# ESP4901 Research Project

Karl Erik BIRGERSSON

# Who am I?

DiSC personality: BLUE, yellow

Almost 5 decades old with 4 kids

Watched Game of Thrones, Lucifer

Likes applied mathematics

For more info, check

Google Scholar

& Linkedin.com

NUS National University of Singapore

# Examiners & teachers

**Mr P Gallo**
*Coordinator of the CELC team*

**A/P J van Kan**
*Physics*

**A/P Md Raisul Islam**
*ME*

**Dr Shen Lei**
*ME*

**A/P E Birgersson**
*ME*

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# Module learning outcomes

- Identify the research problem
- Review sources of information to learn about existing methods, solutions and background
- Specify the objectives and scope clearly
- Develop a methodology and collect data
- Analyse and interpret data
- Communicate findings concisely, precisely and attractively in written reports and oral presentations

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# Mapping of ESP4901 on student learning outcomes. These are the outcomes you are expected to have achieved when you graduate

| | **SLO1:** Engineering knowledge | **SLO2:** Problem Analysis | **SLO3:** Design/ development of Solutions | **SLO4:** Investigation | **SLO5:** Modern Tool Usage | **SLO6:** The Engineer and Society | **SLO7:** Environment and Sustainability | **SLO8:** Ethics | **SLO9:** Individual and Teamwork | **SLO10:** Communication | **SLO11:** Project Management and Finance | **SLO12:** Life-long Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MLO1:** Identify the research problem. | ● | ● | | ● | | | | | | | | |
| **MLO2:** Review sources of information to learn about existing methods, solutions and background. | ◑ | | ◑ | ◑ | | | | | | | | |
| **MLO3**: Specify the objectives and scope clearly. | ◑ | ◑ | | ◑ | | ◑ | ◑ | ○ | | | | |
| **MLO4:** Develop a methodology and collect data. | | | ● | | ● | | | ○ | ◑ | | ◑ | |
| **MLO5:** Analyse and interpret data. | ● | ● | | ● | ◑ | | | | | | | |
| **MLO6:** Communicate findings concisely, precisely and attractively in written reports and oral presentations. | | | | | | | | | | ● | | |

●: Fully consistent (meets more than 75% of SLO)

◑: Partially consistent (meets less than 50% of SLO)

Involves complex-engineering problems

○: Weakly consistent (meets less than 25% of SLO)

Blank: Not related to SLO

# Programme Educational Objectives. You are expected to have achieved one or more of these around 4-5 years after graduation

| Programme Educational Objectives<br>2021 onwards |
|---|
| **PEO1:** Naturally engage in multidisciplinary cutting-edge research and development. |
| **PEO2:** Assume leadership positions with confidence in their chosen professions. |
| **PEO3:** Take innovative and entrepreneurship initiatives . |
| **PEO4:** Have proficiency in written, graphical and oral communication skills. |
| **PEO5**: Actively serve and contribute to society in a responsible way. |
| **PEO6:** Have internalized life-long learning. |
| **Published online:** B.Eng (Engineering Science) |

# CELC Support

1. CELC provides materials on Literature Review writing and Oral Presentation Skills [Canvas].
2. Your CELC tutor will mark and provide written feedback on your Interim Oral Presentation.
3. Your CELC tutor will mark and provide written comments on your draft thesis, focusing on the introduction and literature review.
4. Your CELC tutor will discuss his/her feedback on your interim presentation and draft thesis with you in a 30-minute conference [Sem 2 Weeks 8-9].

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# Schedule*

| Activity | Timeline/ deadline | Academic calendar | Task owner(s) |
|---|---|---|---|
| **Start of FYP** | 08 August 2022 | Monday, week 1, Sem 1 | Students |
| **Submission of interim report and self-assessment rubric** to supervisor(s) via email and to Canvas | 03 January 2023 | Last week, vacation | Students |
| **Interim online oral presentation** (15 min presentation, 15 min Q&A; examiners announce day, and time to students via email; supervisor(s) can attend, but do not have to) | Week of 09 January 2023 | Week 1, Sem 2 | Students, examiners |
| **Submission of video file of interim oral presentation** to Canvas | 13 January 2023 | End of week 1, Sem 2 | Students |
| **Submission of interim marks** to ESP | 20 January | End of week 2 | Supervisors |
| **Submission of introduction and literature review** to Canvas | 10 February 2023 | End of week 5, Sem 2 | Students |
| **Consultation with CELC** | 6-17 March 2023 | Weeks 8 and 9, Sem 2 | Students, CELC |
| **Submission of final thesis and self-assessment rubric** to supervisor(s) via email and to Canvas | 31 March 2023 | End of week 11, Sem 2 | Students |
| **Final oral presentation** (15 min presentation, 15 min Q&A; examiners announce day, time and location to students via email; supervisor(s) can attend, but do not have to) | Week of 03 April to week of 10 April | Week 12-13, Sem 2 | Students, examiners |
| **Submission of graduate-exit and module-learning-outcome surveys** on Canvas | 14 April 2023 | End of week 13, Sem 2 | Students |
| **Submission of final marks** to ESP | 14 April 2023 | End of week 13, Sem 2 | Supervisors |

