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## Faculty of Engineering, Built Environment and Information Technology

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### 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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# 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 on the Department's website at (the 2022 version is not yet available)

[https://www.up.ac.za/media/shared/120/Noticeboard/2021/departamental-studyguide-eng-2021\\_version27may2021.zp204392.pdf](https://www.up.ac.za/media/shared/120/Noticeboard/2021/departamental-studyguide-eng-2021_version27may2021.zp204392.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 emphasized 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 Coordinator

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](mailto:schalk.kok@up.ac.za)

All the lecturers in the department are involved as study leaders 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 study leader the Module Coordinator must be consulted.

### 2.2 Topic Allocation

A list of topics, including short project descriptions, is collected from all study leaders. 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 at the end of the prior academic year.

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 30 preferred topics. **If a student failed MRN the previous year, he/she may not select a topic from the same study leader.** If students require more information on a particular topic, they are welcome to discuss it with the particular study leader that proposed the topic before the ranking is done. Although the Department will try to accommodate the preferences of the student, it is not always possible.

Students are allocated to study leaders on the basis of:

- The individual workload of study leaders.
- 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 (December 2021). **Once the list is placed on ClickUp the allocations are final.** The study leader 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. These allocations are based primarily on study leader workload, and student topic preference plays a minor role. Any student that does not have a topic by the time they successfully register for MRN412 in 2022 should contact the Module Coordinator via email ([schalk.kok@up.ac.za](mailto:schalk.kok@up.ac.za)) to request a study leader.

## 2.3 Study leader meetings

During the course of the year the student must interact on a regular basis (preferably weekly) with the study leader to discuss progress on the Research Project and to inform the study leader 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 study leader 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 (digitally in the case of online meetings) at each interaction between the student and the study leader. After each meeting your Meeting Log Card should be signed (digitally in the case of online meetings) by both the student and study leader. 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.

Please note that there are some external study leaders not employed by the University that offer their time and service to the University. In the case of external study leaders, the students must make sure that they contact the respective external study leaders to make the initial appointments (online meetings are acceptable).

## 2.4 Research Project

### 2.4.1 Research Project Proposal (RPP)

Students must arrange two meetings with their allocated study leader. 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 study leader 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 study leader for approval. It is important that during this meeting, the student determines what the minimum requirements of the study leader are. Students can also present their own ideas about the execution of the Research Project in the RPP and negotiate these with the study leader. The RPP should be seen as a document in which the student and the study leader 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 study leader and indicated as **revision 0**. If later-on changes to the RPP are agreed between the student and study leader, 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	08-12-2021
Introductory lecture	23-02-2022
Arrange 2 appointments with Study leader, 2 <sup>nd</sup> appointment should be before	04-03-2022
Handing in of RPP	07-03-2022
Compulsory progress report MRN 412 (minimum 10 pages)	25-04-2022
Final report MRN 412 (maximum 30 pages)	06-06-2022
Study leaders to submit MRN 412 grades to course administrator	27-06-2022
Submission date for handing in the rectified report for students that received a supplementary exam for MRN 412.	25-07-2022
Compulsory progress report MRN 422 (minimum 20 pages)	26-09-2022
Final report MRN 422 (maximum 50 pages)	11-11-2022
Presentation and oral examination	28-11-2022 till 30-11-2022

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

Publication of allocation list	08-12-2021
Introductory lecture	23-02-2022
Arrange 2 appointments with Study leader, 2 <sup>nd</sup> appointment should be before	04-03-2022
Handing in of RPP	07-03-2022
Compulsory progress report MRN 412 (minimum 10 pages)	28-03-2022
Final report MRN 412 (maximum 30 pages)	21-04-2022
Study leaders to submit MRN 412 grades to course administrator	29-04-2022
Compulsory progress report MRN 422 (minimum 20 pages)	16-05-2022
Final report MRN 422 (maximum 50 pages)	10-06-2022
Presentation and oral examination	29-06-2022

There is no formal process to apply for the 6 month option: Any student that can **graduate** by the end of the first semester is allowed to submit according to the 6 month timelines. Should you be unable to keep to the 6 month timelines, you automatically revert back to the full year option. Also note that less calendar days are given for MRN422 than MRN412, although MRN412 is only 16 credits and MRN422 is 24 credits, so plan accordingly. Do not wait for formal feedback from your study leader, continue working while waiting for feedback.

