Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Biomedical Engineering

MAI Handbook
2017–2018
## Contents

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Overview

Dear Biomedical Engineer,

As students of the Biomedical Engineering stream of School of Engineering, you are among the select few who have joined the biomedical engineering community at Trinity College Dublin for an education that will enable you to become the next leaders in the field of biomedical engineering.

As you now know some of the most exciting work in engineering today takes place at the intersection of disciplines. Research in biomedical engineering is an example of where the biological, physical and digital worlds intersect and where you have the opportunity to have a profound impact on society. Engineering is not just about crunching numbers or solving problems; it is seeing how problems affect society and how society actually changes because of the solutions you provide. You have an opportunity here as students in biomedical engineering to become involved in that community, so that, as you move into your professional life, you will become a leader who has an impact on the human condition.

You are part of a discipline that offers great opportunities for learning and advancement within Ireland’s premier university. You are now part of the Trinity Centre for Bioengineering. The Centre brings together over 30 academics from the Schools of Engineering, Natural Sciences, Dental Sciences and Medicine in Trinity and colleagues from the Royal College of Surgeons in Ireland, Dublin City University and University College Dublin. There are also over 100 postdoctoral, PhD and MSc researchers working in the Centre. All of these researchers are involved in exciting new developments in biomedical engineering ranging from developing new materials for use in cardiac care, analysing minute electrical signal changes in the brain for neurological diagnosis to artificially growing new tissue for organ transplantation. The Trinity Centre for Bioengineering has extensive clinical research in all the five teaching hospitals in Dublin (St James’s Hospital, Tallaght Hospital, St Vincent’s University Hospital, The Mater Misericordiae Hospital and Beaumont Hospital). As a member of this biomedical community, use the opportunity to learn from activities in the Trinity Centre for Bioengineering, so that you can relate your course material to the real clinical challenges that are being researched and the solutions being generated.

The Trinity Centre for Bioengineering is based in the Trinity Biomedical Sciences Institute and many of its laboratories are located here. You will be sent emails of seminars, news and other developments. Keep up to date with these and your studies will become more fruitful and relevant.

This handbook contains information regarding the course including modules, assessment, course regulations, faculty members and important contact details.

On behalf of all the lecturers and staff, I would like to wish you every success. We look forward to you becoming part of the Trinity College Biomedical Engineering family as you embark on making your mark on society at large.

If you have any questions or comments, please do not hesitate to contact us.

Professor Daniel Kelly
Course Director MAI Program in Bioengineering
Biomedical Engineering – Mission Statement

The Trinity Centre for Bioengineering (TCBE) in the School of Engineering at Trinity College Dublin carries out world class research in four research themes: (1) Tissue Engineering & Regenerative Medicine, (2) Medical Devices & Advanced Drug Delivery, (3) Biomechanics & Mechanobiology and (4) Neural Engineering. These themes are based on the intersection of biomedical science and engineering and form the foundation for advances in external and implantable devices, surgical and medical device design, as well as informing clinical studies and interventions in ageing, neurodegeneration and rehabilitation. The Centre provides a structure to bring bioengineers, basic scientists and clinicians together to focus on important clinical needs.

The TCBE also has a long and distinguished tradition in postgraduate education, combining fundamental research with translation to clinical practice. The new Biomedical Engineering stream now extends this to the undergraduate BA/MAI programme within the School of Engineering. The main objective of this new stream is the pursuit of excellence in teaching and research in Biomedical Engineering with the central aim of producing graduate engineers with a capacity for independent thought in problem solving and creative analysis & design.

To achieve this, we must:

- instil in students an enthusiasm for the art and practice of Biomedical Engineering;
- teach engineering, medical sciences and mathematics which underpin the subject areas of Biomedical Engineering;
- demonstrate the application of these principles to the analysis, synthesis and design of biomedical engineering components and systems;
- foster the development of team working skills;
- encourage students to exercise critical judgment and develop communication skills necessary to make written and oral presentations of their work.

These objectives are underpinned by:

- undertaking both basic and applied research
- provision of advanced facilities for students to undertake graduate research degrees
- the development of academic staff in teaching and research by ensuring that adequate resources are available to assist them
- ensuring that the research work is of the highest international standard by participation in international conferences and publication in peer-reviewed scientific journals.

In addition, we must consider:

- the requirements of the relevant professional institutions
- the needs of Irish and European industry in the curriculum.
Staff contact procedures

From time to time, you may find it both useful and in some cases, necessary to contact members of the teaching staff on the degree programme. You should respect the importance for academic staff of maintaining an orderly timetable of work, and therefore you should not contact teaching staff out of agreed hours. If in some cases contact is made by email, messages should be polite and succinct, clearly indicating the nature of the query within both the subject title and body of the text.

Before contacting individual members of staff it is worth asking yourself the following questions:
1. Is speaking with the member of staff the best way of resolving the issue?
2. Have you investigated any other methods of addressing the problem using your own initiative?
3. Is it a matter that might best be first addressed to someone other than this particular member of staff, e.g. class representative, college tutor, course director, course administrator?

