UBC Engineering Projects Project Lab
www.engphys.ubc.ca/projectlab

Guide to Proposal Submissions   *Last Revision: 2009 August 31*

A well-written project proposal serves many purposes in allowing project work to proceed smoothly. Below are components which must be a part of the proposal for projects in the Project Lab for APSC 459 and 479. This structure is in place to streamline the review process and to force student groups to address issues which are particularly problematic for projects in APSC 459/479.

For the parts of the proposal, suggested maximum page numbers are indicated for each section.

Letter of Transmittal

Title Page
Executive Summary
Table of Contents, List of Figures, List of Tables

1. Background and Motivation (4 pg)
2. Project Objectives (1 pg)
3. Proposed Method and Deliverables (5 pg)
4. Team Responsibilities and Contacts (1 pg)
5. Work Plan and Schedule
    5.1. Tasks and Project Timeline (5 pg)
    5.2. Communication Plan (1 pg)
6. Milestones (1 pg)
7. Project Wrap-Up (1pg)
8. Technical Resources and Budget (2 pg)
9. Risks Anticipated and Contingency Plan (2 pg)
10. Value of the Results (1 pg)

    Appendices (no limit)
    References

    Total: ~20 pages (excluding Summary, Figures and Appendices)

Letter of Transmittal

The letter of transmittal, or cover letter, introduces you to the recipient of the proposal, establish your credentials for the project, highlight special features of the proposal that you want the reader to consider, and remind the reader of the reason for the proposal.

Letters of transmittal should be included to your project sponsor.

The letter of transmittal is not bound into the proposal since it is always written to an individual person, whereas the proposal may be read by several people in order to be evaluated.

Title Page

Below is a sample of the title page used for your documents. Note that the Project Number is assigned to each group at the start of the academic term.
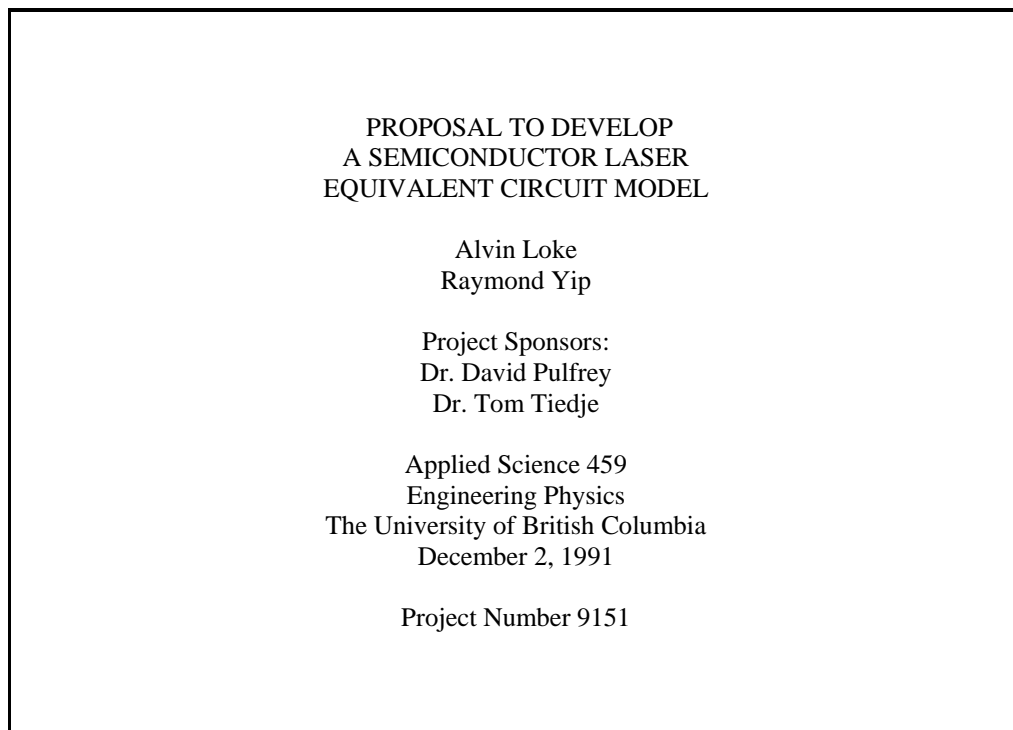
PROPOSAL TO DEVELOP
A SEMICONDUCTOR LASER
EQUIVALENT CIRCUIT MODEL

Alvin Loke
Raymond Yip

Project Sponsors:
Dr. David Pulfrey
Dr. Tom Tiedje

Applied Science 459
Engineering Physics
The University of British Columbia
December 2, 1991

Project Number 9151

Figure – Sample Title Page for APSC 459/479 project proposals

Executive Summary

The Executive Summary should be a clear statement of the research objectives, the anticipated results and benefits, and the technical resources required to achieve the objectives. Ideally, the abstract or summary will be a self-contained and require no specific background in order to understand the general objectives and tasks associated with the project. You should indicate clearly and succinctly what you intend to deliver to the client.