## Progress Meetings

Students must meet study leaders **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 study leader. 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 study leader. The outcome of each meeting is then written-up as minutes in the journal, signed off and dated by both the study leader 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 Study leaders

Study leaders participate in an advisory capacity. Except for initially proposing the topic, study leaders are not be expected to take the initiative with any part of the Research Project. Study leaders are also not responsible for the project management. ***The input from study leaders 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 study leaders 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. There is no requirement that a study leader should assist the student to solve parts of the research problem that the student struggles with.
4. To assess progress of the Research Project, and to give early warning to the student if the student's progress is judged to be inadequate.
5. To assist the student with the planning of the documentation. To provide critical (high level but not detailed) comments on draft reports.
6. To examine the final deliverables and provide a numerical grade (with the assistance of an external examiner in the case of MRN422).

## 2.6 Finances

Each study leader 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. Study leaders can divide this budget as they see fit amongst the projects they lead. Study leaders 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 study leader. 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 study leader, the student will be liable for the amount exceeding the budget. Students are also liable for all expenses not approved by the study leader, 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 study leader 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 study leader signs this form and indicates if dismantling is required. If dismantling is required, the study leader 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 study leader's signature on all your drawings. No parts will be manufactured without the approval of your study leader.
- 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 Software and specialized equipment**

A number of software packages do exist that can aid in completing the project. Additional training in the use of specialist analysis software as well as specialized equipment in the laboratories will be provided. Dates will be posted.

## **2.13 Other General Research Project Rules**

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

- It is the duty of the student to search for literature and equipment for the project. The study leader 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 study leader 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 after normal working hours, 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 study leader. 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 study leader 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 external examiners.

If the final mark is

- 1) between 40% and 49%, or
- 2) 50% or more but one of the Graduate Attributes is failed (mark less than 50%),

the student qualifies for a supplementary exam. The study leader 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: the supplementary exam was awarded because of substantial deficiencies that cannot be rectified in a few hours.

If the MRN 412 mark is less than 40%, the student does not pass MRN 412 and may therefore not proceed to MRN 422. The student has to redo MRN 412 the following year. Students that pass MRN 412 with a mark greater than 50% have to retrieve their graded reports from their study leaders at

the start of the second semester. It is expected that the **errors in the MRN 412 report** that were pointed out by the study leader are **corrected in the compulsory progress report for MRN 422**.

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 MRN 412 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.

#### 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.

### 3.3 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 study leader 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 study leaders 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, and to design their experimental setup. 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.

Study leaders 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 MRN 412 and MRN 422. If you do not submit a

progress report containing sufficient content, 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 study leader name respectively. The rest of this page contains an Executive Summary, which focuses on the technical progress to date. **Do not start your progress report with a colorful cover page** that adds no technical content.
- 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). Number each section (1, 2, etc.), use an **11pt font** of your choice with **single line spacing** and **2.5cm margins**.
  - The following is expected for the MRN 412 progress report, which must be **at least 10 pages in length** (Section names and numbering can be altered if necessary):
    - 1. Introduction
      - Background and previous work, supported by literature
      - Problem statement, following from the background and previous work
      - Overview of remaining sections in the report
    - 2. Literature survey
      - Summary of relevant theory
      - Summary and critical discussion of relevant literature, that enables the student to formulate a solution to the research problem
      - Limited to 10 pages in length to force students to focus on **relevant** theory and literature
    - 3. Detailed Research Proposal
    - 4. Any additional completed work (4, 5, etc.)
    - 5. Reflection on the way ahead
  - The following is expected for the MRN 422 progress report, which must be **at least 20 pages in length** (Section names and numbering can be altered if necessary):
    - 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:
      - 1. Introduction
        - Background and previous work, supported by literature
        - Problem statement, following from the background and previous work
        - Overview of remaining sections in the report
      - 2. 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
      - 3. Numerical simulation or theoretical work completed to date
      - 4. Experimental work completed to date