Please use the following general guidelines for staff contact:

- **Module Coordinator** (email addresses listed in module summaries): Contact the module coordinator directly for queries relating to a specific module. e.g. any issues with content and assessment of Module, blackboard/lecture material, attendance at practicals/tutorials, etc.
- **Year Coordinator** (Prof. Daniel Kelly, email only at kellyd9@tcd.ie) issues relating to the course in general, any queries that could not be resolved by contact with module coordinators. The year Coordinator and Programme Director can be consulted in person by appointment only. Please make an appointment via email several days in advance. Please respect the time allocated for consultations.
- **Discipline Administrator** (bioeng@tcd.ie) - all general queries

**Personal References**

Members of staff are usually willing to act as referees. It is an important courtesy that each individual is asked before giving his/her name as a referee. If s/he is has not given permission, s/he could properly refuse to provide a reference. Please allow adequate time for references to be prepared. This is 1-2 weeks. **Please provide a CV and personal statement and details of the reference required in your initial email to avoid unnecessary correspondence.**
MAI Prerequisites

The MAI programme is structured to facilitate delivery of higher-level content through prerequisite modules. The term ‘prerequisite’ indicates a module which it is strongly recommended to complete prior to embarking on a new one. Only in exceptional circumstances will a student be permitted not to complete prerequisite modules. Some of the fourth year modules are prerequisites for some of the fifth-year modules and some MAI projects in the different disciplines. In general, it will not be possible to take fifth-year modules or MAI projects without having completed the required prerequisites for these activities (see module descriptors for details). Accordingly, for students opting for a placement in their fourth year, or for those following Unitech/Erasmus or another period of study abroad, it will be necessary to ensure prerequisites are met for a suitable set of modules and the project work in the fifth-year.

Meeting the prerequisites in cases where a student opts for a placement in their fourth year, or for those following Unitech/Erasmus or another period of study abroad might be achieved by:

1. in the case of a half-year placement, the student taking the prerequisite modules for their intended fifth-year modules/project work in the semester they spend at College (this will generally be the first semester). Prerequisite modules will, where possible, be timetabled for the first semester.

2. in the case of a period of study abroad, the student taking modules equivalent to the prerequisites for their intended fifth-year modules/project work during their period of study abroad in their fourth year.

3. by the student taking only fifth-year modules/projects which do not have prerequisites.

4. by student taking fourth year prerequisite modules in the first semester of their fifth-year. However, for the latter option, since this would be on a case-by-case basis, the timetable cannot be specifically arranged to facilitate this.

In relation to point 4, the following guidelines apply across all stream of the M.A.I.:

“To enable an appropriate fifth-year study plan for all students who go on internship in the second semester of their fourth year and for those students who have studied abroad for all or part of their fourth year, it will be allowable in some circumstances for fifth-year students to take up to 10 ECTS of appropriate fourth-year modules. These modules must be chosen so as to strengthen their chosen area of specialism and, where possible, also support their fifth-year project work. The choice of modules for the fifth-year for all students intending on going on internship should be made with the agreement of the Head of Discipline or his/her delegate. Note: timetabling requirements will prevail and may prevent particular combinations of modules which are acceptable from an academic perspective. In these limited cases where fifth-year students do take some fourth year modules (up to a maximum of 10 ECTS), different assessment procedures will apply, and hence different module codes and MAPS will be needed. In general, the pass requirement for fifth-year students will be 50%.”
The table below shows the MAI modules, their credit value and the coordinator. Each student in this stream must take 5E1 and 5E2. In addition, they must select other modules with a combined value of 30 credits. The availability of modules, or combinations of modules, is subject to departmental resources, timetabling constraints and sufficient student numbers.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Code</th>
<th>Module Title</th>
<th>ECTS</th>
<th>Term</th>
<th>Module Coordinator</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE5E01/ME5E01</td>
<td>5E1</td>
<td>Biomedical Engineering Research Project</td>
<td>25</td>
<td>All year</td>
<td>Prof. Daniel Kelly (<a href="mailto:kelly9@tcd.ie">kelly9@tcd.ie</a>)</td>
</tr>
<tr>
<td>CE5E2</td>
<td>5E2</td>
<td>Research methods</td>
<td>5</td>
<td>1</td>
<td>Prof. Bidisha Ghosh (<a href="mailto:BGHOSH@tcd.ie">BGHOSH@tcd.ie</a>)</td>
</tr>
<tr>
<td>ME5BIO1</td>
<td>5BIO1</td>
<td>Medical devices</td>
<td>10</td>
<td>1 + 2</td>
<td>Prof. Bruce Murphy (<a href="mailto:murphb17@tcd.ie">murphb17@tcd.ie</a>)</td>
</tr>
<tr>
<td>ME5BIO3</td>
<td>5BIO3</td>
<td>Tissue engineering</td>
<td>5</td>
<td>2</td>
<td>Prof. Conor Buckley (<a href="mailto:cbuckle@tcd.ie">cbuckle@tcd.ie</a>)</td>
</tr>
<tr>
<td>ME5BIO7</td>
<td>5BIO7</td>
<td>Advanced Medical Imaging</td>
<td>5</td>
<td>1</td>
<td>Dr. Michael Monaghan (<a href="mailto:monaghmi@tcd.ie">monaghmi@tcd.ie</a>)</td>
</tr>
<tr>
<td>ME5MM3</td>
<td>5MEMS3</td>
<td>Supply chain management</td>
<td>5</td>
<td>1</td>
<td>Prof Garret O'Donnell (<a href="mailto:Garret.ODonnell@tcd.ie">Garret.ODonnell@tcd.ie</a>)</td>
</tr>
<tr>
<td>ME5MEMS7</td>
<td>5MEMS7</td>
<td>Risk management and safety assessment systems</td>
<td>5</td>
<td>1</td>
<td>Prof Anthony Quinn (<a href="mailto:Anthony.Quinn@tcd.ie">Anthony.Quinn@tcd.ie</a>)</td>
</tr>
<tr>
<td>EE5C03</td>
<td>5C3</td>
<td>Statistical Signal Processing</td>
<td>5</td>
<td>1</td>
<td>Prof Anthony Quinn (<a href="mailto:Anthony.Quinn@tcd.ie">Anthony.Quinn@tcd.ie</a>)</td>
</tr>
<tr>
<td>EE5C04</td>
<td>5C4</td>
<td>Speech and audio engineering</td>
<td>5</td>
<td>1</td>
<td>Prof Naomi Harte (<a href="mailto:nharte@tcd.ie">nharte@tcd.ie</a>)</td>
</tr>
<tr>
<td>ME5BIO4</td>
<td>5BIO4</td>
<td>Finite element analysis</td>
<td>5</td>
<td>2</td>
<td>Dr David Nolan &amp; Prof Caitriona Lally (<a href="mailto:dnolan4@tcd.ie">dnolan4@tcd.ie</a>)</td>
</tr>
<tr>
<td>ME5MM1</td>
<td>5MEMS1</td>
<td>Micro and precision manufacturing</td>
<td>5</td>
<td>2</td>
<td>Prof Rocco Lupoi (<a href="mailto:lupoi@tcd.ie">lupoi@tcd.ie</a>)</td>
</tr>
<tr>
<td>ME5B10</td>
<td>5B10</td>
<td>Instrumentation and experimental techniques</td>
<td>5</td>
<td>2</td>
<td>Prof. Dermot Geraghty (<a href="mailto:TGERGHTY@tcd.ie">TGERGHTY@tcd.ie</a>)</td>
</tr>
<tr>
<td>EE5C01</td>
<td>5C1</td>
<td>Digital media engineering</td>
<td>5</td>
<td>2</td>
<td>Prof. Anil Kokaram (<a href="mailto:Anil.Kokaram@tcd.ie">Anil.Kokaram@tcd.ie</a>)</td>
</tr>
<tr>
<td>EE5C07</td>
<td>5C7</td>
<td>Complex systems science for communication network</td>
<td>5</td>
<td>2</td>
<td>Prof. Nicola Marchetti (<a href="mailto:marchetn@tcd.ie">marchetn@tcd.ie</a>)</td>
</tr>
</tbody>
</table>
Lecture and Tutorial Timetable

