EPSRC Centre for Doctoral Training in Photonic Integration and Advanced Data Storage

Summer Research Project (60 credits)

IMPORTANT DATES – SUMMER RESEARCH PROJECT

Project Start Date: 11 June 2018
Project Report Submission: 24 August 2018

PLANNING AND CONDUCTING YOUR SUMMER RESEARCH PROJECT

It is expected that you will agree the scope of your project with your project supervisor by the end of May 2017. Careful planning is essential. This is especially important if you depend on delivery of items or on facilities which are heavily used by other people. You are expected to show initiative and work independently on your project,and should not expect the supervisors to tell you what to do all the time. You must agree your project objectives with your supervisor. These must indicate the expected outcomes of the work: your project will be assessed against how well you achieve these outcomes. You should then write a short outline of your project. The contents must be agreed with your supervisor no later than 22 June 2018, before you commence detailed work on your project. It must include:

- the objectives
- a brief description of the project and its background
- a Gantt chart identifying the main tasks and a schedule for carrying these out
- resources needed, when they are required and how they'll be obtained.
- an initial list of key references

Please remember that you are expected to work full-time on your project from 11 June until 24 August 2018.

During this period you are normally expected to have regular meetings with your supervisor. It is your responsibility to agree the schedule for these with your supervisory team and to organise them. In addition, you are expected to keep a record of your work in a Lab Book, which should be discussed with your supervisor during your review meetings.

ASSESSMENT OF YOUR SUMMER RESEARCH PROJECT

Overview
Summer research projects are assessed on the basis of a written project report (50%) and continuous assessment (50%). The Report must be submitted by all students by 24 August 2018. Your supervisor will mark your summer research project according to the Summer Research Marking Guide on page 6 which refers to both the effectiveness of project execution and the written report. Your written report will also be marked by a second marker.

Your Written Report
Please refer to Appendix 1 on page 7: How to Write a Technical Report.

The structure of the report should be agreed with your supervisor. Although there are no strict limits with regard to length, normally a report might be expected to have a length of approximately 40 pages (excluding appendices), with approximately 25 being typescript. These guidelines might vary if, for example, there were extensive tables or there were results, such as simulations, provided via a computer readable medium.

Submitting Your Written Report
An electronic version of your report must be submitted as a PDF document to TURNITIN UK on or before 24 August 2018. The CDT Administrator will give you specific instructions on how to do this 2 weeks before the deadline.

You must check your Written Report using the TURNITIN software. You should bring a copy of your TURNITIN report and discuss it with your supervisor.

Penalties for Late Submission of Coursework
Late submissions will be penalised at the rate of 5% of the total mark available for each working day it is late, up to a maximum of five working days (i.e. Monday to Friday excluding days of official University closure). Coursework submitted more than five working days late will be awarded a mark of zero. Where the assessed work element accounts for a certain proportion of the module mark the penalties for the late submission will apply to the assessed element mark only and not the overall module mark. All coursework submitted after the deadline is subject to these penalties unless there are exceptional circumstances which have been reported in line with the regulations:

http://www.qub.ac.uk/directorates/AcademicStudentAffairs/AcademicAffairs/StudentGuidance/ExceptionalCircumstances-AStudentGuide/

EPSRC CDT in Photonic Integration & Advanced Data Storage

Mark Sheet for the Summer Research Project

Written Report

Please use the Summer Research Marking Guide to determine the mark.

Student Name:	***Student Number:***
Name of Marker:	

Mark (out of 100): Written Report Quality

Mark (out of 100): Understanding

Brief Comments: (e.g. Structure, Organisation, Production, Use of English and Scientific/Technical Expression, Title and Abstract, Introduction, Recent research in area, Methodology used, Presentation of results including their limitations. Use additional sheet if required)

EPSRC CDT in Photonic Integration & Advanced Data Storage

Mark Sheet for the Summer Research Project

Continuous Assessment

Student Name:	***Student Number:***
Name of Marker:	

Please use the Summer Research Marking Guide to determine the mark.

