Faculty of Engineering and Computer Science
Department of Electrical and Computer Engineering

COEN / ELEC 490
CAPSTONE PROJECT

MANUAL

CONCORDIA UNIVERSITY
2017

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Course Description

The ELEC/COEN 490 project is intended as a culmination project in our engineering programs. It is designed for students to gain significant design experience while applying integrated knowledge from several courses. It is also a means to practice project management, technical writing, and technical presentation and other soft skills.

Students work in groups under faculty supervision to solve complex interdisciplinary design problems typically involving communications, signal processing, control systems, electromagnetics, power electronics, software design, and/or hardware design. The project fosters teamwork between group members and allows students to develop their ability to carry out the work in various aspects of real engineering projects.

Tutorial: one hour per week, two terms. Equivalent laboratory time: four hours per week, two terms.

NOTE: All written documentation must follow the Concordia Form and Style guide. Students are responsible for obtaining this document before beginning the project.

The two-term project is divided into three phases:

Phase 1: Project selection and planning: formation of the team, selection and definition of the project, plan of the technical contents, work breakdown into manageable tasks for each group member, and work schedule and budget justification.

Phase 2: Design and implementation: carrying out the design work as scheduled in Phase 1, documenting the design and implementation, preparing the design review, and updating the schedule and plan.

Phase 3: Design, implementation and testing: completion of the design and implementation work as scheduled in Phases 1 and 2, verification and testing if necessary, preparation of the final design review, technical and user manuals.

At the end of Phase 1 as well as Phase 2, students are required to submit progress report and make oral presentation. Phase 3 is completed with a pre-demo, a final and comprehensive project report and a presentation in a poster/demo session.

Registration Requirements

- Minimum of 75 credits in your BEng program
- No registration without prerequisites
- FNS, DEF, INC, PEND do not satisfy prerequisite requirements.
- Prerequisites:
    - Computer Engineering: ENGR 371, COEN 352, COEN 390; ELEC 311 or SOEN 341

    - Electrical Engineering: ENGR 371, COEN 311, ELEC 364 or 342, ELEC 390
- Readmitted students must repeat Ds and replace them with Cs (or higher) for 490 prerequisites
- Students cannot take COEN/ELEC490 without completion of all required 200 level courses

Recommended Textbooks

- Project Management & Teamwork, by Karl Smith
- Tools and Tactics of Design (paperback) by Peter G. Dominick et al. Wiley, 1st edition (2000). ISBN: 0471386480.
- Guidelines to Professional Practice (free, available on-line) by the OIQ, 1999. ISBN: 2980218618.
- IEEE 315-1975 (Reaffirmed 1993) Standard (available at the library through IEEE Xplorer)

Project Selection

- The list of projects is currently available at Projects List: (http://users.encs.concordia.ca/~eceweb/capstone/index.php). This list is updated until the mid-September.
- Each project group consists of 3 to 5 students. Single student projects are not allowed.
- Projects, posted on the ECE web site, will be assigned on first come first served basis. Professors may examine the background/competences of the students who intend to do the projects and then decide if he/she would supervise them.
- Alternatively, students can propose a project for their own group, providing that the project will be approved and then supervised, solely or jointly, by a faculty member in the Department. The project must be pre-approved by the Technical Coordinator.
- Once you and your group members have agreed with a professor on a certain project, all members should sign Project/Group Selection Form (available in the capstone website), get the signature of the supervisor, and submit it to the Academic Coordinator.
- Projects will not be assigned to a group until the Project/Group Selection Forms are signed by the Academic Coordinator.
- Students should elect a group leader who will coordinate their activities.
- Students who are unable to join a group may be grouped by the Coordinators and assigned to an available project in line with their discipline, subject to the availability and the agreement of the people concerned.
- Communication with students will be done through Departmental ELEC/COEN 490 mailing list and MOODLE site. **Make sure that at myConcordia portal you have a valid e-mail address that you check on a daily basis!**

How to Find a Project Group

In the process of finding a group, a project, and group members, the MOODLE general forum serves as a message board for students to communicate with their classmates. The Academic and Technical Coordinators can also help you for this purpose.