*Attendance at lectures is compulsory.*  *Attendance at laboratories and tutorials is compulsory.*

The timetable for lectures is provided below. The tutorial Schedules will be announced at the start of each semester. Please note that you must attend the particular tutorial sessions to which you have been assigned. Students cannot swap sessions because of the complexity of the timetable, the large numbers in the year and the limited accommodation available.

The most up to date timetable is **always** online at:

https://www.tcd.ie/Engineering/undergraduate/pdf/MAIyear5Timetable_BIO.pdf

You are advised to check the online timetable regularly.
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<th></th>
<th>Cal. Wk</th>
<th>Dates 2017/18 (week beginning)</th>
<th>Outline Structure of Academic Year 2017/18</th>
<th>Notes</th>
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<tr>
<td>1</td>
<td>02-Sep-17</td>
<td>Supplemental Examinations</td>
<td>Statutory Term (Michaelmas) begins</td>
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<tr>
<td>2</td>
<td>11-Sep-17</td>
<td>Freshers' Week / Undergraduate Orientation Week</td>
<td></td>
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<tr>
<td>5</td>
<td>25-Sep-17</td>
<td>Teaching Week 1</td>
<td>Michaelmas Lecture Term begins</td>
<td></td>
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<tr>
<td>6</td>
<td>02-Oct-17</td>
<td>Teaching Week 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>09-Oct-17</td>
<td>Teaching Week 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>16-Oct-17</td>
<td>Teaching Week 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>23-Oct-17</td>
<td>Teaching Week 5</td>
<td></td>
<td></td>
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<tr>
<td>10</td>
<td>30-Oct-17</td>
<td>Teaching Week 6 (Monday, Public Holiday)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>06-Nov-17</td>
<td>Teaching Week 7 - Study Week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>13-Nov-17</td>
<td>Teaching Week 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>20-Nov-17</td>
<td>Teaching Week 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>27-Nov-17</td>
<td>Teaching Week 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>04-Dec-17</td>
<td>Teaching Week 11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>11-Dec-17</td>
<td>Teaching Week 12</td>
<td>6-Michaelmas Term ends Sunday 17 December 2017</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>18-Dec-17</td>
<td>Christmas Period (College closed)</td>
<td>22 December 2017 to 1 January 2018, inclusive</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>25-Dec-17</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>19</td>
<td>01-Jan-18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>08-Jan-18</td>
<td>Foundation Scholarship Examinations</td>
<td>Note: it may be necessary to hold some exams in the preceding week.</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>15-Jan-18</td>
<td>Teaching Week 1</td>
<td>Hilary Term begins</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>22-Jan-18</td>
<td>Teaching Week 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>29-Jan-18</td>
<td>Teaching Week 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>05-Feb-18</td>
<td>Teaching Week 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>12-Feb-18</td>
<td>Teaching Week 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>19-Feb-18</td>
<td>Teaching Week 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>26-Feb-18</td>
<td>Teaching Week 7 - Study Week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>05-Mar-18</td>
<td>Teaching Week 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>12-Mar-18</td>
<td>Teaching Week 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>19-Mar-18</td>
<td>Teaching Week 10 (Monday, Public Holiday)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>26-Mar-18</td>
<td>Teaching Week 11 (Friday, Good Friday)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>02-Apr-18</td>
<td>Teaching Week 12 (Monday, Easter Monday)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>09-Apr-18</td>
<td>Revision Trinity Week (Monday, Trinity Monday)</td>
<td>6-Hilary Term ends Sunday 8 April 2018</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>16-Apr-18</td>
<td>Revision</td>
<td>Trinity Term begins</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>23-Apr-18</td>
<td>Revision</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>30-Apr-18</td>
<td>Annual Examinations 1</td>
<td>Annual Examination period: Four weeks followed by five weeks for marking, examiners' meetings, publication of results, Courts of First Appeal and Academic Appeals.</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>07-May-18</td>
<td>Annual Examinations 2 (Monday, Public Holiday)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>14-May-18</td>
<td>Annual Examinations 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>21-May-18</td>
<td>Annual Examinations 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>28-May-18</td>
<td>Marking/Courts of Examiners/Results</td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>04-Jun-18</td>
<td>Marking/Courts of Examiners/Results (Monday, Public Holiday)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>11-Jun-18</td>
<td>Marking/Courts of Examiners/Results</td>
<td></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>18-Jun-18</td>
<td>Marking/Courts of Examiners/Results/ Courts of First Appeal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>25-Jun-18</td>
<td>Courts of First Appeal/Academic Appeals</td>
<td>6- Statutory (Trinity) Term ends Sunday 1 July 2018</td>
<td></td>
</tr>
<tr>
<td>45 to 52</td>
<td>02 Jul 2018 - 26 Aug 2018</td>
<td>Postgraduate dissertations/theses/Research 1-8</td>
<td>8 Weeks between end of statutory (Trinity) term and commencement of statutory (Michaelmas) term. This period is also used for writing up Masters dissertations and research theses due for submission in September.</td>
<td>6- Ends Sunday 26 August 2018</td>
</tr>
</tbody>
</table>
MAI Module Sheets
Details of all modules in the MAI Year are available online at