An abstract for a student proposal may contain several paragraphs, and should not normally exceed one page.

Table of Contents, List of Figures, List of Tables

Always provide a full list of the contents of the proposal starting with the Abstract. The first sections of the proposal are numbered with Roman numerals starting with the Title Page, which is page i (but not shown on the page). The first page of the body of the proposal, traditionally called the Introduction, is numbered starting at page 1. All pages, including any appendices, are numbered consecutively.

1. Background and Motivation

Background information is required so that problem is placed into context for the reader. The statement of the problem will be supported by references to current information and data, previous research, and state-of-the-art solutions.

The Background and Motivation section may contain a number of subsections which may include:
- Technical background for individuals that are not experts in the field.
- Discussions on the state of the art and what industrial competitors are doing.
- Discussions on alternative strategies which were considered but not pursued.
- Theoretical work developed to help define the proposed solution
- Results from previous experimental work.
- Exact requirements, technical specifications, codes or standards that you must satisfy for the project.

The section should answer the following questions:
- Who is sponsoring the project?
- What is the rationale for doing the project?
- What are the key issues to be addressed?
- What is the significance of the work in a general context?

The Background and Motivation section is intended to be a stand-alone section, and should provide the reader with sufficient justification for the need of the project without needing to refer to another document or section of the proposal.

2. Project Objectives

You must provide a list of clear and obtainable objectives that can be measured and readily identified, and describe the list of deliverables that are expected at the completion of the project.

Objectives are the intended goals of the project. A well-formed project objective is a statement that describes a specific verifiable condition that must exist to fulfill the affiliated goal. One mnemonic used in project management for evaluating project objectives is SMART, which stands for:

- Specific: The goals and methods are clearly defined.
- Measurable: The objectives can be measured quantitatively.
- Action-oriented: The objective should be linked to a specific action, such as deliver, implement, establish, or supply.
- Realistic: The objective is a result that can be achieved in the time allowed.
- Time-bound: The objective includes a specific date for its achievement.

As much as possible, include quantitative information and target values for the desired performance of the system – this makes it possible to objectively examine each part of proposed solutions, and to understand the magnitude of the project.

As the project progresses, individual tasks may have to be changed given any number of unexpected events.   Individual tasks can be changed, but the objectives of the project as defined in this section should be considered things that remain fixed throughout the project.

3. Proposed Method and Deliverables

Proposed Method

The Proposed Method for the project describes the materials and techniques the group will use in order to meet the Project Objectives. It is useful to present an overview of the approach separate from the Work Plan, in that technical information and justification for different steps in the procedure can be discussed in detail separately from the proposed work plan.

The Proposed Method section may include:
- **Theory** – This can include published papers, or relevant discussions from textbooks. Theoretical descriptions which might be useful as a reference but would not be considered essential to understanding the method can be included as an Appendix.
- **Proposed Design –** Include drawings and sketches of any preliminary design ideas which may be the foundation of the final prototype or instrument.
- **Proposed Analysis –** Describe the approaches used to analyze the system during the project – analytic examinations, finite-element analysis, or numerical simulations may be appropriate tools to use at different stages of the work.
- **Evaluation of Alternative Designs** – It is not only necessary to identify any alternative designs, methods and techniques which might be used, but to identify how one of these methods will be selected in favour of the other alternatives. What quantitative measurement will be used to choose one method over another? (cost, strength, number of calculations, speed, minimum fabrication, etc).
- **Proposed Verification Procedure** –The proposal must include a description of the measurements to be taken during development and at the end of the project to measure overall performance. There should be a focus on quantitative aspects of the project, either as absolute measurements or compared to existing solutions. Please also consider measurement error and minimum required sampling data, as you have done in earlier Physics lab courses.

