CAPSTONE PROJECT COURSE

BME499, BPM499, EAS499, ENG499, FEM499, ICT499, MTD499 and MTH499

Course Handbook

Updated: 06 February 2018

INTRODUCTION

The Capstone Project Course is unlike most other SUSS courses in that you will not be swamped with literature (no specialist course notes, media material etc). It is essential that you plan your project carefully as time and resources are not to be wasted. From a rather sketchy idea of what **you think** you want to do; you have to produce a **well-reasoned** and **well-researched** project. This is a daunting task, but with clear aims and self-discipline you will find the experience both rewarding and fascinating.

Capstone project is a Level 4 course, and it is regarded as the summit or apex of your undergraduate degree studies. In it we expect you to integrate the concepts you have learned in past courses and apply them to a **significant real world problem**.

This handbook aims to provide you with advice on how to go about the various stages of your project and also includes information on the formal academic reporting system you have to comply with.

This course uses a key skills framework to help you tackle your project. The framework is to help you develop your communication skills, and monitor, assess and review your own performance during the year. More details about the key skills approach are given in Section 10.

You will be working **independently**. Rather than being one of a large supervision group, you will be known personally to your supervisor. You will meet your supervisor at regular intervals over two semesters, including the month(s) between these semesters. Your supervisor will be the main source of guidance in your area of specialized investigation work.

Objectives

The main aims of the Capstone Project may be summarized as follows:

- To provide an opportunity for you to draw together and integrate the knowledge you have gained and skills you have developed in other courses from the degree programme in which you are currently pursuing.
- To give you an opportunity for independent study, and to develop an ability to organize work with a view to achieving a clearly specified goal (for example to complete a simulation model, write a piece of interface software, build/test an integrated electronic system, execute a product design, or design an information system). It is essential that students should choose project areas relevant to the degree specialisation in which they have chosen and not in areas unrelated to the degree programme curriculum.
- To develop skills in some combination of design, electronics, materials/mechanical engineering and mathematical/computer simulation analysis as an integrative activity appropriate to **Electronic Engineering, Biomedical Engineering, Information and Communications Technology, Multimedia, Mathematics, Aerospace Engineering and other honours programmes at the School of Science and Technology** and in the presentation of an account of the work in written and oral form.
- To undertake an academic project based on sound technological principles and intellectual reasoning. It is not just the **production of a descriptive technical report.**

Learning Outcomes

The learning outcomes of the Capstone Project may be summarized as follows:

1. Discuss the scope of your capstone project problem to be investigated
2. Analyse the motivation / benefits / rewards of your project problem
3. Review the literature to gather information about the project and the available solutions
4. Examine the constraints / drawbacks in the available solutions
5. Define the assumptions / conditions relevant to your project
6. Formulate your project problem/ model / system
7. Design / implement / simulate the system
8. Test the system / model / software
9. Compare your results with the solutions available in the literature
10. Draft a detailed report on your project work
11. Summarize the project work as a poster, defining the project problem, the solution(s), benefits of the solution(s) and any improvements that can be done
12. Give an oral presentation

1 TIMETABLE

The **timetable** alongside with **dates of project workshops** as indicated by week number on the course schedule are printed separately, but have been posted on the Canvas. The guidelines to the stages of the project are given in Section 2.

The **first** and **last** workshops are compulsory.

Notice that there are a number of fixed points in the course schedule. These meetings and deadlines are to assist you in pacing your work, and to enable your supervisor to watch your progress throughout the year. It is in your own interests to submit the project proposal and project report on time, and to attend the associated face-to-face supervisions where arranged between you and your supervisor.

The only flexible dates in the timetable are the dates of face-to-face supervisions. Your supervisor has been asked to arrange them near the dates shown, but may alter them or add extra supervisions to suit your particular project. Your relationship with your supervisor should be viewed as critical in moulding your project. Do not ignore advice on structure or content without good reason from your supervisor.

It is important for you to be in close communication with your supervisor over the entire period of your project.

It is particularly important that you should meet the cut-off date for submission of your project report, because the project report has to be read and assessed by both your supervisor and examiner before the poster presentation day. Students who do not submit by the stipulated deadline will be automatically extended by 6 months, with grade penalty and fees charged. The grade will be deducted by 5 marks (or equivalent to 0.5GPA) and a fee of **$550*** will be charged for the 6-month extension. **(* This fee is subjected to revision)**

2 STUDY PROGRAMME

Your first formal meeting with your supervisor will take place in the early part of the first semester of your project. This meeting is the start of the course and you will discuss your project in detail and consider how it is to be tackled, culminating in the **successful completion** of your PROJECT PROPOSAL. Your supervisor will want you to outline the broad strategy, to assess your strengths and weaknesses and to agree a preliminary reading list (literature survey or other information sources). In general, projects for this Capstone Course are expected to include **both investigative and integrative** elements of the proposed project work.

At this first meeting, you may also decide how future contacts are to be made, by telephone, SMS messaging, email; or at face-to-face supervisions.

After this first meeting, you should minute down the criteria and targets you have agreed with your supervisor, the skills you will need to achieve them, an assessment of your strengths and weaknesses and your priorities for the first stage of the project.

You are to record all capstone matters discussed with your supervisor after every meeting in a meeting log and send a copy to your supervisor. Your supervisor will be able to see your meeting log to ensure the accuracy of the matters discussed during every meeting with him/her. Upon the school requests, you have to submit a copy of all meeting logs.

It is **compulsory** for you to have regular meet ups with your assigned supervisors.