http://www.tcd.ie/Engineering/undergraduate/maiyear5/biomedical/
Guidelines for Thesis Report and Presentations

Objectives
The project forms the final part of the course. Members of staff propose projects pertinent to their own research interests. Candidates may propose their own projects, particularly in cases where the candidate has an industrial link, but these projects must be linked to the expertise of the proposed supervisor. Each project is supervised by an academic in the School of Engineering. In some cases other academics (either within TCD or the other institutions affiliated to the course) may also have a substantial involvement. Furthermore, additional guidance may come from medical or healthcare professionals. In these cases, the project usually sets out to solve a problem experienced by these healthcare professionals in the use of a particular medical device.

From 2017 onwards, MAI Projects will be issued by the School Office. All deadlines will be set and communicated centrally by the School Office.

Guidelines for Thesis Report and Presentations
This section emphasises the school's important regard for the acquisition of communication skills. These notes will help you to develop those skills and that you will take pride and pleasure in that development. You will find that you will not absorb all this information in a single reading. You should refer to these notes whenever you are carrying out a significant piece of writing and especially when you are writing your thesis.

These instructions have been prepared to indicate to both thesis supervisors and students the expected standard of report writing. It is likely that up to 20% of marks are lost by poor presentation of work. These notes are designed to help students to avoid common faults and improve presentation of work. The advice can be applied to major theses but also relevant to short reports and essays which may form part of in-course assessments.

Preparing a Synopsis
It is essential to prepare a detailed synopsis of any piece of written work which is likely to be more than one page long. A synopsis helps the writer to see clearly what the main points are and to arrange the material so as to bring out the important points. For the MSc thesis, the synopsis would show the order in which the material is to be presented, some idea of the length of each section, what is to be included in each section and an indication of the location of Figures and Tables.

There are two main objectives in preparing a synopsis:-
a) to produce a written document which can be discussed with the supervisor before a great deal of writing is performed.
b) to help the writer to plan the work to the maximum effect
This is essential for large reports and is strongly recommended as a general practice A carefully produced synopsis can save hours of writing time and will allow alterations and additions. Work which is not well-planned is likely to ramble and the main points will be lost.

Report Outline
Reports should be divided into the following standard sections:

1. Title Page
2. Abstract (Summary)
Occasionally the nature of the material may require a different format. **Students should consult supervisors before deviating from the standard arrangement.**

**Scheduling**

- **Literature Review** should be written early in the project when you have read in detail journal articles in the project area. The Literature Review will need to be brought up to date with new, more relevant papers as you continue to research the project.
- The **Methods** section should also be written very early in the project, after the Literature Review and “polished” later.
- **Results** should be in the process of being written up during the experimental part of the project.
- The **Introduction** is normally written last and is used to build the argument why the area of study is of interest and importance in bioengineering.

Now follows a short discussion of the headings listed above.

**Title Page**

This page should include:
- Concise title (not more than 15 words). Should be informative. Abbreviations should be avoided
- Author’s name
- Supervisors name
- Affiliation
- Date
- Degree for which thesis is being submitted

**Abstract**

- The abstract (maximum one A4 sheet) should be clearly written and readily comprehensible to a broad readership. The abstract should provide a concise summary of the objectives, methodology, key results, and major conclusions of the study. It should be written in complete sentences, without explicit subheadings.

**Table of Contents**

- This should include chapter headings and details of sections within chapters, with page numbers.