Deliverables

Deliverables are the tasks and physical items that the group has promised to accomplish and provide to the client at the end of the work. Deliverables which may be a part of any particular project may include:

- Engineering recommendation report.
- Prototype device or instrument you may have assembled.
- A specific recorded demonstration of the results to a selected audience.
- Documented results from instrument testing.
- Documentation describing all components in the system.
- Software package with documentation.
- Complete set of design drawings.

Note that:

Objectives are the problems or issues that the client wishes to have addressed.

Deliverables are the physical prototypes, software, specific measurements, or any item created by the team to specifically address these objectives.

4.   Team Responsibilities and Contacts

In APSC 459/479, different group members are assigned different managerial roles within the group.   Your proposal should identify the members who have responsibility for these managerial functions.

Project Manager
- Ensures that the schedule is maintained and work is done according to schedule
- Maintains communications with the client and resource people
- Schedules meetings and resolves general problems that arise.

Editorial Manager
- Submits the Proposal and the Recommendation Report
- Delegates the preparation of these documents.
- Ensures weekly reports are submitted to the project advisors
- Records alterations to the schedule and milestones.

Technical Manager
- Obtains access to equipment and resources
- Maintains drawings, calculations, and software for the project.
- Sets up experiments and collects data with assistance from other team members.
- A 2-person group does not have a technical manager, or can be assigned to one of the two members.

Technical Contacts
The identities and contact information of other resource people for the project must be stated. These may include:
- Specific individuals from the sponsoring company.
- Faculty or technical staff on campus.
- Other students that have specific expertise.

It is crucial that you list as much information as possible about each of these contacts as you can, including: name, job title, e-mail address, telephone number and mailing address.

5. Work Plan and Project Schedule

The Work Plan is developed so that you can accomplish each of the objectives for the project. The work plan is a list of tasks that describes in detail every step that will be done during the project, determining the time and resources necessary to the tasks, and providing the relationship between tasks to allow work to be done.

Step 1 - Identify Tasks
A task can be defined as the smallest activity that can be non-trivially described and normally will take no more than several hours to do. The tasks must be explicit, they must spell out precisely what methods will be used, and they must state who is responsible for the task.

> e.g. It is not acceptable to say that one of your tasks is write the assembly language program to make a microprocessor control a process. Rather, describe tasks and steps involved in getting the microprocessor to control a process, which starts with defining the inputs and outputs and ends with loading and debugging the code.

Developing the work plan can be viewed as an exercise in reverse engineering. You have the starting point, which is your current understanding of the problem, and you know the finishing point, which is providing the deliverables to the client. Your work plan must bridge the gap between the starting point and the deliverables.

Here are some things to keep in mind about tasks.
> A task consists of one activity.
> Each task describes in detail what you propose to do.
> Tasks should not be done concurrently unless done by different members of the team.
> Identify the person responsible to complete each task.
> Each task requires a start date and an estimated duration for the activity.
> A task may have one or more precedents (tasks that must be completed before the task can start).

Step 2 - Estimate Task Durations
It is difficult to estimate how long individual tasks should take to complete. It helps to have experience to determine the task duration but, even if you have never done something before, it is in the best interest of the project to make a reasonable estimate of how long it will take to do each task. Poor time estimates leads to delays in the entire project, inappropriate resource/time allocation, and potential cost overruns.

Keep the following points in mind:
1. Understand in as much detail as possible what is to be done in each task.
2. Identify what resources, techniques, and software is required to accomplish each task.
3. Break the work down into the smallest complete tasks that can be easily described.
4. Be certain that the task list covers the entire project. Tasks that are often overlooked, such as parts sourcing and documentation, are the source of underestimating project time.
5. Put in a contingency for things you didn't think about or for unexpected delays. Allow for technical uncertainty or for problems beyond your control (but you are still obligated to keep the project on schedule).

Step 3 – Set the Project Schedule
Several techniques and software packages are available to prepare a project schedule. Some of the planning and scheduling techniques are: precedence and dependency networks, arrow diagrams, critical path management, program evaluation and review technique (PERT), and Gantt or time-line charts.

Although Gantt Charts are typically used for submitting timelines in APSC 459/479, students are encouraged to identify other project scheduling alternatives to organize and present their project timelines, either embedded into their Project Proposals or presented otherwise.