By middle of your first semester, you should be well under way with the opening stages of your project. These depend to some extent on the investigative method you are using. They will normally include searching the literature, making preliminary enquiries and preparing work outlines for a **PROJECT PROPOSAL.** During this period, you can expect supervision help specifically directed to this kind of preparation. After marking your Project Proposal, your supervisor will normally hold another meeting, using your Project Proposal to develop a strategy for the main project report.

The major work of your project takes place between mid of 1st semester to later part of 2nd semester. During this long period you may expect supervision support by any of the routes mentioned above, depending on circumstances. Specific details of the requirements for the Project Proposal are given in Section 7.

We also require you to keep a *project diary* during the year. At the very least, this should be checked against your weekly objectives and should contain details of what you have learned and the time you have taken. Your supervisor may ask you to submit a monthly summary based on the diary. These are not assessed, but give the supervisor and student a very good idea of what is happening and whether the project is progressing to the schedule agreed between them. You should include provision for this in your project plan. You will find it useful when you come to write your project report, and it could come in handy at the poster presentation day if you are asked questions about the progress of the project.

3   HEALTH AND SAFETY

Some projects related to a student's work may have implications under MOH (Ministry of Health) regulations. Both the employer and the employee have a duty to ensure that, as far as is reasonably practicable, they do not put themselves at risk whilst carrying investigation work to fulfill the requirements of the course.

SUSS cannot authorize any risky and unsafe activity that you may undertake at your place of work. If your project will involve any such activities you should already have discussed this with your employer and provided a statement on your employer's headed notepaper, signed by your manager or other responsible person, to the effect that:

- your employer agrees to your use of any equipment and/or facilities;
- your employer will not hold SUSS or its full or part-time supervisors liable for any loss or damage that may occur as a result of your investigations carried out in the project work.

In addition, and even if you are carrying out all your project work at home, you must consider the safety aspects of any work you do. You should discuss health and safety with your supervisor at the first supervision. You may be required to prepare a written risk assessment, identifying the risks involved in the proposed activities and what steps will be taken to eliminate or minimize them. If the work involves any hazardous substances, then a written safety assessment by the sponsoring laboratory/company where the chemicals are used must be obtained from the laboratory manager/supervisor. The assessment should be signed and dated and form part of the documentation of the project (in the Project Report).

4 LEVEL, SCOPE AND COMMITMENT

These are three common aspects of the Capstone Project Course. This course, by its designation, is a **Level 4** course. Generally you will have undertaken Level 3 courses underpinning your project, and you will be well acquainted with the concepts and principles taught in them. You will also be familiar with aspects such as the investigative methods available and the level of modelling required. The Level 4 designation comes about since you now have to *apply* the modelling, concepts and principles at this level to your own particular problem. You will obviously have to go further in fleshing out the necessary background, hence the importance we attach to investigative method, background reading and the literature search.

Addressing the question of the scope of your project, there are dangers in having project aims that are either too focused or too wide. To some extent you should adjust your aims within the context of the level of work expected and the time available. It is preferable to constrain the scope so that the project can be completed without leaving a large number of questions unanswered. However, if this can only be done at the cost of trivializing the problem, you will have to reassess your aims particularly in projects where problem analysis is itself the core of the project. No one expects you to define these perfectly at the beginning of your project, which is why we ask you to reiterate your aims and objectives in the Project Proposal.

Commitment can be divided into time and attitude components. The study time is expected to be 400 – 600 hours, but because of the stop-start nature of the project work it is inevitable that you will take **more time** than this, especially if you have to go out and about to see people. Everyone works at their own rate; by now you will have a pretty good idea of whether you are a fast, slow or average person in SUSS terms.

The question of attitude is also extremely important. A few students regard the Capstone Course as a simple course and fail to take it seriously enough. Inevitably their poor performance is a disappointment to both themselves and their supervisor. This is an honours level course and should be treated as such, comparable to one from the local universities (for example the NUS, NTU and SMU).

There are ups and downs in all project work, and you will inevitably discover some dead ends. These can be very demoralizing, but coping with them constructively is an important aspect. One reason for having a good project framework is that you can tackle other areas if one area appears to dry up. If you do appear to be on the wrong tack, make sure you contact your supervisor without delay.

The Capstone Project Course is **academic** in nature. It is to do with learning, choices, sifting of evidence, and backing conclusions based on fundamental concepts. It should not be confused with a **business or technical report** such as you might write for your place of employment.

5   YOUR SUPPORT SYSTEM

You are by now quite familiar with the regular mailings, broadcasts and continuous assessment of other undergraduate courses. You may need to consult your supervisor about any difficulties that emerge from your reading of this *Course Handbook*.

SUSS provides investigation/measurement facilities in the form of a number of laboratories located on Levels 3 to 5 at Block C.

The software available includes:-
  a) LABVIEW Professional (Development Version)
  b) MATLAB with a full-range of toolboxes
  c) ELVIS prototyping system
  d) VICON motion capture system with MAYA animation which we can use for multimedia, biomedical as well as electronics
  e) Gtech for measurements of EEG/EMG - for electronics and biomedical
  f) Quanser Control System for biomechanics and electronics
  g) 6-DOF Haptic Robot for electronics, biomedical
  h) MIMICS for rapid prototyping/materials design
  i) Prime 3.1 Computer Algebra Software

Please contact your respective Head of Programme for a detailed list of available research measurement and modeling tools.

In the Capstone Project Course, the programme of study is largely in your own hands. The university's obligation is twofold:

  • to give you the best possible support;
  • to see that your work is properly assessed.