**List of Tables**

- This should include details of all tables with page numbers.

**List of Figures**

- This should include details of all figures with page numbers.
Acknowledgements
- Acknowledge all those who provided support to you and your project (e.g., organisation, funding body, supervisor, technicians).
- The Acknowledgements should be placed at the end of the text (before the references) except in the MSc Thesis, when they should immediately follow the Title and Summary.
- As a matter of courtesy all staff mentioned should be given a title (Prof., Dr, Mr, Ms) and both forename and surname. Only intimates should be referred to by first name only.
- Work contributed by others to your project must be acknowledged. Such a situation would arise if, for example, stored samples generated by another researcher were used in the project or if the nature of specific experiments to be included in the project dictated that they must be carried out by an experienced researcher. The titles and names of such contributors and the precise nature of their contribution must be included in this section in a clear statement of acknowledgement. An omission of such an acknowledgement, where required, is plagiarism. Plagiarism, as outlined elsewhere in this Handbook, is regarded by College as a serious offence and the student concerned will be penalised.
- All the foregoing are 'preliminaries' and should not be numbered with the main body of the text. Instead, give preliminaries Roman numerals (i, ii etc.). The pages of the main text should be numbered using Arabic numerals (1, 2, etc).

Introduction
- This should emphasise the importance of the research study and provide an overview of the key concepts and questions posed. Therefore, the Introduction should include a statement of the problem, research question or hypothesis, the objectives of the study, operational definitions of term used and the background to the study.

Literature Review
- A summary of the background literature is necessary. You should aim to produce a detailed overview of the current knowledge of the problem under study and outline a theoretical framework or rationale as a basis for your study. It is important to critically analyse existing literature on your research project.
- A clear statement of the problem and the immediate background as well as the aims of the project and its relevance should be given.

Methods
- A clear account of all the experimental, materials, methods (including statistical analyses) and experimental designs used must be given so that others can repeat the experiments. (The anonymity of human subjects must be preserved, by using code numbers or letters.) In particular, it should always be clear to the reader exactly what is being measured, and how many measurements (or animals or subjects) there are in each value. Failure to do this will result in loss of marks. It may be useful to clarify here the contribution of others to the practical work (see Acknowledgements).
- This section will provide a comprehensive explanation of the procedures used including details of the following:
  - Overall design and justification of methods used.
  - A clear indication of the sample sizes used.
  - A detailed description of all experimental procedures; this should be sufficiently detailed to allow replication.
  - A description of the instruments used.
Results
This section, or sections should be a description and explanation of results using narrative, tables and figures as appropriate. It should deal with facts and findings only, without interpretation (which will be included in the Discussion).

- This is usually the most poorly-presented section of a thesis and yet it is one of the most important. The reader must be led carefully through the results step by step. You should carefully consider the order of the figures to be presented. The order of figures presented may or may not follow the order the experiments were originally performed. You should consider which figures need to be presented. The objective is not to include all your figures to simply show how much work you have done, but to include those figures which are pertinent to the work. The main observations must be brought out; it is NOT sufficient to present figures or tables and then leave the reader to work out the conclusions (see later sections: Figures and Tables).

- Second-order variables. If you are using some transformation of the raw data, you should explain why you are doing so and, if possible, what, if any, difference the transform makes. When results are presented as % control, the absolute value of the control should be given in the Figure/Table legend.

- Presentation of Statistics. This requires particular attention and is a skill which must be acquired. Always state clearly what measure (mean, etc.) and what measure of variation (SD, etc.) is being used. The number of observations (n) must be clearly stated and specifically given if SDs are used. Do not give excessive numbers of decimal places; measures of variation should have one more significant figure than the mean. It is important to clearly state the direction and magnitude of the change observed. Do this first, and then give the result of any statistical tests used to determine significance.

- Over-interpretation of results is a serious error. You must demonstrate that you understand the significance of statistical testing. If a difference (or other statistical result, e.g. correlation) is not statistically significant, you should not treat it as if it is. If you want to discuss a non-significant ‘trend’ in your results, make it clear that you know the difference.

Discussion
This section should deal with discussion and interpretation of the data obtained and should include a critical assessment of the data in light of previous findings, speculation on the meaning of the results obtained, analysis of the original hypothesis in the context of the findings, a discussion of whether or not the findings support the hypothesis proposed and an assessment of the limitations of the study. This should be concluded with a summary and conclusions and suggestions for further research.

- This section often presents the most problems. In particular, it is often difficult to decide what should go in the Discussion and what should go in the Results (see Preparation of a Synopsis, below). A good guideline is ‘When in doubt, put it in the Discussion’, and leave the presentation of results as uncluttered as possible.

- The Discussion will include the following:
- Interpretation of the significance of your results.
- A comparison of results (not forgetting control values) with those in the literature.
- A discussion of your results in context of the relevant literature.
- A critical discussion of possible sources of error in the results. Critical means not only listing the sources of error but also saying how important they are likely to be.

This list is by no means exhaustive and the categories will often overlap, but it should be helpful at the planning stage.