- 5. 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 study leader 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 MRN 412

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 MRN 412

A typical MRN 412 report will contain the following sections:

- Cover page
- Executive summary (start page numbering using Roman numerals i, ii, etc.)
- RPP Compliance Matrix (indicate which objectives in the RPP have been achieved)
- Table of contents
- 1. Introduction (restart page 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
- 2. Literature survey
  - Summary of relevant theory
  - Summary and critical discussion of relevant literature. The included theory should be essential in order to propose a plan on how to solve the research problem.
  - Limited to 10 pages to force student to focus on **relevant** theory and literature
- 3. Detailed Research Proposal (NOT to be confused with the RPP generated at the start of the semester). **This section is compulsory and counts a lot of marks**
  - 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
- 4. 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 (2<sup>nd</sup> semester), it is anticipated that you would include the completed analytical or numerical work (1<sup>st</sup> semester).
    - For topics that primarily require numerical simulation (2<sup>nd</sup> semester), it is anticipated that you would include the completed experimental work (1<sup>st</sup> semester).
  - Typically, 10 to 20 pages.
- 5. Reflection on work to be done to complete MRN422 (the remaining steps in you “Detailed Research Proposal”)
- 6. References
- Appendix
  - A. RPP
  - B. Part I of the MRN 412 Progress Report (see Section 4.2)
  - C. D. etc. Other Appendices that might be required

#### 4.3.3 Submission of Final Report for MRN422

Submit 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.

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 in Section 2.4.3:

*“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 MRN 422 progress report in the Appendices. If these documents are not included or should there be any indication that the interaction with the study leader 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 (page number i)	4.3.5	
RPP Compliance Matrix (page number ii)	4.3.5	
Acknowledgements (page number iii)	4.3.5	
Table of contents	4.3.5	
List of Symbols	4.3.5	
1. Introduction (page number 1)	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. Writing reports with length restrictions requires good planning and, in most cases, more time than would be the case if there were no restrictions. A concise report is more valuable since it says what needs to be said in less space and therefore takes less time of the reader to study and understand its contents.

This module evaluates the ability of each student to write such a restricted length document. 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 study leader, is given. Underneath the title the initials and surname of the author, student number, study leader, 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 study leader. The format to be used for the compliance matrix is shown in Appendix C in this study guide.

### **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 findings 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 study leader 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 MRN 422 Progress Report as Appendix B. This enables the External Examiner to gauge the student's progress during the semester.

#### **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 catalogues 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.

Example: “Newton’s second law of motion is stated as

$$\sum F_i = ma, \tag{1}$$

where  $F_i$  is the external loads acting on the system,  $m$  is the mass of the system and  $a$  is the acceleration of the system’s centre of mass.”

#### 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 MRN 412/422 the ECSA Graduate Attributes are as follows:

### **Graduate Attribute 4: Investigations, experiments and data analysis (MRN 422)**

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 (MRN 412 and MRN 422)**

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 (MRN 412)**

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 Study leader 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 are 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 Study leader. 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: \_\_\_\_\_

Study leader title and surname: \_\_\_\_\_ Year: \_\_\_\_\_

Research Project Title: \_\_\_\_\_

Date	Student signature	Study leader signature	Comments
			Initial discussion
			Research Project Proposal discussion

ADDITIONAL COMMENTS:

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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 <sup>th</sup> 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: \_\_\_\_\_

Date: \_\_\_\_\_

Research Project Title: \_\_\_\_\_

The experimental equipment has to be dismantled: Yes / No

\_\_\_\_\_  
Study leader Name

\_\_\_\_\_  
Study leader 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**

<input checked="" type="radio"/>	<b>EXAM</b>
<input type="radio"/>	<b>SUPPLEMENTARY EXAM</b>

Student initials & last name:		Study leader:	
Student number (8 digits):	u	Date:	2021-04-19
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.