It is impossible to separate support from assessment, because your supervisor and SUSS are interested in both. Your supervisor will be your immediate point of contact for all academic problems. He or she will decide whether to call in help from the Head of Programme.

We are conscious of the remoteness and isolation you will experience and have, therefore, devised a system of checks to monitor your progress.

The examiner reads and assesses the project report and assesses your poster presentation at the end of the course.

The *BME499, ENG499, MTD499, ICT499, EAS499, MTH499, FEM499 and BPM499* Capstone Project Courses are administered by a faculty member, with the help of the School of Science & Technology Administration as well as the Examinations and Assignments (EA) Department of SUSS.

This team monitors the presentation of this course each semester, and looks at ways in which it might be improved.

The Course Chair is responsible for the appointment of your supervisor and will keep an eye on your progress through the course.

6 ASSESSMENT

The assessment of projects will be based on the following components and weightings:

1.   Project Proposal   10%
2.   Interim Report   10%
2.   Project Report   40%
3.   Oral Presentation   20%
4.   Questions and Answers   20%

The assessors of these components will be:

1.   Project Proposal   — supervisor (10%)
2.   Interim Report   — supervisor (10%)
2.   Project Report   — supervisor (10%) and examiner (30%)
3.   Oral Presentation   — supervisor (10%) and examiner (10%)
4.   Questions and Answers   — supervisor (10%) and examiner (10%)

Based on the Gantt chart in the Project Proposal, your supervisor will track your progress at the end of the first semester of your project. Students who are behind schedule by 8 weeks or more will be sent a warning letter. These students will then need to submit to their supervisors a rescheduled Gantt chart that is realistic to their supervisor, and must adhere to the rescheduled time line. When a student cannot follow their proposed Gantt chart in Project Proposal by the end of their first semester, their slow progress will be taken into consideration for the final marks.

Each student is required to keep a meeting log after every meeting with their supervisor and send the meeting log to their supervisor the following day. At the end of the two semesters, students should have accumulated a minimum of 10 meeting logs. The University will randomly select students throughout the Capstone project period. Students will have to submit them to sst-capstone@suss.edu.sg within a week. Each meeting log should include:

1.   Date, venue and time (state the duration) of the meeting
2.   Matters discussed, and
3.   Decisions made.

To gain at least a **PASS** you will have to:

1.   gain at least 40% for the aggregate of Project Proposal and Interim Report (if you do not achieve this, then you are deemed to have failed),
2.   gain at least 40% for the total marks of Project Report, Poster presentation and Q&A
3.   Attendance at the poster presentation is **compulsory**

All marks contribute to a single final rank score, from which a Letter Grade will be awarded as Course Result. The Letter Grade System will be used as you will graduate with a SUSS Award.

7 PROJECT PROPOSAL AND INTERIM REPORT

Please note that your supervisor will only give marks for what is contained in your report. No credit can be given for work he or she may know you have done but which is not included in the report. Supervisors are instructed to reserve a proportion of the total marks available for report that demonstrate a level of scholarship and authority in their approach that is appropriate to an honours level course. This does not mean that you should be undertaking original research, but that you should have shown a thorough grasp of the basic principles involved and shown that you can handle the material in an authoritative and original way.

> **Please note that the detailed requirements for project reporting at all stages will vary to some extent depending on the nature of the project. You should always negotiate a clear understanding with your supervisor of what you each expect in your particular area of investigation.**

7.1 PROJECT PROPOSAL

7.1.1 PROJECT PROPOSAL STRUCTURE

Your Project Proposal will usually be presented in three main headings in an **essay** form. The percentage given alongside each section indicates the approximate weighting of marks given.

PART 1: PROJECT DEFINITION (30 PER CENT)

It should include:

1. ***Project objective:*** the 'what' of the project. A statement of what is to be achieved, the expected outcome and possible use or value of the project. In experimental studies, this could be represented by the hypothesis that is to be tested.

2. ***Overall objective***: the 'why' of the project. Why you consider the project is important and worthwhile. Merely 'because it's there,' or 'data collection for its own sake,' are not good objectives. They are means to the end of confirming or confounding your predictions.

3. ***Proposed approach and method to be employed***: the 'how' of the project. A statement of how the objective is to be achieved.

4. ***Skills review***: this should be a review of the skills you will need to tackle the project. You should report on:

    - the criteria and targets you have chosen to help you assess your progress and performance during your project;
    - the skills you will need to achieve your targets;
    - your strengths and weaknesses;
    - your priorities for improving your skills.

PART 2: INVESTIGATION OF PROJECT BACKGROUND (40 PER CENT)

This will vary, depending on the investigative method being used. For instance, in strongly client-orientated investigations in the project areas of Design or Systems, it may well include investigations of client requirements and context. It will almost always include a critical appraisal of any background literature you have found to be important in formulating and developing your project. It should also relate the topic clearly

to existing similar work, where appropriate, and build on concepts and principles you have learned in other SUSS courses. This section is allocated the most marks, reflecting the importance that this aspect will represent in your project report.

PART 3: PROJECT PLAN (30 PER CENT)

This should include a diagram - a Gantt **chart,** matching the specific tasks to be completed in your project against the time available. There are many useful open source tools which can help you to create the Gantt chart and use it for tracking throughout the project phase.

Steps in creating a project plan:-
    a.   Identify the main phases in your project
    b.   In each phase, identify the tasks required
    c.   Estimate the effort for each task. Effort is expressed in hours.
    d.   Include exam revision week, plan the schedule for the whole project
    e.   Conclude the total effort required for your project in man-days (one man-days = 6.5 hours)

In addition, you should conduct a **risk assessment** and; report on the risks identified and the mitigation steps to be taken to ensure a successful project.