Mark (out of 100): Planning & Initiative
Mark (out of 100): Experimental Work
Mark (out of 100): Achievement

Brief Comments: (e.g. practical skills demonstrated, lab book keeping, achievement compared to agreed objectives, leadership in shaping direction, interaction with others)

What aspects of the project, or the student performance, could be been improved?

EPSRC Centre for Doctoral Training Programme in Photonic Integration and Advanced Data Storage

Summer Research Project Marking Guide

Grade range **Aggregation Score**	**Distinction** 70-100	**Commendation** 60-69	**Pass** 50-59	**Fail** 0-49
REPORT				
1 Written Report	Arguments well presented. Major findings clear and accessible. Accurate writing. Good English.	Well organised; written clearly in good English. Results were critically assessed.	Satisfactorily written & presented.	Poor organisation & presentation. Poor writing style; parts difficult to follow.
2. Understanding	Excellent understanding of the underlying theory/techniques/software and the wider relevance of the work	Good understanding of most of the underlying theory/techniques/software and of applications.	Satisfactory general understanding of what was done, though somewhat lacking in depth.	Shortfalls in understanding apparent in some key areas.
CONTINUOUS ASSESSMENT: Planning and Experimental Work etc.				
3. Planning & Initiative	Made major input to the content and direction of the work. Showed substantial initiative.	Progressed the work well and brought useful ideas. Overcame problems with little reliance on supervisor.	Progressed the project as directed by the supervisor. Needed assistance from supervisor on points of detail.	Relied heavily on supervisor and did not always follow directions. Brought little thought to the project.
4. Experimental Work	Well organised; high work rate throughout project.	Worked hard and conscientiously	Worked satisfactorily for most of the time.	Poor organisation or planning led to insufficient work.
5. Achievement	Achieved all major objectives and overcame significant challenges. Excellent work of near publishable quality.	Achieved several challenging objectives. Good quality work.	Achieved the straightforward objectives. Competent work; results can be trusted.	Achieved little. Results of dubious value.

HOW TO WRITE A TECHNICAL PROJECT REPORT

ABSTRACT
All reports start with an *abstract*, which contains a summary of the project: its aim, what was done and what was achieved. This document describes the requirements for your project report and gives advice on how to get better marks. It includes guidance on:

1. Introduction
2. Body of the report
3. Discussion
4. Conclusions
5. References
6. A Appendices
7. B University's Plagiarism Statement

1 Introduction

Whew – I've finished the work, now I only have to write the report. Sound familar? Many students put off writing until too late and don't leave enough time to make a good job of the report. This is a serious mistake because the report typically accounts for a large fraction of the assessment. Start early – most people find report-writing difficult. Think about the report throughout your project, keep track of references and collect material to illustrate the report.

1.1 Mechanical aspects

The length of the body of the report will be specified in the instructions for the project. Extra material may be provided in appendices but this material should be for reference only: you cannot assume that the reader will study it. In other words, do not put vital points in an appendix.

You will probably think that the report is too short but this is deliberate. Most reports are submitted to busy managers, who do not have time to read lengthy documents. It is important to learn how to pick out the vital points and write a concise report with maximum impact.

Reports should be word-processed using A4 page layout and a clear typeface such as 12-point Times, number the pages and leave margins of at least 25mm all round. Follow this layout (this document breaks some of the rules to keep it compact).

- The front cover should show the title of the project with your name(s) and matriculation number(s) and the name of your supervisor(s).
- Put the abstract on the next page. It should be about 100–250 words and give a brief summary of the report including the background and aims of the project, the principal results and conclusions.
- The next page should show the table of contents.
- The body of the report should be divided into numbered sections, each starting on a new page. Figures (diagrams, plots or photographs) and tables need captions and should be numbered. They should also be referred to in the body of the report.

1.2 What goes into the introduction?

Explain the background to the project and the reasons why your particular piece of work was considered worthwhile. This leads to the **aims** of the project: what you are trying to achieve. Be specific.

2 Body of the report

2.1 Structure and sections

The structure of the report and the titles of sections depend on the nature of the project. Here are suggestions for two extreme types, which can be adjusted to suit your report.

Research Projects

Here you are given a starting point and a general direction: your aim is to discover something new. The report would probably be divided into sections with familiar titles.