<b>GRADUATE ATTRIBUTE 6: PROFESSIONAL AND TECHNICAL COMMUNICATION</b>				
<i>Evaluate the following criteria</i>	Total	Mark	Yes	No
<b>1. Does the executive summary convey the project objectives, methods, and results to date?</b> <input type="radio"/> No executive summary <input type="radio"/> Adequate executive summary (mentions some objectives and methods) with some results <input checked="" type="radio"/> Concise, focused executive summary that conveys all the project objectives, methods and results to date	4	4	X	
<b>2. Does the RPP Compliance Matrix list those RPP objectives that have been met?</b> <input type="radio"/> Compliance matrix absent <input type="radio"/> Compliance matrix with the RPP objectives, but not clearly indicated what has been met <input checked="" type="radio"/> Compliance matrix present, containing all the RPP objectives, and those already satisfied indicated clearly	4	4	X	
<b>3. Does the introduction provide sufficient background to explain the project to a non-expert?</b> <input type="radio"/> No introduction <input type="radio"/> Vague introduction that does not explain the problem or the objectives of the investigation <input type="radio"/> Adequate introduction that explains the important aspects of the problem and main objective of the investigation <input type="radio"/> Good introduction that explains most aspects of the problem and most objectives of the investigation <input checked="" type="radio"/> Concise, focused introduction that motivates and explains the entire problem, and all the project objectives	12	12	X	
<b>4. Does the literature survey (LS) present a coherent review of published work relevant to the project?</b> <input type="radio"/> LS absent <input type="radio"/> LS contains mostly irrelevant information, not sufficient to address the problem <input type="radio"/> LS contains relevant and irrelevant information, adequate to address most aspects of the problem <input type="radio"/> LS contains mostly relevant and limited irrelevant information, adequate to coherently address the entire problem <input checked="" type="radio"/> LS contain only relevant information, condensed and interpreted in a coherent way to address the entire problem	16	16	X	
<b>5. Is the report sufficiently detailed to allow a fellow finalist to complete the project?</b> <input type="radio"/> The entire report is vague and non-specific <input type="radio"/> The report contains mostly vague and only some specific descriptions <input type="radio"/> The report is mostly specific, with some vague sections and contains some padding (unnecessary content) <input type="radio"/> The report is sufficiently detailed that another person can complete the project, but contains some padding <input checked="" type="radio"/> The report contains all the required information to complete the project, and is free of padding	18	18	X	
<b>6. Does the completed work reflect 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?</b> <input type="radio"/> Completed work demonstrates almost no progress <input type="radio"/> Completed work is superficial and disconnected with minimal progress <input type="radio"/> Completed work is somewhat coherent with some demonstrated progress, approach not consistently rigorous <input type="radio"/> Completed work is mostly coherent and clear progress was made towards solving the problem, mostly rigorous <input checked="" type="radio"/> Completed work is coherent, follows a rigorous approach and significant progress was made towards solving the problem	18	18	X	
<b>7. Does the report make use of proper grammar, use clear and concise language, correctly reference sources, correctly number and reference equations, tables and figures?</b> <input type="radio"/> Language error frequency every sentence, lots of formatting errors, and meaning of all sentences unclear <input type="radio"/> Language error frequency every paragraph, some formatting errors, and meaning of most sentences unclear <input type="radio"/> Language error frequency every page, few formatting errors, with meaning of most sentences clear <input type="radio"/> Language error frequency every chapter, almost no formatting errors, with most sentences clear and concise <input checked="" type="radio"/> Faultless document with clear and concise phrasing of all sentences	16	16	X	
<b>8. Is the student's response to study leader feedback (provided during meetings, on the progress report or on the final report in the case of the supplementary exam) about written communication acceptable?</b> <input type="radio"/> Student ignores feedback, errors identified by the study leader are left as is and additional errors are introduced <input type="radio"/> Student fixes some errors identified by the study leader, but introduces new errors in new sections of the report <input type="radio"/> Student fixes most errors identified by the study leader, but introduces new errors in new sections of the report <input type="radio"/> Student eliminates all errors identified by the study leader and does not introduce any new errors <input checked="" type="radio"/> Student eliminates all identified errors, learns from the feedback and improves the overall quality of the report	12	12	X	
<b>Total for Graduate Attribute 6</b>	100	<b>100</b>		
Did the student communicate effectively in writing within engineering audiences and to the community at large? <b>If the answer is "NO" a mark of less than 50% must be awarded.</b>			X	