You should also consider the resources required for successful completion of the project, e.g. information or access to equipment and facilities. Be as specific as possible and state the position regarding agreements that have been reached about use of facilities, and so on. You should explain why you have created the plan in the way you have.

7.1.2 WRITING OF PROJECT PROPOSAL

This **Project Proposal** should be about 3000 words long. Your supervisor's comments written on the report will be reinforced in the subsequent supervision.

Your supervisor will be looking for the following:

- references studied, with comments as to their relevance;
- your understanding of the basic principles underlying the project;
- identification of a definite topic and relation to existing similar work;
- specification of the goals of the project;
- outline of a strategy for achieving these goals.

Throughout the report your supervisor will be looking for a critical and analytical approach to the problem being investigated. Be careful that in your enthusiasm you do not lose sight of the aims of the Capstone Project Course and the objectives of your project.

It is important that you include as much detail as possible in your Project Proposal, to enable your supervisor to give you guidance and advice. It may be that as a result of the submission of this Project Proposal you will have to revise the aims and methodology of your project, and in this respect it is crucial to consider your supervisor's advice very carefully.

7.2 INTERIM REPORT

This report should be presented under three headings.

PART 1: PROGRESS SINCE THE PROJECT PROPOSAL REPORT (30 PER CENT)

This section should contain a brief statement of the following elements:

1. A restatement of the project objective: has the objective changed or been developed since the submission of the Project Proposal? If it has not changed or developed, state why it has stayed the same.

2. Your progress: use the criteria you recorded in your Project Proposal report to judge your performance and progress. You should:

    (a)   review the targets you have set yourself;

    (b)   identify what you have achieved so far and where you may need to focus your efforts;

    (c)   state what action you have taken in response to your tutor's comments on your work;

    (d)   record any new targets you have agreed for the next stage.

3. Problems and successes: a comment on the successes of the project so far and/or any practical problems that have arisen and how they were tackled;

4.   A critical assessment of any further literature you have read, or a reinterpretation of some of the material you presented in the Project Proposal report, in the light of further experience;

5.   Project plan. Refer back to the plan you proposed in your Project Proposal report. How successful has it been? Explain the reasons for any changes you have made. Summarize the tasks you have to complete in the time remaining.

PART 2: DRAFT CHAPTER (40 PER CENT)

In general, the draft chapter should indicate your grasp of the method(s) of investigation you are using in your project, though the most appropriate way to do this may vary with the investigative strategy being employed. Discuss with your tutor **how best to do this**. In many projects, it will be appropriate for the chapter to be a presentation of the theoretical background you are using, the methodological options that were available to you, the methods you are actually planning to use, and your interpretation of any findings to date in the light of the literature you have studied so far. However, in projects with a strongly iterative element (commonly the case in projects using systems or design methods) it will often be much more appropriate for this chapter to be a presentation of your first iteration through the method (showing the output at each stage), your rationale for approaching it in this way, and your reflections on your first attempt.

Treat this as though it were a chapter in your final report, (although remember that it is a draft, and can be amended or replaced later if necessary) so make sure you read the notes on style and presentation in Section 8.

If you submit a draft chapter on **literature review** or just a **summary on different sections of the proposed final report**, **NO MARKS** will be awarded.

PART 3: REPORT STRUCTURE (30 PER CENT)

This section should include a list of chapter headings for your final report, with a brief synopsis outlining the likely content of each section. You should also include an approximate word or page count for each chapter.

The interim report should be 3000-3500 words overall in length.

7.2.1 ADMINISTRATION OF PROJECT PROPOSAL AND INTERIM REPORT

For administrative purposes, the assignment numbers of the initial and interim reports are:

- Project Proposal report: TMA 01

- Interim report: TMA 02

The cut-off dates for submission of these are shown on the separate project activity timetable.

Your Project Proposal and Interim Report will need to be submitted electronically to Canvas. Instructions on how to submit will be disseminated to you via Canvas. Essentially, you would have to complete your Project Proposal/Interim Report in a **WORD** document. Where questions require you to provide diagrams, illustrations or equations, you would need to use the drawing tools or equation editor from your software. You need to make sure that your diagrams are clearly illustrated and labelled.

Plagiarism or copying from other persons' work, either from other students or published material in books or papers and submitted as your own for assessment is considered a form of cheating. This is considered to be a serious offence and will be penalised according to the extent involved and whether it is decided there was an attempt at deliberate deception, or whether bad practice was involved. If you do use information or ideas obtained from textbooks or other published material you must give a precise reference to the source both at the appropriate point in your narrative and in a list of references at the end of your work. Direct quotations from published material should be indicated by quotation marks and referenced in the text.

8   Project Report

8.1 COMPONENTS AND MARKING

The Project Report is a very important element in the course **and** accounts for **40% of the total marks** available for the course. Your supervisor and the examiner both mark your report, but you will not receive any feedback until the presentation day.

The Course Team's recommended marking schedule for the project report is shown below. The project report is a composite document with two distinct parts.

PART 1 TECHNICAL REPORT

The first, and major, part is a technical report on your work. This should be written in a form suitable for publication to inform others working in the same area about your work. It should be about 7500 words in length, excluding appendixes. Further guidance is given below in sub-section 8.2. The general mark allocation for a typical report might be:

Design   **20%**
A critical analysis and explanation of the project and clarification of its aims and the production of evidence showing that a computer model, a mathematical model or a system prototype (could be a mix of hardware/software) has been constructed.