- **Theory** – Explain essential background theory that is vital to understand your report. Select and present the material to show its relevance to the project and demonstrate your understanding. Do not repeat standard material from textbooks, which is a waste of space; give a reference instead.

- **Experimental Techniques** – Give an account of your experimental (or numerical) techniques. Emphasise details that would be necessary to continue the work or to compare your results with those of other experimenters. Aim to include what you would have liked to know at the start of your project.

- **Results** – Describe these at an appropriate level of detail to support your conclusions. Lengthy tables should be left to an appendix. Avoid unnecessary detail: describe preliminary experiments briefly if at all, unless they illustrate some important point.

Design, build and test projects

Here the goal is specified, more or less precisely: your job is to work out how to get there. The titles of the sections are less standardised but here is a possible approach.

- **Specification** - Typically you are given only a vague description of the functions required and must first develop this into a firm specification against which your final product will be judged.

- **Possible strategies** – Evaluate *briefly* the possible approaches that you considered and explain why you selected one of these. Avoid excessive detail of discarded possibilities.

- **Implementation** – Describe the final product. Concentrate on key features that required advanced design and skim over well-known aspects. Mention useful points that might help future students, such as tricky sections of data sheets.
  Software is tricky. Often the best approach is to describe the high-level structure in the main text (a diagram of a state machine for example) and pick out any special features of the program. A complete listing should be included as an appendix.

- **Testing** – This is equivalent to the 'Results' section of a research project.

2.2 Style of writing

One of the most difficult aspects of writing is to judge the level and background of your readers. Typically, the report will be assessed by your first supervisor, who is an expert on the topic, and your second supervisor, who is not. You should therefore assume that the reader is a *well- educated, graduate scientist/engineer* but not an expert on the subject of the project. Assume that he or she is familiar with the general concepts taught in courses up to level 3 but not with the details of specialised courses at higher levels.

It is also difficult to appreciate that most readers are not interested in the nitty-gritty detail. They want to know *what* you did and *why* you did it that way but they don't want a step-by-step account of *how* you did it. Your watchword should therefore be: **SUMMARISE!**

Of course some people need the details – a person continuing work on the project requires precise

experimental methods, for instance. Such material may be better in an appendix. The same is true for computer programs and schematics of complicated circuits. Design-and-build projects may need a User's Manual, which should be included as an appendix. A report is a formal document and should be written in appropriate language. Numerous books offer advice on writing reports and a selection [1, 2, 3, 4] is listed in the references at the end. Here are a few tips.

- Reports should be written in correct English. Break text into paragraphs, keep sentences to a reasonable length and insert appropriate punctuation. Use a spell-checker and a grammar-checker if desired but neither is a substitute for careful reading.

- A report is not a story. Write 'The voltage was measured' rather than 'I measured the voltage'. This document contains instructions and therefore uses a different style.

- Define all abbreviations when they are first used: 'The accelerometer uses a serial peripheral interface (SPI)'. Provide a list of abbreviations if you use a large number of them.

- Don't write material that you don't understand. It will be obvious to the reader.

The quality of English is assessed as part of the report. Foreign students may feel this to be a burden but part of their education in this country is to learn to work effectively in an English speaking environment.

2.3 Precision

Scientific and engineering reports must be precise. This applies both to the language and to numerical values. For example, the words *precision* and *accuracy* are often used interchangeably in non- technical discussion but the distinction between them is vital in engineering. Quote numerical results to an appropriate number of significant figures. For example, it is pointless to claim that a length was 12.345 mm if it was measured with a pocket ruler. Don't simply write down all of the digits displayed on your calculator.

Analyse the uncertainties in your results to increase the impact of your results. Please avoid horrors like this:

> *The gain was quite accurate.*

The sentence is meaningless and the reader will doubt whether you have any idea of the accuracy. Contrast this sentence:

> *The accuracy of the gain was estimated to be ±2%, limited by the tolerance of the resistors. A detailed analysis is given in Appendix C.*

This is informative and convinces the reader that you have a full understanding.

2.4 Figures and tables

Figures and tables must have informative captions and be numbered as in Figure 1 on the following page. Axes of graphs should have scales, titles and units, otherwise the plot is meaningless. All text must be legible, roughly the same size as the main text. Be warned that plots from Excel need extensive editing to bring them up to an acceptable standard. Oscilloscope screenshots can make good illustrations and are simple to capture on modern equipment.