GRADUATE ATTRIBUTE 9: INDEPENDENT LEARNING ABILITY				
Evaluate the following criteria	Total	Mark	Yes	No
<b>1. Does the literature study include relevant material not formally taught in the undergraduate curriculum?</b> <input type="radio"/> Literature study contains only formally taught material (no new material) <input type="radio"/> Literature study contains some new material, but the new material is not relevant to the problem <input type="radio"/> Literature study contains some new material that is relevant to the problem but omits some expected new material <input type="radio"/> Literature study contains most of the new material the student is expected to include in the literature survey <input checked="" type="radio"/> Literature study contains all the new material the student is expected to include in the literature survey	16	16	x	
<b>2. Does the student demonstrate an in-depth understanding of such new material?</b> <input type="radio"/> No attempt to demonstrate understanding of new material <input type="radio"/> Superficial attempt to demonstrate understanding of new material, typically only in the literature study <input type="radio"/> Some evidence that new material is understood (e.g. own interpretation <i>or</i> attempted implementation) <input type="radio"/> Strong evidence that new material is understood (e.g. own interpretation <i>or</i> working implementation) <input checked="" type="radio"/> Compelling evidence that new material is understood (e.g. own interpretation <i>and</i> working implementation)	16	16	x	
<b>3. Has the student synthesized and documented a feasible "Detailed Research Proposal", consistent with the problem statement and literature?</b> <input type="radio"/> Absent "Detailed Research Proposal" or the research proposal addresses a different problem <input type="radio"/> Vague, non-specific research proposal with no details about equipment, measurements, software, simulations etc. <input type="radio"/> Research proposal is sufficiently detailed that the majority of the required tasks can be executed <input type="radio"/> Research proposal is sufficiently detailed that all the required tasks can be executed, but justification of tasks poor <input checked="" type="radio"/> Research proposal is sufficiently detailed that all the required tasks can be executed, justification of tasks present and clear	16	16	x	
<b>4. Does the student demonstrate the ability to critically evaluate the quality of information?</b> <input type="radio"/> Student makes frequent errors on taught material (fundamental engineering knowledge) <input type="radio"/> Student includes lots of wrong or misleading information in the report, and typically cites few sources (<10) <input type="radio"/> Student includes very little wrong or misleading information in the report, and cites order of 15-20 sources <input type="radio"/> Student cross-checks information from appropriate number and mostly good quality sources <input checked="" type="radio"/> Student cross-checks information from appropriate number and consistently good quality sources	16	16	x	
<b>5. Does the student demonstrate the ability to work according to the project plan, critically assess progress, and make the necessary adjustments?</b> <input type="radio"/> No evidence of project planning and reflection <input type="radio"/> Minimal evidence of project planning (e.g. one Gantt chart) and reflection, and poor progress overall <input type="radio"/> Minimal evidence of project planning (e.g. one Gantt chart) and reflection, but good progress overall <input type="radio"/> Some evidence of project planning (e.g. Gantt chart revisions) and reflection, and good progress overall <input checked="" type="radio"/> Strong evidence of project planning and adjustments (e.g. Gantt chart revisions) and critical reflection, and good progress overall	12	12	x	
<b>6. Does the student demonstrate the ability to operate independently in complex, ill-defined contexts requiring responsibility and initiative?</b> <input type="radio"/> Student did not work independently, took no initiative during the semester, typically waiting for instructions <input type="radio"/> Student showed limited independence, rarely took initiative during the semester, poor progress to date <input type="radio"/> Student worked somewhat independently, sometimes took initiative during the semester, some progress <input type="radio"/> Student worked mostly independently, frequently took initiative during the semester, good progress <input checked="" type="radio"/> Student worked independently, consistently took initiative during the semester, progress ahead of schedule	12	12	x	
<b>7. Is the student's response to study leader feedback (provided during meetings, on the progress report or on the final report in the case of the supplementary exam) about understanding relevant new material acceptable?</b> <input type="radio"/> Student ignores feedback, misconceptions identified by study leader are left as is and many misconceptions are added <input type="radio"/> Student rectifies some misconceptions identified by the study leader and some misconceptions are added <input type="radio"/> Student rectifies the majority of misconceptions identified by the study leader and few misconceptions are added <input type="radio"/> Student rectifies all misconceptions identified by the study leader and demonstrates improved understanding <input checked="" type="radio"/> Student rectifies all misconceptions identified by the study leader and demonstrates mature understanding	12	12	x	
<b>Total for Graduate Attribute 9</b>	100	<b>100</b>		
Is the student capable of acquiring unfamiliar knowledge and can the student interpret this newly acquired knowledge? <b>If the answer is "NO" a mark of less than 50% must be awarded.</b>			<b>x</b>	