References

- All cited references and only cited references should be included. The format used is the Harvard referencing system.
- Note that all references cited in text must appear in the list of references. General reading such as textbooks should not be cited, unless you are using a figure or referring to a very specific point.
- In the text...
  - When you make a scientific statement of fact, you must reference an original article with data to support this fact (Smith et al., 1999).
  - If there is only one author, quote the name only followed by the year the paper was published (Jones, 2000). If there are two authors, use both names followed by the year the paper was published (Murphy & Quinn, 2001). If there are more than two authors, use et al. (always in italics with a full stop afterwards), which is the Latin term for ‘and others’ (Smith et al., 1999).
  - If you want to reinforce the point and use several articles, they should be listed from the earliest to latest, and separated by a semicolon (Smith et al., 1999; Jones, 2000; Murphy & Quinn, 2001).
  - If you are quoting two articles by the same person in the same year, denote one as ‘a’ and one as ‘b’. This is done alphabetically according to the second author on the paper (Smith et al., 1999a; Smith et al., 1999b).
  - When including the reference in the text, follow the following formats. ‘Smith et al. (1999) have shown that…’, ‘It was shown by Smith et al. (1999) that…’.

Style of References

- Most journals use an abbreviated format for Journal titles. When abbreviating Journal titles make sure to use the correct abbreviation. You can find the correct abbreviation of any journal on PUBMED (http://www.ncbi.nlm.nih.gov/pubmed/). Some examples are as follows:
  - A = “Ann Biomed Eng” (single word journals are not abbreviated)
  - Annals of Biomedical Engineering = “Ann Biomed Eng”
  - Journal of Biomechanics = “J Biomech”
  - Journal of Neural Engineering = “J Neural Eng”
  - Below is the reference style used by the IEEE Transactions on Biomedical Engineering. There are different styles for journal articles, books, and book chapters as illustrated below.

Journal article

Cited in text as: (McMahon et al., 2008)
Book
Cited in text as: (Simms and Wood, 2009).

Chapter in a book

The most important thing to remember when citing references is to be consistent.

Appendices
- This should include details of equipment and instruments used, details of software developed and, in some cases tables of raw data. When appropriate, it should also include a copy of any questionnaire used.
- This should contain essential data and details of any other methods. Note that all entries in the Appendix must be properly described in suitable legends. It is not inappropriate to repeat relevant statistical summaries in the Appendix. All Tables in the Appendix must have fully descriptive titles so that they can be understood without reference to the main text.

Figures and Tables
- These are a great deal of trouble to prepare and it is a pity to waste them for the sake of a little attention to detail. All Figures and Tables must be numbered and have a descriptive legend, so that each can be understood without reference to the text. Legends precede Tables and follow Figures. It may be desirable to include the important observation or conclusion in the legend. All units of measurement and statistical parameters must be identified. Axes on graphs and columns in tables must be labelled so that it is clear what each point or value represents.
- Try to keep graphs uncluttered. Use conventional symbols of open and filled squares, triangles or circles. Shading aids clarity in histograms. Tables should be as simple as possible. Try not to put all your results in one huge Table because it is daunting for the reader.
- The most common fault is failure to integrate Figures and Tables with the text. The reader must be guided and the main points clearly brought out — even at the cost of some repetition of material between legend and text. If Figures or Tables are large it may not be possible to include the legend on the same page. In such cases, put the legend on the facing page. If Figures, Tables or collages (mounted groups of photographs) are brought together, rather than being interspersed with the text, say so and tell the reader where they are. If it is necessary to put a figure or table sideways in the text, it should be arranged so that is viewed from the right.
- You should avoid directly copy-pasting figures/mechanistic diagrams from elsewhere; you will not be awarded any marks for using previously published figures/mechanistic diagrams. You are expected to take time to draw the major parts of such figures/mechanistic diagrams that are most relevant to your research. If you do decide to copy a figure from somewhere else, or modify it only a little, the original figure must be acknowledged (with reference in the legend and in the list) (see Plagiarism).
**Grades of Heading**
Careful attention should be given to this point at the planning stage. Examples of the usual grades of heading are given below with a short description of each in brackets). Use bold or italic type as shown.

**HEADING: RESULTS** [capitals in bold print, centered, no underline or stop]

**Subheading: Electroencephalographic Analysis** [Upper and lower case in bold print, centred, no stop]

**Further subheading: EEG Feature Extraction** [Upper and lower case in bold italic print, centred, no stop]

**Word Processing**
- There are some conventions which should be followed. Paragraphs should be created by leaving a blank line and not by indenting. Do not put spaces before a punctuation mark because it might be carried over to the beginning of a new line.
- All punctuation marks should have only a single space after them, never before.

**Spelling, English and Grammar**
- Poorly written reports stem from poorly crafted sentences. Sentences that are long or poorly written can be frustrating to read and will lose you a great deal of marks. You are expected to spend time on writing each and every sentence in your thesis with care. Make sure you do not forget the basic rules of English. Use nouns, verbs, adverbs, adjectives accordingly in each sentence. A common mistake is to make sentences too long. Keep sentences short and simple as far as possible.
- Do not expect that the reader will remember what has been said in previous sentences. Make sure you clearly spell out what is meant in each sentence, even if it means repeating yourself. Be specific and clear and avoid being vague. Ideally each sentence should be self-explanatory.
- Your supervisor will focus on the scientific content and is not expected to check spelling, to correct your English or any mistakes in grammar. A spell check should be performed before handing documents to your supervisor and before final submissions. Ask a colleague to read your report before handing any material to your supervisor, and before final submission. If your colleague does not understand what you have written, you should make corrections before handing to your supervisor.
- Ensure the spell checker is set to ‘English (UK)’ and not ‘English (US)’ by using the ‘Language’ option on the Tools menu. Remember that you will still need to proof-read the final draft; the spelling checker will not find all errors. Pay special attention to names and technical terms.
- Here is a list of the correct forms of words that are commonly mis-spelled.