Conduct of the technical investigations and experiments   **30%**
Integration of technological understanding in achieving the aims of the project. Show how a design is tested, and how the results will be evaluated in the light of suitable established performance metrics.

Review of literature   **10%**
Independent reading and study, and critical use of literature in discussing the findings of the project. Ability to demonstrate use of referencing in literature review.

Project management   **10%**
Organization of work and of component activities of the project with an understanding of how modern engineering project management techniques are used in the project work.

Reporting quality   **10%**
Clarity of presentation of the report and the quality of the language used as well as that of the clarity of diagrams/drawings.

Overall, this part will carry **80%** of the marks for the project report.   The project report must be written in reported speech.

PART 2 CRITICAL REVIEW AND REFLECTIONS

The second part of the project report is a critical review of the process you have been engaged in as you tackled your project and what you have learnt in doing it. It should be 500 words in length and should not have any appendixes other than diary summaries. This section gives you an opportunity to gain credit for otherwise non-assessed parts of your work.

An important part of your review is to provide an account, based on your meeting logs, reports, plans, logbook and any other notes you have made, of how your skills have developed over the project. You

should refer back to the criteria and targets you set at the beginning of the project, and assess your performance and progress against these. Comment on how you tackled the skills you identified as being weaker, and what you did to adapt your learning in response to your supervisor's comments. You will find more details about what you should include in your review in Section 10.

It is important that as well as your successes, you record your failures; that is, the dead ends or false trails. Explain the reasons for the failures and why they were not predicted. Some of this may appear in your technical report. You must decide the balance between the two parts. One of the aims of the course is to *teach you how to do a project.* Some students may not reach a definite outcome, such as a solution to a problem or a working model. They may nevertheless have learned just as much, if not more, than those who do. Unless you record the whole progress of your project, the examiners will be unable to tell what you have learned.

Keeping a project diary from the initiation of your project is a good way of recording events and reflections. It will provide the basic material from which to construct this part of the report.

This part will carry **10%** of the marks for the project report.

ORIGINAL AND IMAGINATIVE WORK

The marking scheme for the two parts outlined above account for 90% of the marks available for the project report. The remaining **10%** of the marks are awarded for reports that demonstrate a thorough grasp of underlying principles and their application to the project topic in an original or imaginative way. These marks are available to all students, as it is recognized that these qualities may be present in reports which for other reasons will not score high marks. They will be awarded by the markers on the bases of their overall impression of the report.

REVIEW OF WORKING MATERIALS

During your project you should be prepared to pass to your supervisor for review any working materials you have developed. A supervisor may call for material to provide evidence of claims you make in your reports; such as a request to see a questionnaire, interview notes, detailed calculations, or a project diary.

Some of your working materials may usefully be included in appendixes to your project report to illustrate key points. However, you should beware of creating vast detailed appendixes of photocopied articles, completed questionnaires, etc. In general, **material in appendixes** should **illustrate, support and enhance** points in the main report. The report itself should be capable of standing alone, being logically complete and making sense without the appendixes.

LENGTH

The formal requirements of the *Capstone Project* allow for some flexibility, but the average length of a project report (Parts 1 and 2 together) should be about 8000 words. Consult your supervisor if you think that yours may exceed 10000 words. It may be that you are including unnecessary material, or could organize the structure in a better way. *Reports which exceed 11000 words, excluding appendixes, will be penalized.*

CONFIDENTIAL MATERIAL

SUSS's Examination and Awards Committee cannot accept a project report which contains confidential material. The reason for this is that all project report will be made available for future references.

ACKNOWLEDGEMENTS IN PROJECT REPORT

You are required to specify and acknowledge the kind of support in your project work you may have received from your employers, or anyone else, by completing the statement. *Assistance received from employer or other source* included at the back of this handbook and submitting it with your project report.

This formal requirement does not remove the need for the inclusion of the usual acknowledgement of assistance from any source.

SUBMISSION OF YOUR REPORT

You must provide **two** word-processed, hard copies, of the project report and upload the softcopy of the **report and any other software developed** for supervisor and examiners' review. The 2 hard copies should be bound using plastic binding combs. You are strongly advised to keep an **extra** copy of the report. Both hardcopies will be retained by SUSS. Remember to allow plenty of time to make corrections and final amendments. **Handwritten** reports are not accepted.

Checklist:
- 2 hard copies (bound using plastic binding combs)
- Upload softcopy of:
  - One folder for report (this is a must).
  - One folder for meeting logs (this is a must).
  - One folder for software system (only if applicable).
  - One folder for any other item if applicable (e.g. item A).
  - One folder for any other item if applicable (e.g. item B).

Samples of project report cover page, table of contents and references are shown at the end of this handbook.

Hard copies of your project report should be printed on single-sided A4-size paper. Please reference the sample cover page and ensure that your name, personal identifier, project title and project code are printed.

SENDING IN YOUR REPORT

Detailed instructions on how to submit your project report will be sent to you later in 2nd semester of your project.

Note that since this report has to be assessed prior to the presentation day, **no reports will be accepted after the cut-off date of submission.**

For the case of late submission or non-submission, student's project will be automatically given an in-progress status, i.e. an extended of 6 months, and will be charged $550** for this extension. For this case, the student's project report submission and poster presentation will be done 6 months later together with the later batch of students. There will be a deduction of 5 marks (which is equivalent to a drop of 0.5 GPA) for the student's capstone project grade. (** This fee is subjected to change).