### Summary of examination

Graduate attribute 6: 100 / 100 (sub minimum of 50% to pass)

Grand total (GA 6 + 9): 200 / 200

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

FINAL MARK: **100 %**

Final result: STUDENT PASSES THE EXAM WITH DISTINCTION

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**

<input checked="" type="radio"/>	<b>EXAM</b>
<input type="radio"/>	<b>SUPPLEMENTARY EXAM</b>

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

<b>GRADUATE ATTRIBUTE 6: PROFESSIONAL AND GENERAL COMMUNICATION</b>				
<i>Evaluate the written report according to the following criteria:</i>				
	Total	Mark	Yes	No
<b>1. Does the compliance matrix document that all the objectives stated in the RPP have been met?</b>				
<input type="radio"/> No compliance matrix				
<input type="radio"/> Compliance matrix with almost identical objectives than the RPP, and majority of objectives are met	4	4	X	
<input checked="" type="radio"/> Compliance matrix with identical objectives than the RPP, all objectives are met and clearly indicated where				
<b>2. Can the student communicate the purpose, process and objective of the investigation properly, as documented in the introduction?</b>				
<input type="radio"/> No introduction				
<input type="radio"/> Vague introduction that does not explain the problem or the objectives of the investigation	12	12	X	
<input type="radio"/> Adequate introduction that explains the important aspects of the problem and main objective of the investigation				
<input type="radio"/> Good introduction that explains most aspects of the problem and most objectives of the investigation				
<input checked="" type="radio"/> Concise, focused introduction that motivates and explains the entire problem, and all the project objectives				
<b>3. Does the literature survey (LS) present a coherent review of published work relevant to the project?</b>				
<input type="radio"/> LS absent				
<input type="radio"/> LS contains mostly irrelevant information, not sufficient to address the problem				
<input type="radio"/> LS contains relevant and irrelevant information, adequate to address most aspects of the problem	16	16	X	
<input type="radio"/> LS contains mostly relevant and limited irrelevant information, adequate to coherently address the entire problem				
<input checked="" type="radio"/> LS contain only relevant information, condensed and interpreted in a coherent way to address the entire problem				
<b>4. Does the student have the ability to document a research process with clarity, including the descriptions of the experimental, theoretical and/or numerical investigations, as well as the results obtained?</b>				
<input type="radio"/> Research process not documented; no results presented				
<input type="radio"/> Incoherent and brief description of the research process, logical planning absent, no discussion of results	16	16	X	
<input type="radio"/> Most elements of the research process described in the report, most results presented with clarity				
<input type="radio"/> All elements of the research process described in the report, all the results presented with clarity				
<input checked="" type="radio"/> Coherent and detailed description of the research process, results are presented in detail and discussed				
<b>5. Do the executive summary, conclusions and recommendations follow logically from the investigation?</b>				
<input type="radio"/> No executive summary/conclusions and recommendations in the report				
<input type="radio"/> Sweeping statements and generalizations, not connected to the investigations in the report, no recommendations	16	16	X	
<input type="radio"/> Brief summary/conclusions, majority of which follow from investigations in the report, few recommendations				
<input type="radio"/> Summary/conclusions are supported by investigations in the report; some consistent recommendations				
<input checked="" type="radio"/> Detailed summary/conclusions supported by investigations in the report, and consistent recommendations				
<b>6. Is the report properly laid out, with proper language, grammar and general appearance?</b>				
<input type="radio"/> Language error frequency every sentence, lots of formatting errors, and meaning of all sentences unclear				
<input type="radio"/> Language error frequency every paragraph, some formatting errors, and meaning of most sentences unclear	16	16	X	
<input type="radio"/> Language error frequency every page, few formatting errors, with meaning of most sentences clear				
<input type="radio"/> Language error frequency every chapter, almost no formatting errors, with most sentences clear and concise				
<input checked="" type="radio"/> Faultless document with clear and concise phrasing of all sentences				
<b>7. Is the student's response to study leader feedback (provided during meetings, on the progress report or on the final report in the case of the supplementary exam) about written communication acceptable?</b>				
<input type="radio"/> Student ignores feedback, errors identified by the study leader are left as is and additional errors are introduced				
<input type="radio"/> Student fixes some errors identified by the study leader, but introduces new errors in new sections of the report	12	12	X	
<input type="radio"/> Student fixes most errors identified by the study leader, but introduces new errors in new sections of the report				
<input type="radio"/> Student eliminates all errors identified by the study leader and does not introduce any new errors				
<input checked="" type="radio"/> Student eliminates all identified errors, learns from the feedback and improves the overall quality of the report				
<b>Oral presentation (slides and delivery)</b>				
<i>Evaluate the oral presentation according to the following criterion</i>				
<b>8. Does the student demonstrate effective oral communication, using appropriate supporting material?</b>				
<input type="radio"/> No presentation delivered				
<input type="radio"/> Oral communication is not effective, statements are difficult to comprehend, poor slides containing many errors				
<input type="radio"/> Oral communication is somewhat effective, statements are obvious and mostly correct, slides are mostly correct	8	8	X	
<input type="radio"/> Oral communication is mostly effective, statements are correct, good slides containing very few errors				
<input checked="" type="radio"/> Oral communication is always effective, statements are clear and concise and show insight, slides are excellent and contain no errors				
<b>Total for Graduate Attribute 6</b>	<b>100</b>	<b>100</b>		
Did the student communicate effectively, both orally and in writing within engineering audiences and to the community in general? <b>If the answer is "NO" a mark of less than 50% must be awarded.</b>			<b>X</b>	