*subject to change

# Lectures & micro-presentations*

- **Overview of ESP4901**
  - **18:00-20:00, 12 Aug** (Friday, week 1, Sem 1). We go through the module learning outcomes, expectations, rubrics, deliverables and assessments.
- **Introduction to research and research methodology**
  - **18:00-21:00, 26 Aug** (Friday, week 3, Sem 1). We start with the question “What is research?" and move on to a systematic description of research methodology.
- **Introduction to scientific writing**
  - **18:00-21:00; 16 Sep** (Friday, week 6, Sem 1). We work through various aspects of scientific writing and start to prepare a hands-on guide.

- **Feedback session**
  - **18:00-21:00; 27 Jan** (Friday, week 3, Sem 2). We will provide feedback on the interim assessment.
- **Introduction to oral communication**
  - **tba**
- **Recorded micro-presentations**
  - **09:00-18:00; 20 Feb** (Monday, recess week, Sem 2). Students present—f2f in a lecture theatre—for five minutes on the context and novelty of their research project. Everyone will then provide ten minutes of feedback on visual, vocal and verbal channels as well as the perceived value/novelty of the project. We will record the presentations.

*subject to change

# Assessment

| Components | CELC | ESP | Total |
|---|---|---|---|
| Interim report & achievements | | 20% | 25% |
| Interim oral presentation (Zoom) | 5% | | |
| Draft report | 10% | | 75% |
| Final report | | 65% | |
| Final execution & achievements | | | |
| Final presentation | | | |
| Total assessment: | 15% | 85% | 100% |

In addition, EGLIB002 is compulsory

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# Assessment rubric*

| Module learning outcomes | Does not meet expectations | Meets expectations | Exceeds expectations |
|---|---|---|---|
| **Identify the research problem** | ☐ Limited evidence of discovery/value-add/new techniques/new tools/impact | ☐ Some evidence of discovery/value-add/new techniques/new tools/impact | ☐ Exceptional evidence of discovery/value-add/new techniques/new tools/impact |
| **Review sources of information to learn about existing methods, solutions and background** | ☐ Demonstrates poor understanding of subject matter and associated literature | ☐ Demonstrates understanding of subject matter and associated literature | ☐ Demonstrates mastery of subject matter and associated literature |
| **Specify the objectives and scope clearly** | ☐ Objectives and scope are poorly defined | ☐ Objectives and scope are clear | ☐ Objectives and scope are well defined |
| **Develop a methodology and collect data** | ☐ Experiments are not reproduced or have poor statistical confidence levels<br>☐ Mathematical models and simulations are not validated with experiments | ☐ Experiments are reproduced with good statistical confidence levels<br>☐ Mathematical models and simulations are validated with a minimum number of experiments | ☐ Experiments are reproduced with excellent statistical confidence level<br>☐ Mathematical models and simulations are validated in great detail with experiments |
| **Analyse and interpret data** | ☐ Results are presented with too many significant digits<br>☐ Arguments are incorrect | ☐ Results presented are significant<br>☐ Arguments are clear | ☐ Results presented are significant and number of significant digits explained<br>☐ Arguments are superior |
| **Execution** | ☐ Requires detailed instructions and guidance<br>☐ Shows little effort and interest. Did not communicate enough with the supervisor(s) or had to be asked for updates | ☐ Requires general instructions and guidance<br>☐ Shows great effort and interest. Frequent communication with supervisor(s) | ☐ Works independently and needs little to no guidance<br>☐ Shows exceptional effort and interest. Timely and frequent communication with supervisor(s) |
| **Execution & achievement** (overall assessment of the execution and achievement; tick one box) | ☐ Does not meet expectations | ☐ Meets expectations | ☐ Exceeds expectations |
| **Communicate findings concisely, precisely and attractively in written reports** | ☐ Writing and typesetting are weak<br>☐ Numerous grammatical and spelling errors are apparent<br>☐ Organisation is poor<br>☐ Final report has little to no value for continued work by future students/readers | ☐ Writing and typesetting are adequate<br>☐ Some grammatical and spelling errors are apparent<br>☐ Organisation is logical<br>☐ Final report documents the FYP well (including failed attempts) and can be used by future students/readers as reference | ☐ Writing and typesetting are publication quality<br>☐ No grammatical and spelling errors are apparent<br>☐ Organisation is excellent<br>☐ Final report documents the FYP very well (including failed attempts and improvements) and can easily be used by future students/readers as reference |
| **Interim written report** (overall assessment of the written components; tick one box) | ☐ Does not meet expectations | ☐ Meets expectations | ☐ Exceeds expectations |
| **Communicate findings concisely, precisely and attractively in oral presentations** (only assessed by examiner) | ☐ Poor presentation<br>☐ Context and outcomes are not clear<br>☐ Responses are incomplete or require prompting<br>☐ Demonstrates poor understanding of subject matter and associated literature | ☐ Clear presentation<br>☐ Context and outcomes are clear<br>☐ Responses are complete<br>☐ Demonstrates understanding of subject matter and associated literature | ☐ Clear and engaging presentation<br>☐ Context and outcomes are clearly articulated and are exceptional<br>☐ Responses are eloquent<br>☐ Demonstrates mastery of subject matter and associated literature |
| **Interim presentation** (overall assessment of the oral components; tick one box) | ☐ Does not meet expectations | ☐ Meets expectations | ☐ Exceeds expectations |

