 6 AND 50% for graduate attribute 9 to be able to pass the module.

GRADUATE ATTRIBUTE 6: PROFESSIONAL AND TECHNICAL COMMUNICATION				
<i>Evaluate the following criteria</i>	Total	Mark	Yes	No
1. Executive summary conveys project objectives, methods, and results to date 0 No executive summary 2 Adequate executive summary (mentions some objectives and methods) with some results 4 Concise, focused executive summary that conveys all the project objectives, methods and results to date	4			
2. RPP Compliance Matrix lists those RPP objectives that have been met 0 Compliance matrix absent 2 Compliance matrix with the RPP objectives, but not clearly indicated what has been met 4 Compliance matrix present, containing all the RPP objectives, and those already satisfied indicated clearly	4			
3. Introduction provides sufficient background to explain the project to a non-expert 0 Introduction/background absent 4 Vague and misleading introduction/background that does not explain the project adequately to a non-expert 8 Sufficient introduction/background to explain the basics of the project to a non-expert 12 Sufficient introduction/background to explain most aspects of the project to a non-expert 16 Detailed introduction/background that explains and motivates all aspects of the project to a non-expert	16			
4. Literature survey (LS) presents coherent review of published work relevant to project 0 LS absent 5 LS contains mostly irrelevant information, not sufficient to address the problem 10 LS contains relevant and irrelevant information, adequate to address most aspects of the problem 15 LS contains mostly relevant and limited irrelevant information, adequate to coherently address the entire problem 20 LS contain only relevant information, condensed and interpreted in a coherent way to address the entire problem	20			
5. Report is sufficiently detailed to allow a fellow finalist to complete the project 0 The entire report is vague and non-specific 4 The report contains a mostly vague and only some specific descriptions 8 The report is mostly specific, with some vague sections and contains some padding (unnecessary content) 12 The report is sufficiently detailed that another person can complete the project, but contains some padding 16 The report contains all the required information to complete the project, and is free of padding	16			
6. The completed work reflects 160 hours of focused effort towards solving the research problem e.g. theoretical investigation completed and experimental investigation planned, or experiments completed and numerical simulations planned? 0 Completed work demonstrates no progress at all 5 Completed work is superficial and disconnected with minimal progress 10 Completed work is somewhat coherent with some demonstrated progress, approach not consistently rigorous 15 Completed work is mostly coherent and clear progress was made towards solving the problem, mostly rigorous 20 Completed work is coherent, follows a rigorous approach and significant progress was made towards solving the problem	20			
7. Proper grammar, clear and concise use of language, correct use of references, correct numbering and referencing of equations, tables and figures 0 Language error frequency every sentence, lots of formatting errors, and meaning of all sentences unclear 5 Language error frequency every paragraph, some formatting errors, and meaning of most sentences unclear 10 Language error frequency every page, few formatting errors, with meaning of most sentences clear 15 Language error frequency every chapter, almost no formatting errors, with most sentences clear and concise 20 Faultless document with clear and concise phrasing of all sentences	20			
Total for Graduate Attribute 6	100			
Did the student communicate effectively in writing within engineering audiences and to the community at large? If the answer is "NO" a mark of less than 50% must be awarded				

GRADUATE ATTRIBUTE 9: INDEPENDENT LEARNING ABILITY				
<i>Evaluate the following criteria</i>	Total	Mark	Yes	No
1. Does the literature study include relevant material not formally taught in the undergraduate curriculum? 0 Literature study contains only formally taught material (no new material) 5 Literature study contains some new material, but the new material is not relevant to the problem 10 Literature study contains some new material that is relevant to the problem but omits some expected new material 15 Literature study contains most of the new material the student is expected to include in the literature survey 20 Literature study contains all the new material the student is expected to include in the literature survey	20			
2. Does the student demonstrate an in-depth understanding of such new material? 0 No attempt to demonstrate understanding of new material 5 Superficial attempt to demonstrate understanding of new material, typically only in the literature study 10 Some evidence that new material is understood (e.g. own interpretation <i>or</i> attempted implementation) 15 Strong evidence that new material is understood (e.g. own interpretation <i>or</i> working implementation) 20 Compelling evidence that new material is understood (e.g. own interpretation <i>and</i> working implementation)	20			
3. Has the student synthesized a feasible “Detailed Research Proposal”, consistent with the problem statement and literature? 0 Absent “Detailed Research Proposal” or the research proposal addresses a different problem 5 Vague, non-specific research proposal with no details about equipment, measurements, software, simulations etc. 10 Research proposal is sufficiently detailed that the majority of the required tasks can be executed 15 Research proposal is sufficiently detailed that all the required tasks can be executed, justification of tasks poor 20 Research proposal is sufficiently detailed that all the required tasks can be executed, justification of tasks present and clear	20			
4. Does the student demonstrate the ability to critically evaluate the quality of information? 0 Student makes frequent errors on taught material (fundamental engineering knowledge) 4 Student includes lots of wrong or misleading information in the report, and typically cites few sources (<10) 8 Student includes very little wrong or misleading information in the report, and cites order of 15-20 sources 12 Student cross-checks information from appropriate number and mostly good quality sources 16 Student cross-checks information from appropriate number and consistently good quality sources	16			
5. Does the student demonstrate the ability to work according to the project plan, critically assess progress, and make the necessary adjustments? 0 No evidence of project planning and reflection 3 Minimal evidence of project planning (e.g. one Gantt chart) and reflection, and poor progress overall 6 Minimal evidence of project planning (e.g. one Gantt chart) and reflection, but good progress overall 9 Some evidence of project planning (e.g. Gantt chart revisions) and reflection, and good progress overall 12 Strong evidence of project planning and adjustments (e.g. Gantt chart revisions) and critical reflection, and good progress overall	12			
6. Does the student demonstrate the ability to operate independently in complex, ill-defined contexts requiring responsibility and initiative? 0 Student did not work independently, took no initiative during the semester, typically waiting for instructions 3 Student showed limited independence, rarely took initiative during the semester, poor progress to date 6 Student worked somewhat independently, sometimes took initiative during the semester, some progress 9 Student worked mostly independently, frequently took initiative during the semester, good progress 12 Student worked independently, consistently took initiative during the semester, progress ahead of schedule	12			
Total for Graduate Attribute 9	100			
Is the student capable of acquiring the knowledge that he/she is not familiar with and can he/she interpret this newly acquired knowledge? If the answer is “NO” a mark of less than 50% must be awarded				

Summary of examination

Graduate attribute 6: / 100 (sub minimum of 50% to pass) Grand total (GA 6 + 9): / 200

Graduate attribute 9: / 100 (sub minimum of 50% to pass) FINAL MARK: %

Final result:

Name: Internal examiner	
Signature: Internal examiner	

Name: External examiner	
Signature: External examiner	

A student must pass BOTH graduate attributes (GA) to pass, e.g. a mark of 45% for GA 6 and 75% for GA 9 results in a supplementary exam due to the subminimum of 50% not being achieved

Appendix F

**UNIVERSITY OF PRETORIA
DEPARTMENT OF MECHANICAL AND AERONAUTICAL ENGINEERING**

**RESEARCH PROJECT MRN 422
EVALUATION SHEET**

TO BE FINALIZED LATER

Appendix G

**UNIVERSITY OF PRETORIA
DEPARTMENT OF MECHANICAL AND AERONAUTICAL ENGINEERING**

RESEARCH PROJECT MRN 422

RE-EVALUATION OF RESEARCH PROJECT REPORT

TO BE FINALIZED LATER