GRADUATE ATTRIBUTE 4: INVESTIGATIONS, EXPERIMENTS AND DATA ANALYSIS							
<i>Evaluate the written report according to the following criteria:</i>				Total	Mark	Yes	No
<b>1. Did the student conduct the investigation in an appropriate and scientific manner?</b> <input type="radio"/> No investigation is presented. The presented work does not aim to answer a focused research question. <input type="radio"/> Investigation starts and remains trial-and-error based, it lacks a scientific approach <input type="radio"/> Majority of the investigation follows a scientific approach, but some components are trial-and-error based <input type="radio"/> Most aspects of the investigation follow an appropriate scientific approach, almost no trial-and-error components <input checked="" type="radio"/> All components of the investigation follow an appropriate scientific approach, no trial-and-error components				16	16	X	
<b>2. Did the student plan and conduct the investigation and experiments making full use of available and appropriate equipment or software? Take into account if a student took the lead (if applicable) in designing and/or constructing the experimental setup, or in running the simulations.</b> <input type="radio"/> No experiment conducted or no simulations performed <input type="radio"/> Experiments and/or simulations are trivial or wrong, given the available equipment/software and budget. <input type="radio"/> Experiments and/or simulations are appropriate and obvious, but only the bare minimum is executed. <input type="radio"/> Experiments and/or simulations are appropriate and obvious, AND extensive and detailed OR student took the lead. <input checked="" type="radio"/> Creative use of available equipment and/or software to perform the required experiments and/or simulations.				16	16	X	
<b>3. Did the student perform the necessary analysis?</b> <input type="radio"/> No analysis is performed, or analysis that is performed is incorrect <input type="radio"/> Analysis was not appropriate/necessary, but it was executed correctly <input type="radio"/> Necessary analysis was performed, but only the bare minimum was done, sufficient to allow some interpretation <input type="radio"/> Necessary analysis was performed, and this analysis was sufficient for interpretation and documented in detail <input checked="" type="radio"/> Necessary and relevant additional analyses were performed, extensive in scope and documented in detail				16	16	X	
<b>4. Did the student analyse, interpret and derive information from the data obtained?</b> <input type="radio"/> Given available data (from experiments or simulations) no interpretation attempted to derive information <input type="radio"/> Given available data, only trivial attempt made to interpret data (information is obvious from the data) <input type="radio"/> Given available data, minimum interpretation performed to derive only the essential information <input type="radio"/> Given available data, extensive interpretation of data performed to derive essential and other information <input checked="" type="radio"/> Given available data, extensive and creative/non-obvious interpretation of data performed to derive essential and other useful information				16	16	X	
<b>5. Did the student draw conclusions based on the evidence or data obtained?</b> <input type="radio"/> No conclusions provided, or conclusions are not based on evidence in the report <input type="radio"/> Conclusions are based on evidence in the report, but are incomplete <input type="radio"/> Conclusions are based on evidence in the report, are complete, but superficial/obvious <input type="radio"/> Conclusions are based on evidence in the report, are complete and demonstrates some in-depth understanding <input checked="" type="radio"/> Detailed, extensive conclusions are based on evidence in the report, are complete and demonstrates maturity and in-depth understanding of all aspects of the topic				16	16	X	