1. **If you are interested in a particular project listed in the capstone website**
   - Contact the professor who proposed it. Some other individual students might also contact him/her and you may form a group with them.
   - Post your intention of taking the project in the general forum of MOODLE. You may get responses from students who are also interested in doing it.
   - Speak to your classmates when you meet them.
2. **If you have a project and look for group members and a supervisor**
   - Get pre-approval from the Technical Coordinator.
   - Post your project description in MOODLE, and specify which kind of competences your potential group members should have.
   - Speak to your classmates to find group members.
   - Discuss with the coordinators who can recommended a professor to supervise the project.
   - If a professor agrees with the supervision, the project will be officially listed.

3. If you **do not have a project** and wish to join a group
   - Post messages in MOODLE specifying which kind of projects you wish to do and which kind of competences you can offer.
   - Watch the MOODLE forum and respond to the messages looking for members
   - Speak to your classmates.

Grading Scheme

Please see the document available on the Capstone web-site.

Grading check points

- Project content, especially technical, and its scope
- Project execution and management
- Time management
- Project results
- Team: creation & management, task distribution, communications, etc.
- Reports and documentation: content, formatting, use of technical terms and standards
- Presentations
- Learning experience

Graduate Attributes

See a separate document.

Zero Tolerance for any Kind of Academic Misconduct

Students should be familiar with University Code of Conduct (Academic) found at http://www.concordia.ca/students/academic-integrity.html

Each student needs to sign a Form of Expectations of Originality for all the written work of the course to certify that each submission is the original work of the group members and meets the Faculty's Expectations of Originality. The form is available at: http://www.concordia.ca/encs/students/sas/expectation-originality.html
Please make sure that you sign the form **after** reading **the whole** page.

Contacts

1. **Academic inquiries, project assignment:**

Academic Coordinator - Dr. Chunyan Wang,
Office: EV5.121
Email: chunyan@ece.concordia.ca
Phone: (514) 848-2424 ext. 3120

2. **Resources and technical questions**

Technical Coordinator - Mr. Dmitry Rozhdestvenskiy
Office: H851-2
Email: dmitry@ece.concordia.ca
Phone: (514) 848-2424 ext. 3106

3. **General questions, presentation scheduling, special events**

Program Assistant – Ms. Maria Fasciano
Office: EV5.144
Email: mariaf@ece.concordia.ca
Phone: (514) 848-2424 ext. 3102

Project phases

General information on work submission

Report submission deadlines and presentation schedules: refer to the “Capstone Important Dates” web-page at the Department’s web-site:
http://users.encs.concordia.ca/~eceweb/capstone/index.php

Report

Guidelines

- For organization, layout and documentation please follow the guidelines from the Chapter 2-7 of the Concordia Form and Style Guide.
- Schematics, block diagrams, flow charts and any other graphical materials **must comply** with IEEE 315 or IEC 60617 standard.
- For groups doing software projects, you are permitted to use the ANSI/IEEE Standard for Software Requirements Specification, in place of the Concordia Form and Style Guide.

Submission

- There will be a 10% penalty per day for late submission of reports.
- Number of copies to be handed in: THREE, i.e., one for the supervisor and one for the coordinators, and the other to be used for the assessment of the CEAB Complementary skills. This applies to all reports of this course.
- Reports to be submitted to Maria Fasciano (EV5.144).

Presentation

- All members of each group should attend their group's project presentations. We also expect that students make themselves available for the entire hour block.
- Each presentation should be done by more than one student.
- Each group member is expected to talk at least 5 minutes cumulatively in the presentations (Phase 1, Phase 2, and Phase 3).
- The conference room is equipped with a computer, and plasma screen or projector (for those who want to make their presentations with PowerPoint). The screen has a maximum resolution of 1600x900. The projector has a maximum resolution of 1024x768. Make sure that the format of the file (Power Point) is fully backwards-compatible.
- Groups are advised to make use of their web-space to transfer presentation slides to the conference room.
- Each group has to book a time slot that is suitable for all the group members and their supervisor for their presentation.
- This time slot has to be given to Maria at least week before the presentation week.