8.2 STRUCTURE OF PART 1 OF YOUR PROJECT REPORT

CONTENTS OF PART 1

The exact structure of your report will depend on various factors, including the investigative method employed. This is certainly an area you should discuss with your supervisor. A typical Capstone Project report would have the following sections:

- Title page
- Abstract
- Acknowledgments
- Table of Contents
- Introduction
- Aims
- Main text and discussion (usually several sections, each with a title relevant to the context of your particular project)
- Conclusions and recommendations
- Reflection
- References
- Appendixes, including any risk assessment
- Glossary

ABSTRACT

You must include an abstract with your report. The abstract may be as brief as 200-250 words and should never be more than one side of A4. It should fulfill two purposes:

- it should provide a general picture of the report and its contents for someone who has not yet read the report itself, but who, as a result of reading the abstract, may subsequently wish to do so;
- it should also serve as a useful aide-memoire for someone who has read the report but wishes to have an overview readily available.

The range of projects on the Capstone Project Course makes it impossible to be prescriptive about the content and style of an abstract. Indeed, there is no agreed standard layout, but students should be aware of the purposes outlined above and structure the abstract accordingly.

The abstract should therefore:

- say something about project objectives and methodology adopted;
- include any necessary background information;
- comment on any findings or results;
- emphasize any major conclusions;
- have a value as a stand-alone document, giving enough information for the reader to understand what the project has all been about.

In other words, the abstract must be concise, self-contained and self-explanatory.

INTRODUCTION AND AIMS

The introduction should explain the content of your project, placing it in the context of other relevant work in the field. This should be followed by a formal statement of the aims of your work.

MAIN TEXT AND DISCUSSION

The main text consists of one or more sections covering procedure, experimental work, data collections, tabulated or summarized results and an analysis of the accuracy and significance of the results.

In subdividing your sections into a more detailed structure, there are two major factors to consider:

1.   the coherence and logic of the argument;
2.   a strategy for capturing the reader's interest.

CONCLUSION AND RECOMMENDATIONS

The final conclusion and recommendations sum up your achievements and failures and point the way to future work, which could be taken up by students of the *Capstone Project* in future years.

GLOSSARY

Certain projects make extensive use of technical terminology specific to an organization or industry. Others, such as projects in engineering mechanics, use various standard and non-standard symbols and variables.

In-house technical terms should be defined, and variables listed (with units and definitions), in an appendix.

8.3 STYLE, PRESENTATION AND DATA HANDLING

This section is intended as a guide to help you in writing your project report. Within the *Capstone Project Course* there will be significant differences between engineering, design, or analytical reports.

We do not wish to prescribe your style, but merely to affirm that a good piece of writing is easily recognized; being noteworthy, among other things, for its clarity, conciseness and orderly presentation. Above all, remember that your report should be addressed to a general but informed reader, and written so that someone else could, if necessary, continue with the work.

VISUAL PRESENTATION

Appearance is important, though of course it must always remain a matter of taste.

- Use A4-size paper and leave at least 40 mm for the left hand margin and about 25 mm for the right hand margin. Also leave about 40 mm at the top and 25 mm at the bottom of each sheet.
- Use font size 12 and Times New Roman as the font type for your report.
- Ensure that if you work in SI units you use the correct symbols and their prefixes. The same applies to mathematical symbols.
- Number each sheet at the top. Make cross-references by section rather than by pages, because page numbers may change later.
- Chapters, sections and subsections should be numbered for reference, but avoid ugly sub-sub-section numbering such as 4.2.3.6. Mixed labelling can be useful, for instance 4.2(c)(vi). However, such detailed labelling is really only necessary in a closely argued or legalistic document, such as an industrial tender for contract. To keep the contents list short, include only numbered headings. There is probably no need to exceed two numbers here such as 4.2 or 3.4.
- Headings should be used at the beginning of chapters, and wherever necessary elsewhere, to point the way or avoid confusion. They should be underlined, or distinguished by a change of size or font.

FIGURES, TABLES, EQUATIONS

- Graphs, histograms, drawings, diagrams and photographs should all be referred to as figures: Figure 1.1, Figure 1.2, and so on.
- Either places the figures in the text next to where they are first needed or, if there are a large number of them; collect them together at the end of your report.
- Check all references to figures and any information you quote within the details of the figure.
- Tables should be used to present information concisely where graphs or histograms are not appropriate. In setting out tables, arrange the data so that there are more rows than columns and use a minimum of horizontal lines.
- Table headings should be by chapter in the order in which they are mentioned in each chapter, e.g. for Chapter 1 they would be 1.1, 1.2, 1.3, and so on. They can then be referred to in the text by number only (e.g. Table 1.1).
- Where you use a large number of tables they may be collected at the end of the report; but if you use only a few, place them in the text near to where they are first referred to in detail.
- Equations should be numbered only when they are to be referred to later or taken as a result for later mathematics. Numbering them by section (e.g. 2.3, 2.7) ensures that if one is deleted or you need to refer to an equation you have not previously numbered, only those in that section need to be re-numbered. Keep the number to the right, well away from the equations, and check all references to equations when reading your final draft.

REFERENCES

- Reference should be given in the text to any previous work from which you have quoted results, taken tables or reproduced figures, or which you have used for relevant background information.
- At the end of your report give a list of references, either in numerical order if you used numbered references, or in alphabetical order of first authors.
- The main point to consider in giving a reference list is that the work should be easily identifiable if the reader wishes to look anything up.
- You must acknowledge *all* your sources of information, whether publications or people. You will be credited for this. You will be penalized if you try to claim as your own work something that was not, or if you do not provide sufficient details of your sources of reference.
- Producing a reference list *after* completing your project can be tedious and result in inaccuracies. You may have returned a paper to the library and will have to waste time looking up references. Therefore, *we suggest you make notes on the references as you read them* or take material from them following the style given above.
- The format for citing the references must be consistent. Students are advised to refer to recent project report kept in the library.