A list of notable packages can be found at:
        http://en.wikipedia.org/wiki/List_of_project_management_software

The Gantt chart, sometimes called a schedule bar chart, is the most common method of showing the relationships between activities or tasks in a project.
        The schedule lists all the tasks in order,
        Each task has a start date and completion date,
        A task cannot start until its precedent has been completed,
        The time line must show both the projects weeks and the calendar dates,
        Milestones are shown as separate activities on the Gantt chart.

Several software applications used in APSC 459/479 in the past include:
        Planner – Project Scheduling Tool (Linux)
        http://www.simpleprojectmanagement.com/planner/

Gantt Project (Linux, Windows, MacOSX)
http://ganttproject.sourceforge.net/

Gantt PV (Windows, MacOSX)
http://www.pureviolet.net/ganttpv/help/tour.html

6. Milestones and Communication Plan

Milestones

A Milestone is a well-defined conclusion to an activity or series of related activities, and is the logical point where one set of activities stops and another set begins. Milestones allow progress on the project to be quantified or measured in an objective way. For APSC 459/479, milestones are used for two purposes: motivation for the team to proceed at a steady pace throughout the term, and as a means of tracking progress externally for the project.

The percentage value of a milestone should reflect the difficulty of the tasks leading to the milestone.

Guidelines for selecting milestones for APSC 459/479:
1. Choose 3 specific items as project milestones.
2. Milestones should be objective, and should not be items which can be argued as "partially" completed.
3. Select an appropriate weighting for each milestone, as shown in the example below.
4. Do not place project milestone deadlines too close to one another, space them out throughout the term.
5. Submitting the final report is not considered a milestone.

Milestones can be negotiated and readjusted with the Project Lab during the term, but can be readjusted no more than *one week* before the original milestone date (i.e. no last-minute changes).

Example of appropriate project milestones:

	Milestone	Date	Percent
1	Client has reviewed and given go-ahead for purchase of key components.	Jan 10	40
2	Completion of physical fabrication of prototype; First quantitative measurement of system initiated.	Feb. 28	30
3	In-person demonstration of prototype device for Project Sponsor + other external clients.	Mar. 15	30

In order to gain credit for project milestones, the Editorial Manager is expected to file a Milestone Completion Report through the online tracking system.

Communication Plan

Please include a communication plan to ensure that you will be able to confirm meetings with your sponsor, and with team members in your group. There have been several occasions with project groups in the past with expectations which varied from their project sponsors/clients, and other groups that did not set aside a regular time each week to meet and discuss the project.

The Communication Plan may describe several different forms of interactions:

- Forwarding a copy of the weekly report to the Project Sponsor/Client
- Regularly scheduled weekly and biweekly meetings or phone calls, including specific times and locations of these meetings
- If fewer meetings are to be arranged, specific meeting dates (possibly 2 to 4) laid out at the start of the term.
- It is expected that at each meeting, the student group will create an agenda for the meeting, and will produce minutes for circulation after the meeting to confirm any specific details about the meeting outcomes.

A guide to generating useful meeting minutes can be found here:
http://www.meetingwizard.org/meetings/taking-meeting-minutes.cfm

7. Location of Work, Budget and Resources

Location of Work
Many projects will be done in the Engineering Physics Project Laboratory at UBC. However, some projects may be done partially or completely at the project sponsor's site or at some other location.

Please indicate the space/resource requirements for the project (computer, desk space, software, power, test equipment, etc) so that the necessary arrangements can be made in the lab.

Budget
Estimate the cost of equipment and materials that must be purchased from outside sources. This is particularly important for student projects that have a limited budget and a very short time-line to do the work.

Please indicate the source of funding for all items in the project budget. Several past projects have faced challenges because of confusion as to whether the project sponsor, Project Lab, or the students themselves were responsible for funding certain portions of each project. It is the responsibility of the group to confirm with all parties that the funding is available for the project.

A table may be used to identify items to be purchased in the most straightforward fashion:

Resources
The proposal must state in detail what these resources are so that they can be obtained in time to do the work and so that the costs for the resources can be budgeted.

Resources might include:
- Key electronics hardware to be borrowed or purchased;
- Mechanical components such as motors or bearings or structural elements;
- Outside machine shop time to make devices, circuit board fabrication,
- Software applications or high-end computing facilities,
- Special instrumentation for obtaining data,
- Access to outside test facilities (wind tunnel, vibration isolation room, etc)

#	Description	Quantity	Vendor(s)	Cost	To be purchased by:	To be funded by:
1	Servo Motor					
2	Stock Aluminum					
3	DAQ board					

8. Risks Anticipated and Contingency Plan

Contingency planning is not something you improvise at the start of the emergency, but is done during the project planning stage to identify the most likely areas that will cause disruptions in the work described in the schedule.