Phase 1

- Create the team
- Define the project requirements
- Prepare the design specifications
- Define technical contents
- Break the project down into manageable tasks
- Allocate tasks to individual group members
- Prepare the schedule
- Prepare the budget

Deliverables

Group Report (10-15 pages)

- The Phase 1 report is intended to be a detailed project proposal.
- The length of the Phase 1 report is expected to be in the range of 10-20 pages[1].
- The report should contain:
  - Abstract
  - Objectives/Requirements/Specifications. Use Guidelines to Professional Practice (OIQ): 3.1.1.-3.1.3., 3.2.2., 3.2.7. *(From now on, the figures in { } refer to chapters, clauses and paragraphs from this document)*
  - Design specifications (numerical)
  - Measurement of success (numerical)
  - Test plan
  - Review of existing solutions
  - Alternatives
  - Project planning and schedule {4}
  - Team formation {4.1.}
  - Tasks breakdown, description and allocation for each team member {4.1, 4.4}
  - Communication plan
  - Contingency plan {3.2.5}
  - Tools required
  - Budget estimation {3.2.9}

A sample title page is included here in Appendix 7. Please use this title page for all project submissions.

Presentation (based on Phase 1 report, 15 minutes per group)

- This presentation should proof that you:
  - understand what the project is about
  - clearly see the goals and the deliverables
  - can justify that the project will be successfully completed
  - can properly manage the time and the scope of the project
  - have necessary qualifications/competences to complete the project
- Each group is allotted 30 minutes: 15 minutes for presentation, 10 minutes for question and answer session, and 5 minutes for set-up and log-out. In general, you should

[1] If your supervisor has any specific requirements, these should be addressed in this report

provide an overview of your project and present your plan. You can also present any special requirements that your project may have.

Presentations FAQ

FAQ/FGC (frequently given comments) on your presentations and projects[2].

"If you can't describe what you're doing as a process, you don't know what you're doing" – Dr. W. Edwards Deming

1. **What should a project report contain besides the technical aspects of the project?**
   1.1. As per the Project Management Body of Knowledge (PMBOK) the five basic process groups are:
      1.1.1. Initiating
      1.1.2. Planning
      1.1.3. Executing
      1.1.4. Monitoring and Controlling
      1.1.5. Closing

Therefore, "Phase 1" report should contain information on initiating and planning of your project. While planning you project, you should cover the following knowledge areas:

   1.2. Project Scope Management
   1.3. Project Time Management
   1.4. Project Cost Management
   1.5. Project Human Resource Management (Team formation and management, tasks assignment)
   1.6. Project Communications Management (Communications plan, meeting schedule, etc.)
   1.7. Project Risk Management (Define negative and positive risks and the way you will be managing them)

   Optional:

   1.8. Project Quality Management
   1.9. Project Procurement Management
   1.10. Project Integration Management

2. **Specify project goals and clearly list deliverables at the beginning.**

   Example:

   Project name: Fly-chasing robot
   Goal: Build a fly-chasing robot
   Deliverable (s): a working prototype of fly-chasing robot

   Design requirements

   - Functional requirements:
     - Eliminate flies within certain area
     - Log the parameters of the flying habits of the flies
   - Non-functional requirements:
     - Portable
     - Dual power: standard AC outlet and car battery
     - Suitable for outdoor use
     - Easy to setup and operate

[2] Note that not all comments are applicable to research projects

- Safe, etc…

Design specifications[3]:

#	Description/parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
1.	Detection range	Normal[Note1]			10	m
2.	Tracking speed	Normal[Note1]			5	m/s
3.	Hit range	Normal[Note1]	0.1		2	m
4.	Number of flies tracked simultaneously	Normal[Note1]			5	pcs
5.	Performance	Normal[Note1]			3	flies/minute
6.	Size (L/H/W)				200/ 200/ 100	mm
7.	• power requirements[4]: ▪ AC source • Voltage • Frequency ▪ DC source			 120 60 12		 V Hz V
8.	Operational temperature		0		30	C
9.	Storage temperature		-20		+80	C
10.	Relative humidity	Non-condensing			95	%

Note 1: Normal test conditions mean that the test is conducted at ambient temperature +20C, 60% RH, no direct sunlight. There are no obstacles within 15 m from the device. No wind. No precipitation. The device is powered from a standard power outlet (V=120V+-5%, F=60+-1 Hz). The size of the test flies is L/W/H = 5/5/5 mm; colour is black, matt.

Measurement of success: 90% of flies eliminated within 1.2m from the device, given that no more than 2 flies per minute enter in the 2m space around the gadget and no fly leaves it.