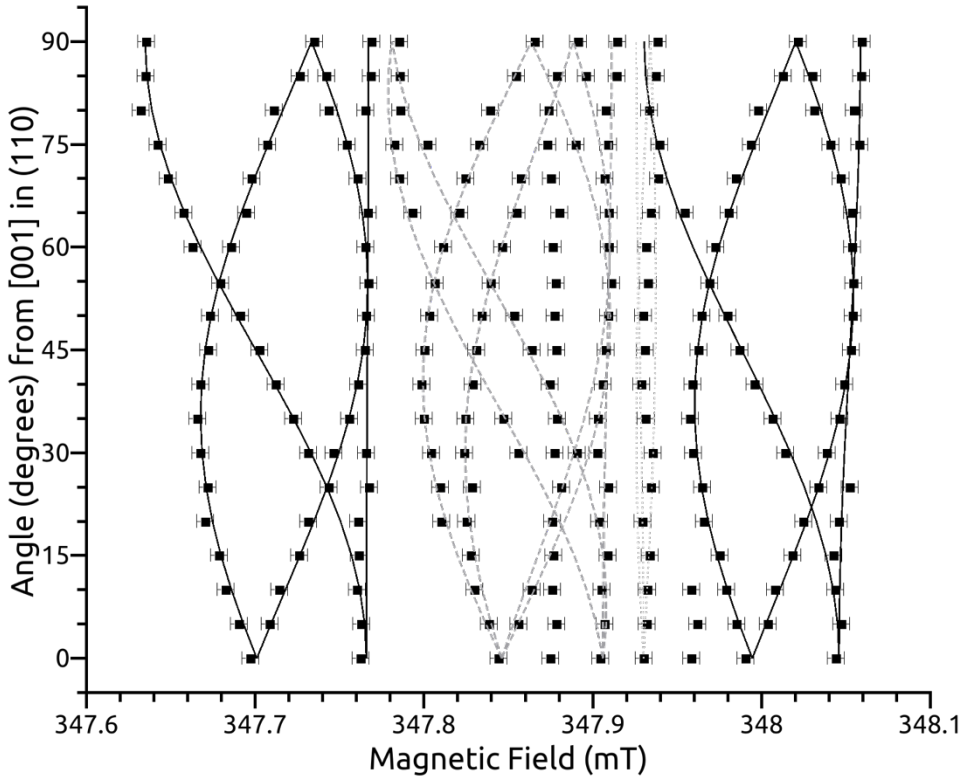

Figure 1. X-band EPR line positions for different orientations of the applied magnetic field in the crystallographic (110) plane. The points represent experimental peak positions and the lines show simulated peak positions for WAR9 as solid lines and WAR10 as dashed lines using the fitted parameters. The dotted line shows the position of the central N_S^0 peak. Figure copied from reference [9].

Tables must have appropriate headings with units. Avoid lengthy tables: consider whether a graph would be clearer, or move them to an appendix.

2.5 References

No project is carried out in isolation. A research project builds on the results of previous workers; a design-and-build project depends on the properties of the components available. You therefore draw on published documents during your project and must provide *references* to these sources in your report. References are cited (a) to give due credit to the originator and (b) to guide a reader who wants more detailed information. You should give a reference wherever it is required for either of these purposes. Properly referenced material from many sources is a sign of a good project report.

References must be cited with sequential numbers in square brackets where they are used in the text, not just listed at the end of the report. Typical usage is 'Fitzmaurice and Hand [5] showed that. . . ' or 'The median is an appropriate estimator for this signal [5]'.

Avoid direct quotations from references in general; make it absolutely clear that the text is a quotation if this is unavoidable. An illustration, such as a diagram from a data sheet, is another type of quotation and must be referenced, typically in the figure caption, see Figure 1. With appropriate referencing, this does not constitute plagiarism; however, you need to check the reuse permissions to make sure you are not breaking copyright.