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# Interim report

# Preparation of Papers for IEEE TRANSACTIONS and JOURNALS (February 2017)

First A. Author, *Fellow, IEEE*, Second B. Author, and Third C. Author, Jr., *Member, IEEE*

***Abstract*—These instructions give you guidelines for preparing papers for IEEE Transactions and Journals. Use this document as a template if you are using Microsoft *Word* 6.0 or later. Otherwise, use this document as an instruction set. The electronic file of your paper will be formatted further at IEEE. Paper titles should be written in uppercase and lowercase letters, not all uppercase. Avoid writing long formulas with subscripts in the title; short formulas that identify the elements are fine (e.g., "Nd–Fe–B"). Do not write "(Invited)" in the title. Full names of authors are preferred in the author field, but are not required. Put a space between authors' initials. The abstract must be a concise yet comprehensive reflection of what is in your article. In particular, the abstract must be self-contained, without abbreviations, footnotes, or references. It should be a microcosm of the full article. The abstract must be between 150–250 words. Be sure that you adhere to these limits; otherwise, you will need to edit your abstract accordingly. The abstract must be written as one paragraph, and should not contain displayed mathematical equations or tabular material. The abstract should include three or four different keywords or phrases, as this will help readers to find it. It is important to avoid over-repetition of such phrases as this can result in a page being rejected by search engines. Ensure that your abstract reads well and is grammatically correct.**

***Index Terms*—Enter key words or phrases in alphabetical order, separated by commas. For a list of suggested keywords, send a blank e-mail to keywords@ieee.org or visit http://www.ieee.org/organizations/pubs/ani_prod/keywrd98.txt**

## I. INTRODUCTION

THIS document is a template for Microsoft *Word* versions 6.0 or later. If you are reading a paper or PDF version of this document, please download the electronic file, trans_jour.docx, from the IEEE Web site at www.ieee.org/authortools so you can use it to prepare your manuscript. If you would prefer to use LaTeX, download IEEE's LaTeX style and sample files from the same Web page. You can also explore using the Overleaf editor at https://www.overleaf.com/blog/278-how-to-use-overleaf-with-ieee-collabratec-your-quick-guide-to-getting-started#.Vp6tpPkrKM9

If your paper is intended for a conference, please contact your conference editor concerning acceptable word processor formats for your particular conference.

## II. GUIDELINES FOR MANUSCRIPT PREPARATION

When you open trans_jour.docx, select "Page Layout" from the "View" menu in the menu bar (View | Page Layout), (these instructions assume MS 6.0. Some versions may have alternate ways to access the same functionalities noted here). Then, type over sections of trans_jour.docx or cut and paste from another document and use markup styles. The pull-down style menu is at the left of the Formatting Toolbar at the top of your *Word* window (for example, the style at this point in the document is "Text"). Highlight a section that you want to designate with a certain style, and then select the appropriate name on the style menu. The style will adjust your fonts and line spacing. Do not change the font sizes or line spacing to squeeze more text into a limited number of pages. Use italics for emphasis; do not underline.