<table>
<thead>
<tr>
<th>correct form</th>
<th>mis-spelled form</th>
</tr>
</thead>
<tbody>
<tr>
<td>accommodate</td>
<td>dependent</td>
</tr>
<tr>
<td>occurred</td>
<td>separate</td>
</tr>
<tr>
<td>loose (i.e. not tight)</td>
<td>lose (i.e. mislay)</td>
</tr>
<tr>
<td>principal (i.e. main)</td>
<td>principle (i.e. underlying tenet)</td>
</tr>
</tbody>
</table>

- ‘UK English’ rather than ‘US English’ forms should be used: e.g. fibre not fiber.
- Student’s t test should have a capital and apostrophe); the t should be italicised.
- “It’s” should never be written in formal prose; always use ‘it is’. The possessive is “its”.

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- Numbers less than eleven should be spelt in full unless they refer to specific units, e.g. '6 days', but 'six subjects.'
- Note that 'sec', 'h', 'min' [no stop] and 'd' are the abbreviations for seconds, hours, minutes and days, respectively. The multiplier 'k' as in km (kilometre) is always lower case. The abbreviations for units never take an 's-plural'.

Headers and Footers
Header can be used to insert space and/or a running title at top of each page; a Footer does the same at the bottom of the pages.

Pagination
Should be checked as the last stage in preparing a manuscript. It is usual to adjust the text so that odd lines or parts of lines do not appear at the beginning or end of a page. The adjustment may be done by inserting blank lines in appropriate places or by using the Insert Page Break command. Word has a ‘Control widows and orphans’ option (see Format menu, Paragraph, Line & Page breaks tab). Remember to set the page style (Page Setup) and printer type (via Chooser) before doing this and work from the beginning of the text.

Font Style
- Choose your font with care. Some fonts take up a lot of space and others may not be suitable for laser-printing. Avoid fonts named after cities. Arial has been found to be a satisfactory, clear and reasonably compact font.
- Fonts are designed for different purposes and a font that is easy to read on a screen (e.g. Geneva) is not necessarily suitable for body-text. Times is designed for narrow columns and does not look well in A4 pages and should not be used. Times New Roman shares many of the characteristics of Times (compact, with a lot of white space) but looks better.

Spacing
If a type-size larger than 10 pt is used, it is unnecessary to double-space. If you use 12 pt body text, 1.5 spacing may be adequate. Check with your supervisor if in doubt.

Special Sorts
There are many special characters which will be useful to you, such as the degree symbol (° — alt+k) and acute accents or fada (alt+e, followed by the letter you wish to accent) and grave accents (alt+~, followed by the letter). For Greek characters it is better to use the ‘insert font’ function rather than using the font Symbol. This allows you to change the font in the document and keep the Greek characters. If you use font Symbol and decide to change the font in the document you will have to go back and individually change all the Greek characters back to Symbol font.

Preparing Material for PowerPoint
Students are required to make oral presentations - another important skill. PowerPoint presentation will be used.

Legibility. Anything less than 18 pt body text will be difficult to read. Headings should be about 24 pt. Use Arial font to improve legibility. Times is not suitable for projection.

Bolding the text is helpful too. Diagrams will usually need to be enlarged. It is useless to merely copy pages from papers or books — the print size will be neither big enough nor dense enough.

Density. Five lines is the useful maximum per slide; and bullet points are better than continuous prose. If you are tempted to put more on, think again.

Practice, Practice, Practice your talk: Avoid reading from your notes and from your slides. Are you trying to write your speaking notes onto the slide? It is not good
technique to simply read out what is on the screen. If you practice your talk beforehand, you will not need to read from your notes.

**Plagiarism**

In the academic world, the principal currency is *ideas*. As a consequence, you can see that *plagiarism* – i.e. passing off other people’s ideas as your own– *is tantamount to theft*. It is important to be aware the plagiarism can occur knowingly or unknowingly, and the offence is in the action not the intent.

Plagiarism is a serious offence within College and the College’s policy on plagiarism is set out in a central online repository hosted by the Library which is located at [http://tcd-ie.libguides.com/plagiarism](http://tcd-ie.libguides.com/plagiarism). This repository contains information on what plagiarism is and how to avoid it, the College Calendar entry on plagiarism and a matrix explaining the different levels of plagiarism outlined in the Calendar entry and the sanctions applied.

Undergraduate and postgraduate new entrants and existing students, are required to complete the online tutorial ‘**Ready, Steady, Write**’. Linked to this requirement, all cover sheets which students must complete when submitting assessed work, must contain the following declaration:

**I have read and I understand the plagiarism provisions in the General Regulations of the University Calendar for the current year, found at: [http://www.tcd.ie/calendar](http://www.tcd.ie/calendar)**

**I have also completed the Online Tutorial on avoiding plagiarism 'Ready, Steady, Write', located at [http://tcd-ie.libguides.com/plagiarism/ready-steady-write](http://tcd-ie.libguides.com/plagiarism/ready-steady-write)**

Plagiarism detection software such as “Turnitin” and Blackboard’s “SafeAssign” may be used to assist in automatic plagiarism detection. Students are encouraged to assess their own work for plagiarism prior to submission using this or other software.
COLLEGE RULES AND REGULATIONS

COLLEGE INFORMATION

Student Disability Services

Do you know what supports are available to you in College if you have a disability or a specific learning disability? If you have a disability or a specific learning disability (such as dyslexia) you may want to register with Student Disability Services. Further information on our services can be found at www.tcd.ie/disability.