General areas of concern include:

- Late delivery on expected orders of items. It is wise to have an alternative course of action if a delivery date is missed, which may include building a temporary part in the machine shop, or having an alternative source of supply for a purchased component, or potentially pursuing a different path for fabrication / testing for the project.

- Anything that might happen not directly under your control, such as relying on feedback from a technical resource person or broken instrumentation. You must consider all the activities or tasks in your proposal that rely on people or events outside your direct control to locate those where slippage in the schedule could affect the tasks that follow.

Contingency plans consist of:
- Identifying the condition which triggers the contingency plan into action
- Describing the likelihood and impact of the condition being met.
- Describing the changes which need to be made to the task list.
- Identifying the date or range of dates at which point this decision will be made.

Using a table to format this section may help to keep

Risk Condition	Probability	Impact	Changes to Work Plan	Expected Date of Risk Decision

Avoid making any part of your project contingent on positive results research-oriented activities, ones in which it is not clear from the outset of the project whether or not certain technical accomplishments are possible. Such tests are the objective of research projects, where the path to successful completion is not clear from the outset and which may or may not have a high likelihood for success. The overarching theme for APSC 459/479 is on design projects and project management, where the focus is placed on projects where it is clear from the very beginning that projects are feasible with the time and resource constraints placed on the students.

9. Value of the Results

The purpose of this section is to indicate the value of the work first to the client or project sponsor and second to a larger audience. There should be a need for the outcome of the project work and the sponsor should provide this information, although it is usually obvious from the problem statement. Naturally, the client or funding agency will weigh the value of the results to the cost of the project. Therefore, you must show that what you propose to do is worth the effort and the cost.

Appendices, References

The Appendices and References for the proposal should include all details that support the technical content to support the proposal. In order to keep the Proposal concise, the Appendix may contain a great deal of the technical information that is not necessarily appropriate in the body of the proposal. This can include:

- A list of all web links with useful and potentially useful information
- Photographs of the current state of the project.
- Calculations and theory required to pursue the project
- Software and algorithms that you will be using during your project.
- Data sheets for key components of the system.
- Journal articles, publications, patents, etc.

Further details on the References section can be found in the Guide to Final Reports on the course website.

Common problems with proposals

Below is a checklist of general problems with proposals at all stages of composition. Please review this list over at different times of the proposal writing stage – or get assistance from other groups in reviewing your work.

Content Issues

- ☐ More planning/designing should be done during the proposal-writing stage, not left until January (for APSC 459).
- ☐ Not enough detail about the proposed solutions (sketches, component I/D, estimated performance, specific algorithms used during the project)
- ☐ Not nearly enough research on existing and state of the art techniques or solutions.
- ☐ Not enough general research done during the Proposal stage.
- ☐ Overambitions - too much work is required to complete all tasks, and the project scope too broad for ~120 hours of work per team member.
- ☐ Technical content is not appropriate for APSC 459/479 (either far too difficult given the time constraints, or far too easy given the skills and backgrounds of fourth and fifth-year Engphys students).
- ☐ No time allotted for midterms.
- ☐ Too little work scheduled at start of term, too much done at end!!
- ☐ Poor communication with project sponsors during the term (this leads to delays in clarifying ambiguous points, delays in ordering components, etc.)
- ☐ Waiting too long to get technical assistance from Project Lab or sponsor.
- ☐ Waiting too long to contact the Project Lab or sponsor about ongoing issues leading to delays in the project.
- ☐ Poor formatting of document – this can include improper page numbering, incorrect dates, poor spelling and grammar.

Formatting and Structural Issues

- ☐ Abstract is missing specific details about the project.
- ☐ Project rationale is not complete.
- ☐ Background information for the project is missing (state of the art).
- ☐ Project objectives are not clear or are given as tasks, or include irrelevant information.
- ☐ Tasks are not detailed and complete.
- ☐ Task duration is given without justification.
- ☐ Tasks do not have one person who is responsible for the work.
- ☐ Tasks cannot overlap in time without proper resources.
- ☐ Milestones cannot happen before January.
- ☐ Provide details of the job description for each member (section 7).
- ☐ Figures are very helpful when explaining the project. Include them.
- ☐ Risk analysis does not consider uncertainty in completing all tasks.