Plagiarism

If you copy from another person's work (project report, book, journal, web page or any other document) without acknowledging the source, you are guilty of *plagiarism*. This is a disciplinary offence and the University has procedures for handling it. The failure to acknowledge a source is considered as plagiarism even if there was no deliberate intention to cheat. Avoid any risk of plagiarism by providing a reference for all sources that you use. Please refer to the regulations regarding academic offences:

QUB:
http://www.qub.ac.uk/directorates/AcademicStudentAffairs/AcademicAffairs/GeneralRegulations/Procedures/ProceduresforDealingwithAcademicOffencesincludingresearchmisconduct/

University of Glasgow:
http://www.gla.ac.uk/services/senateoffice/studentcodes/staff/plagiarism/

List of references

All reports must have a section entitled 'References' after the main text but before any appendices. This comprises a list of references, numbered to match the citations in the text. Each reference requires the following information and the cited references provide examples:

- **Journal paper**: author(s), title of paper, name of journal, volume number, page numbers and year [5]. Many journals now use article numbers instead of page numbers.

- **Book**: author(s), title, edition, publisher and year of publication [1]. Include the number of the chapter or page(s) if you refer to only a small part of the book.

- **Data sheet**: company, title, edition and date [6]. Application notes, technical reports and similar documents should be cited in the same way.

- **Web page**: author(s) or organisation, title, full URL and date of viewing [7]. See below.

The reader must be able to find the document without searching for further information.

References from the Web

The World Wide Web is a wonderful resource because it is so easy to search. It is therefore tempting to use web pages as references. *Proceed with caution* because the accuracy of many web sites cannot be verified. This is particularly true for anonymous sites such as Wikipedia. Use them only as a starting point: good pages provide references to more authoritative sources. Reports whose references are all or mainly from the web, especially from anonymous sites, will be penalised.

3 Discussion

The discussion is your opportunity to impress an expert with your depth of understanding. Don't worry so much about the non-expert reader – she or he can skip to the Conclusions.

For a research project this section should provide a logical argument leading from the experimental observations to the final conclusions. Evaluate your results thoroughly and gain every possible piece of understanding from them. Compare the results in detail to other work in the field. This should be a *critical* comparison so don't just say that your results are different from previous work; explain *why*. Never say 'The results were as expected' unless you have already described exactly what was expected!

The main purpose of the Discussion in a design-and-build project is to assess the performance of your product against the specification, showing its strengths and weaknesses.

4 Conclusions

Every report must have conclusions, built on the discussion. This section includes a summary of the main achievements of the work but is more than that. The noun 'conclusion' can be defined as 'a

judgement or decision reached by reasoning' [8] so you should highlight what has been learnt as a result of your project. What is the big picture that the reader should take away?

References

[1] Joan van Emden, *Writing for Engineers*, 3rd Edition, Palgrave Macmillan (2005).

[2] Marun K. Mitra, *Effective Technical Communication: A Guide for Scientists and Engineers*, Oxford (2006).

[3] David F. Beer and David McMurrey, *A Guide to Writing as an Engineer*, 3rd Edition, Wiley (2009).

[4] Trevor M. Young, *Technical Writing A–Z: A Commonsense Guide to Engineering Reports and Theses*, American Society of Mechanical Engineers (2005).

[5] G M Fitzmaurice and D J Hand, *A comparison of two average conditional error estimators*, Pattern Recognition Letters, **6**, 221–228 (1987).

[6] Freescale Semiconductor, *Datasheet for MC9S08QG microcontroller*, revision 4 (2008).

[7] Morgan Advanced Ceramics, *Advanced Ceramics: Silicon Nitride*, http://www.morgantechnicalceramics.com/mtc_materials/silicon_nitride.htm (viewed 2009 May 13).

[8] Oxford University Press, *AskOxford*, http://www.askoxford.com/?view=uk (viewed 2009 May 13).

[9] S. Felton, B. L. Cann, A. M. Edmonds, S. Liggins, R. J. Cruddace, M. E. Newton, D. Fisher, and J. M. Baker, "Electron paramagnetic resonance studies of nitrogen interstitial defects in diamond", *J. Phys.: Condens. Matter*, **21**, 364212 (2009), online at stacks.iop.org/JPhysCM/21/364212