Declan Reilly and Alison Doyle are the Disability Officers in College. You can make an appointment to see them by phoning 6083111, or emailing them at: disab@tcd.ie.

Skills4Study Campus (S4SC)

Skills4studycampus (S4SC) is a fully interactive e-learning resource, which helps students to develop study skills and is suitable for students on all modules and in any year of study.

Published by Palgrave Macmillan, core skills are developed through personalized interactive activities, tests and assessments. Utilised by HEIs in UK and in ROI includes UCC and UCD.

In 2011 – 2012 piloted to all JF students in School of Nursing and Midwifery, Social Work and Social Policy, Drama and Theatre Studies, TAP, Mature and disability students.

Feedback from staff has been very encouraging. Fully embedded by School of Nursing (module handbook, skills module) and end of year analysis of academic performance indicates positive correlation with S4SC usage / module completion.

Study skills can be provided ‘anytime, anywhere’, fully accessible to students living outside of Dublin, or who commute long distances, have family or work commitments, extensive off campus placements, or heavy timetables.

Due to the large number of students it is not possible to provide this via the Blackboard Learn, the College Disability Service will fund access to S4SC for all TCD undergraduate students and academic staff for AY 2012 – 2013. Login will continue to be provided via the link on www.tcd.ie/local, additional links should be added on Student Homepage, Orientation website and the new student portal my.tcd.ie.

A key factor is engagement and support from academic staff and embedding of resource within module materials. The College Disability Service proposes to present S4SC to all Directors of Undergraduate Teaching and Learning at the beginning of the next academic year.

The first module ‘Getting ready for academic study’ is a free open resource. It is suggested that a link is added to the registration email issued to all prospective students via GeneSIS. This will identify this resource at the point of pre-entry so that students have already been familiarised with its structure and content.

Student 2 Student

S2S offers trained Peer Supporters if you want to talk confidentially to another student or just to meet a friendly face for a coffee and a chat. Peer Supporters are there to assist with everything from giving you the space to talk about things to helping you access resources and services in the College. You can email us directly to request a meet-up with a Peer Supporter or can pop in to the Parlour to talk directly to one of our volunteers and arrange a meeting.

S2S is supported by the Senior Tutor's Office and the Student Counselling Service.
Safety

We operate a ‘safe working environment’ policy and we take all practical precautions to ensure that hazards or accidents do not occur. We maintain safety whilst giving you the student very open access to facilities. Thus safety is also your personal responsibility and it is your duty to work in a safe manner. By adopting safe practices you ensure both your own safety and the safety of others.

Please read the following Safety Documents for working practices in the Departments of Mechanical and Manufacturing Engineering and in the Department of Electronic and Electrical Engineering:

http://www.mme.tcd.ie/ (bottom left tab)

If you are working in Trinity Centre for Bioengineering Laboratories in Trinity Biomedical Sciences Institute, please contact Mr Simon Carroll, Senior Technical Officer at scarrol6@tcd.ie to complete necessary Health and Safety paperwork prior to completing any laboratory work.

Please ensure you comply with the instructions given in these important documents. Failure to behave in a safe manner may result in your being refused the use of departmental facilities.

Staff/Student Committee

The Staff/Student Committee meets once a semester to discuss matters of interest and concern to students and staff. It comprises class representatives from each year.

Facilities

All modules in the Sophister years are supplemented by a full programme of laboratory work. The Junior Sophister laboratory timetable is co-ordinated by Dr. Gareth Bennett in the Department of Mechanical and Manufacturing Engineering and Dr. David Corrigan in the Department of Electronic and Electrical Engineering. The laboratories are well equipped for undergraduate work and, in addition, we have extensive research facilities, which are available for projects. The Department of Mechanical and Manufacturing Engineering has its own well-equipped workshops which are managed by Mr. Mick Reilly. The Computer Applications Laboratories are administered by Mr. John Gaynor and we have state of the art work stations which are used extensively in both the Design Module in third year and for the Project work in fourth and fifth years as appropriate. Students are encouraged to make use of these facilities.

The department of electronic and electrical engineering has an undergraduate experimental laboratory on the ground floor of the printing house with bench facilities and equipment for approximately 50 students. It also houses a computer laboratory with provision of state of the art PC’s for 30 students. There is also a project laboratory shared by Senior Sophister students. Teaching facilities in Áras an Phiarsaigh include a 20 seat laboratory containing music technology application hardware and software, a smaller teaching laboratory as well as a small recording studio and an audio/video editing facility. The Microelectronics Technology Laboratory located in the Sami Nasr building has a class 1,000 area which contains a wet bench and two furnaces where undergraduate students can carry out experiments in the integrated circuit fabrication process under close supervision. A mask aligner, Micromanipulator test probe set-up and various microscopes are also available.
Location of the TRINITY CENTRE FOR BIOENGINEERING (TCBE) and SCHOOL OF Medicine
Contacts:

<table>
<thead>
<tr>
<th><strong>Director MAI Biomedical Program/Academic Contact Point</strong></th>
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</tbody>
</table>

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<thead>
<tr>
<th><strong>STAFF NAME</strong></th>
<th><strong>EMAIL ADDRESS</strong></th>
<th><strong>OFFICE LOCATION</strong></th>
</tr>
</thead>
<tbody>
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<td>Parsons Building 3.03</td>
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<td>Level 3 Bio-Sciences</td>
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<td>Parsons Building 1.03C</td>
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</table>