THE PLACE OF COMPUTER PROGRAMS

A number of projects involve some software development. At one extreme this may actually be the point of the project. At the other extreme it may be a fairly standard program that you have either written or adapted.

Simple programming and data manipulation are considered as a means to an end, and details can often clutter up the text. If you have undertaken something which you consider above the ordinary, include a description of the procedure in the text and *confine details of any software to an appendix.* This will allow you to present your findings clearly.

If, however, you have based your work on a novel mathematical model, you should describe this in the text.

MEASUREMENT AND ACCURACY

Where your work is based on experiments that include actual measurements made, it is necessary to give the reader some indication of the anticipated errors (in this sense, error relates to a limit in accuracy rather than a mistake).

9   VIDEO SUMMARY, ORAL & POSTER PRESENTATIONS

9.1 WHAT TO EXPECT

In all academic, commercial or industrial employment you will find that you have to give some form of oral presentation to your colleagues as well as having to produce written reports. Additionally as training to develop the creation of personal portfolios, you will learn how to produce a video and poster summaries of your project work. The Capstone Project Course recognizes all these needs. In this course you will be expected to write a project report, produce a video project summary and to present your work orally by giving a short illustrated talk beside a poster to both your supervisor and examiner. Besides other senior academic staff from SUSS as well as the general public may also show great interest in your work and request for an oral account of your project work.

Presentation day will take place a few weeks after the cut-off date for submission of your project report. You will be able to use this time to prepare for your presentation. You should not let the need to prepare your talk influence the quality of your written project report. This will normally take place in November (for projects starting in Jan of the same year) or May (for projects staring in July of previous year).

The School will write to you in **2nd semester** through **MyMail** as well as **posting an announcement on Canvas** to inform you of the venue and date for the poster presentation. Attendance at the poster presentation in person is **compulsory**. Failure to attend the poster presentation constitutes to an **overall FAIL** grade in THE CAPSTONE PROJECT COURSE. The poster presentation serves as training for THE CAPSTONE PROJECT COURSE students to practise the presentation of technical project work in front of an audience, which is frequently required in professional engineering work.

In **exceptional circumstances**, the poster presentation might be conducted by a video conference or other means if, for example, a student is disabled in a way (due to severe illness) which prevents attendance at presentation day in person.

9.2 Video, Poster and Powerpoint Slides

Using your poster and powerpoint slides as visual aids, you will prepare a talk on your work for the Capstone Project Course. After your talk, be prepared to answer questions for ten minutes. The length of your talk is important; you should keep it to about 15 minutes. Your supervisor will be able to give you some help in preparing your illustrated talk.

Do not attempt to get too much information over in such a short time. You will need to mention the scope, outcomes, successes and failures of your project and any significant learning experiences during your year with the Capstone Project Course.

Your poster design should follow the Poster Design template given in Canvas, including the background color.

Additionally, you must submit a short video summary (as an *.mp4 file) describe the problem you are trying to solve, the methods/approaches used to solve the problem as well as an evaluation/reflection of how successful the problem solution process had been for you. This video summary should be of 3 to 5 minute duration and submitted at the same time as the hard copies of the final report. You will need to upload this onto the Capstone link on the CANVAS system. The video summary will be assessed alongside the poster presentation. Only students admitted to the Capstone Course from January 2018 onwards need submit the video summary.

9.3 Grading Criteria

Oral Presentation	
Criteria	**Description**
Delivery	• Voice, poise, and eye contact make a favourable impression • Smooth and clear delivery • Adhere to timing of 15min
Organization	• Presentation has a logical organization • Speaker makes clear what was done and how it was done
Content	• Presenter demonstrates adequate knowledge of the subject • Design, methods, results and conclusions are clearly stated • Information given is consistently accurate
Poster/Video Summary Design	• Adhere to poster design/video summary requirements • All points are well organized and the main points stand out • Information is concise
Slide Design	• Accurate and concise content • Organisation and completeness of slides • Effective use of text/ animation/ graphics
Question and Answer	
Criteria	**Description**
Accuracy	Correctness in answering fact-based/ open-ended questions
Clarity	Clear reasoning and/or appropriate use of examples/ illustrations for answering questions
Knowledge	Ability to cite/ specify theories in answering questions
Confidence	Responds well to questions
Communication	Ability to explain well and convince the audience

10 SKILLS

10.1 WHAT ARE KEY SKILLS?

In the broader sense key skills are those fundamental, taken-for-granted skills that we all use as we learn new things, whether we are carrying out everyday tasks and activities or more formal academic or work-related projects. These generic skills are not only essential to effective learning but are also widely valued by employers who want flexible, adaptable individuals capable of identifying their own learning needs and able to take the initiative in planning their own professional development.

The rationale for including key skills in this course is to provide a focus to help you to set your own targets, and monitor and assess your own performance during the project. Once you get started it is easy to become absorbed in the details and forget that an important goal of the course is learning how to do a project. This means learning how to plan, manage and review your project as it develops, and being consciously aware of how you are using and developing your skills.

THE key skills work focuses on communication and learning how to learn. Communications skills are central to the course. During the course you will be writing reports to present your plans, progress and results. As the project develops you will be discussing your ideas with your supervisor accounting for your successes and failures and setting targets for each stage. You will be keeping a log book of your activities, recording ideas, successes and setbacks. Finally, you will be presenting your project at the presentation day. Doing well in the course, therefore, hinges on the skill of being able communicate effectively about your project in a number of different ways.