To insert images in *Word*, position the cursor at the insertion point and either use Insert | Picture | From File or copy the image to the Windows clipboard and then Edit | Paste Special | Picture (with "float over text" unchecked).

IEEE will do the final formatting of your paper. If your paper is intended for a conference, please observe the conference page limits.

### A. Abbreviations and Acronyms

Define abbreviations and acronyms the first time they are used in the text, even after they have already been defined in the abstract. Abbreviations such as IEEE, SI, ac, and dc do not have to be defined. Abbreviations that incorporate periods should not have spaces: write "C.N.R.S.," not "C. N. R. S." Do not use abbreviations in the title unless they are unavoidable (for example, "IEEE" in the title of this article).

This paragraph of the first footnote will contain the date on which you submitted your paper for review. It will also contain support information, including sponsor and financial support acknowledgment. For example, "This work was supported in part by the U.S. Department of Commerce under Grant BS123456."

The next few paragraphs should contain the authors' current affiliations, including current address and e-mail. For example, F. A. Author is with the National Institute of Standards and Technology, Boulder, CO 80305 USA (e-mail: author@ boulder.nist.gov).

S. B. Author, Jr., was with Rice University, Houston, TX 77005 USA. He is now with the Department of Physics, Colorado State University, Fort Collins, CO 80523 USA (e-mail: author@lamar.colostate.edu).

T. C. Author is with the Electrical Engineering Department, University of Colorado, Boulder, CO 80309 USA, on leave from the National Research Institute for Metals, Tsukuba, Japan (e-mail: author@nrim.go.jp).

# Final report



## INSTRUCTIONS ON FORMAT OF FINAL YEAR RESEARCH THESIS

### 1. OVERALL FORMAT

**General**

A final year research thesis should make some contributions to knowledge and not be mere collation of existing material. The thesis should be written in English.

**Word Limit**

The length for the thesis (including footnotes, appendices, bibliography, charts, statistical tables, graphs, illustrations, maps etc.) should be between 40-60 pages.

The following guidelines indicate ESP's general requirements in the preparation of a thesis. The emphasis here is on documentation style that is acceptable in terms of print quality, margin, spacing, page numbering, tables, equations, and other illustrative materials. Certain degree of freedom is thus left to the individual student to allow him/her to find the best possible way to present the actual subject matter on hand.

In what follows, statements typed in normal print signify the requirements that must be compiled with. Sentences in italics are merely some additional suggestions or recommendations for a good thesis presentation.

**Paper and margin**

The thesis should be written in English, submitted on white A4 size paper and printed on both sides of the paper. The left-hand margin should be 37mm to allow for binding. Margins on the remaining three sides should be 25mm each. The text area (i.e., the space covered with type) would then be approximately 148 x 247mm. *Justified right margins are preferred in the text; however ragged right margins are also acceptable.*

The text should have a font size of 12 points (font is the height in points, with 28 points = 1 cm). The entire thesis (with the possible exception of figures and appendices) should be in the same typeface. Do not choose a typeface that is difficult to read. Times Roman is preferred.

The text should be 1.5 lines-spaced throughout with the following exceptions:

- Captions for Figures/Tables – should be single-spaced
- List of Figures/Tables – should be single-spaced and double-spaced between entries
- Footnotes – should be single-spaced

**Print quality**

Clear, clean and sharp copies are required. In the case of photocopies, no fading, extraneous marks or grey background should appear.

**Heading**

The chapter titles, headings, and sub-headings may be of appropriately larger font sizes; 14- and 16-point types are acceptable. *The lowest grade of heading may be run on at the beginning of a paragraph instead of occupying a separate line; it should then be followed by a full stop. Headings on separate line should never have a full stop at the end. Avoid italics in all headings.*

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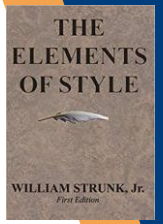
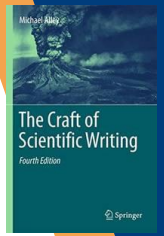
# You can read any relevant books for this module (or not), but I recommend…




The Elements of Style, William Strunk Jr (any version is ok)


The Chicago Manual of Style, The essential guide for writers, editors, and publishers (any version is ok). Free online version via NUS library.




The Craft of Scientific Writing, 4th ed, Michael Alley. Free online version via NUS library.


Research Methodology and Scientific Writing, 2nd ed, C. George Thomas. Free online version via NUS library.

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