<b>6. Is the student's response to study leader feedback (provided during meetings, on the progress report or on the final report in the case of the supplementary exam) about investigations, experiments and data analysis acceptable?</b> <input type="radio"/> Student ignores suggested improvements, wrong/non-scientific/trial-and-error investigations are persisted with <input type="radio"/> Student implements few of the study leader suggestions, resulting in marginal improvements in the investigations <input type="radio"/> Student implements some of the study leader suggestions resulting in noticeably improved investigations <input type="radio"/> Student implements the majority of the study leader suggestions resulting in substantially improved investigations <input checked="" type="radio"/> Student implements all the study leader suggestions resulting in mature investigations based on sound scientific principles				12	12	X	
<b>Oral examination</b>							
<i>Evaluate the oral examination according to the following criterion</i>							
<b>7. Could the student provide adequate answers to the technical questions posed during the oral examination?</b> <input type="radio"/> Student could not answer any of the technical questions / no presentation delivered <input type="radio"/> Student could only answer some technical questions, even after guidance by examiners <input type="radio"/> Student could answer the majority of technical questions, but required some guidance by examiners <input type="radio"/> Student could answer most technical questions, and required almost no guidance from the examiners <input checked="" type="radio"/> Student could answer all technical questions with clarity, did not require guidance by examiners				8	8	X	
<b>Total for Graduate Attribute 4</b>				100	100		
Is the student capable of applying research methods, plan and conduct investigations and experiments using appropriate equipment? <b>If the answer is "NO" a mark of less than 50% must be awarded.</b>						X	

### Summary of examination

Graduate Attribute 6: 100/ 100 (sub minimum of 50% to pass)

Grand total (GA 6 + 4): 200/ 200

Graduate Attribute 4: 100/ 100 (sub minimum of 50% to pass)

FINAL MARK: 100 %

Final result: STUDENT PASSES THE EXAM WITH DISTINCTION

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 4 results in a supplementary exam due to the subminimum of 50% not being achieved

Appendix G

UNIVERSITY OF PRETORIA  
DEPARTMENT OF MECHANICAL AND AERONAUTICAL ENGINEERING  
RESEARCH PROJECT MRN 422  
SUPPLEMENTARY EXAM INSTRUCTIONS

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

**You did not pass the following evaluation criteria, and have to improve these marks to be able to pass the supplementary exam:**

Graduate attribute 6: Professional and technical communication

Detailed instructions by internal examiner on shortcomings that have to be addressed from the list above:

Graduate attribute 4: Investigations, experiments and data analysis

Detailed instructions by internal examiner on shortcomings that have to be addressed from the list above:

Name: Internal examiner	
Signature: Internal examiner	

Name: Student	
Signature: Student	

Name: External examiner	
Signature: External examiner	