10.2 THE CAPSTONE PROJECT COURSE KEY SKILLS FRAMEWORK

Key skills work is embedded in THE CAPSTONE PROJECT COURSE and is explicitly addressed in the initial and project report. From the beginning you will be encouraged to take an active role in setting realistic targets for what you want to achieve, planning your project work appropriately and regularly reviewing your progress. The emphasis is on you taking control of your project, rather than it controlling you. It is in the nature of project work that some things go well and others not so well, some activities may take longer than you expected, and some targets may turn out to be unreachable. What is important is that you regularly record and review your progress so that you can give an account of how you coped with the problems as well as the successes. The key skills framework of THE CAPSTONE PROJECT COURSE is intended to help you focus on the skills you need to steer your way successfully through the project.

You will need to integrate, monitor, develop and critically reflect on your learning and skills within the context of your project. You should be able to identify what skills you need, be able to use and adapt your prior academic and work experience, and extend and apply your knowledge and skills to meet the demands of your project as it develops.

At this level the focus is on helping you develop as an independent learner. Setting your own criteria to help you judge how well you are doing, being aware of your strengths and weaknesses, targeting weaker areas for improvement, identifying where you need help, and regularly reviewing your progress against criteria are all part of high-level key skills.

You should ask yourself:

- Am I able to identify and analyze the activities I need to do?
- Am I able to schedule my work?
- Am I able to agree criteria and targets for the different stages of the project and monitor my work?

- Am I able to assess my progress against the criteria, and identify potential problems in achieving them?
- Am I able to record and review my decisions and activities throughout the project?

The checklist of key skills indicates the standard you should be aiming for and the generic skills (those not specific to the subject area of your project) that you will need to focus on.

As you work on your project you will undertake four main types of activity:

- preparing and planning
- exploring and researching
- doing and presenting
- reflecting and reviewing

Although most preparation and planning will be at the start of your project and the majority of reflecting and reviewing towards the end, in fact you will iterate between these activities throughout the project.

Here are some examples of how key skills relate to these activities.

In the early stages of your project you will be identifying what you need to know and what you need to do to achieve your goals. From a key skills point of view, you will need to think about:

- What skills will you need to tackle the project? For example, skills related to searching for and selecting information, skills related to learning technical detail, and skills related to communicating your ideas clearly.
- How will you judge your progress? You will need to propose a set of criteria against which you can assess how well you are doing. It is important to set targets and be able to refer back to them. Such criteria are not set in stone, you may refine or change them as the project develops. What is important, however, is to be clear about your current targets and to be able to explain how you intend to achieve them. In the project report you will be asked to review and reflect on your progress using the criteria you have proposed.
- Why have you chosen your particular criteria and targets? You should be able to justify your choice of criteria and explain if they have changed from those you recorded after your first meeting with your supervisor.

Later you will need to take stock of and report on your progress. You should review your progress critically against the criteria and the plan you established at the start.

Are you working to the standards implied by the criteria? Are you on schedule? Do you need to change your plans or your targets, and if so, why? You will have received feedback from your supervisor (as well as from your own experiences) about finding out what has worked well and not so well. Ask yourself how you have responded to this feedback, what actions you took and what the results were. Try to assess what you have learnt so far about managing your project, what has worked well and what would you have done differently?

Learning how to present your work clearly and effectively is an important part of this course. You will need some practice and guidance in presenting your results both in written form (via the Project report) and orally. Arrange with your supervisor or a friend to have a session where you can practice your presentation day skills. You will need to be able to produce posters or films which capture the essence of your project, and talk through the points you have listed. Audit your own skills: identify your strengths and weaknesses, say where you need advice, and decide what you intend to do about the advice you have been given.

10.3 SUMMARY

Being able to look critically at how your work is progressing, being able to explain and justify any changes, being able to identify areas that you need to concentrate on or skills that you need help with, are all part of you taking an active role in learning how to do a project.

Taking a critical approach to your own skills development is central to being an independent and active learner. The key skills you develop and demonstrate in your work are rapidly becoming as important as the subject knowledge you acquire. Subject knowledge can become outdated relatively quickly in some areas but the key skills component of your studies are intended to underpin a longer-term goal of being able to learn effectively, long beyond formal study. The skills you have learnt from this Capstone Project Course should put you in a better position to:

- focus on what you are learning and how you are learning it,
- learn effectively in new situations and contexts;
- be clear about your strengths and weaknesses;
- recognize and develop your range of skills.

SINGAPORE UNIVERSITY OF SOCIAL SCIENCES
SCHOOL OF SCIENCE AND TECHNOLOGY
(Times new roman, 16pt, Bold, CAPS, Centered)

INVESTIGATING THE USE OF ENCRYPTION TECHNOLOGY IN SMART CARDS
(Times new roman, 20pt, Bold, CAPS, Centered)

STUDENT   **: XXXXXXX (PI NO.)**
SUPERVISOR   **: XXXXXXX**
PROJECT CODE   **: JAN2010/XXX/YYYY**
(Times new roman, 14pt, CAPS, Centered)

A project report submitted to Singapore University of Social Sciences
in partial fulfilment of the requirements for the degree of
Bachelor of Engineering (*or Bachelor of xxxx*)
(Times new roman, 14pt, Centered)

November 2017

<Copy for Supervisor/Examiner>

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Place a list of the references you have cited in the text. Arrange this in alphabetical order of authors' surnames, and chronologically for each author, where more than one work by that author is cited.