IMPORTANT: For each number you write you must to have an idea how to prove that your design has met it. In other words, you must have an idea how you will write a **test case** for it.

3. **Analyze the market**: is there a similar product/solution? If so, explain why and what you are going to improve. If you are planning to redesign an existing product – just say so.
4. **Alternatives analysis**
   4.1. Define your key parameters. This is applicable to each and every stage when you deal with alternatives (solutions, approaches, hardware, etc.).
   4.2. Pick 2-4 alternatives.
   4.3. Analyze alternatives using numbers instead of words, e.g.:

Parameter	Importance	Alternative 1	Alternative 2	Alternative 3
Key parameter 1	95	7	10	9
Key parameter 2	90	9	5	10
Key parameter 3	88	6	7	10
Parameter 1	60	10	2	1
Parameter 2	40	7	10	0
Cost	-50	9	10	8
Total score:		24.33	20.36	22.95

As you can see, “cost” is a negative parameter. You might have to add other “negative” parameters (i.e. effect on the environment).

[3] Software projects are NOT exempt from specifications

[4] Might not be applicable to all projects. It might be a part of the design decisions.

If you mention numbers – be ready to explain how you got them (i.e. calculation, article, etc.).

5. **What is the difference between Phase 1 and Phase 2 alternatives analysis?** Phase 1 - SYSTEM level ("big picture"), phase 2 – system COMPONENT level. Example: your task is to design a machine that cuts trees. Thus, based on the size of the tree, cutting time, environment, etc. (i.e. project/design requirements) you have to make a choice of tools: chain saw, axe, knife, hand saw, etc… That's Phase 1. Let's say, you've picked an axe. In Phase 2, you have to decide on the blade and handle material and shape; how to sharpen the blade, etc…
6. **Cost estimation.** At the first stage, usually, you do not know what components you will be using, thus you cannot calculate cost based on the parts list. Instead, you can search the market and find the similar products. Your project cost estimation should be based on this information.
7. If you want to improve an existing product, do cost/benefits analysis.
8. **Deliverables** should be clearly stated for each phase.
9. Clearly state what you are **going to show** at the final presentation.
10. **Feasibility study** should justify that the project is doable within given time and budget.
11. **Do not omit the following areas:**
    - 11.1. Team formation and management //justify each team member selection//
    - 11.2. Communication plan
    - 11.3. Time management
    - 11.4. Risk management
12. **Use Guidelines to Professional Practice (OIQ):**
    - 12.1. Objectives/Requirements/Specifications: 3.1.1.-3.1.3., 3.2.2., 3.2.7.
    - 12.2. Task Description/Allocation for each group member: 4.1., 4.4.
    - 12.3. Project planning: Chapter 4
    - 12.4. Team formation: 4.1.
13. **Slides**
    - 13.1. **Number the slides! Don't number the title page.**
    - 13.2. Use tables, graphs and sketches instead of plain text
    - 13.3. Use legible color schemes and font size
    - 13.4. Put on the slides only necessary information

Phase 2

- Design and implementation
- Document the above
- Carry out the design work scheduled in Phase 1
- Prepare the design review
- Update schedule and plan (final deliverables evaluated against the revised plan)

Deliverables

Group Report (15-20 pages)

- Abstract
- Review the design specifications {3.2.11, 3.3.14}
- Present a design review (go over what has been done up to this point). Use necessary graphical materials (block diagrams, flow charts, graphs, etc.)
- Alternatives {3.1.2}:
    - List and analyze
    - Clearly describe trade-offs
    - Justify your choice (use numbers!)
- Developing the solution selected {3.1.4}
- Design development {3.2.4}
- Discuss and justify deviations from the initial task allocation/schedule
- Update the schedule. Show how you addressed the deviations
- Each student submits 1-2 page summary of his/her contributions

Presentation

- 40 minutes per group: 20 minutes for presentation of the work, 15 minutes for questions and answers, and 5 minutes for set-up and log-out.
- Those team members, who did not present the Phase 1 work, must make presentation for Phase 2.
- The presentation should be based on the report.
- Present your main design/implementation results in Phase 2 and the problems to be solved in Phase 3.
- Justify the modification of your schedule and project scope, deliverables, specifications, etc. given in Phase 1 if applicable.
- A working demo is encouraged, but not mandatory.

Phase 3

- Design/Implementation
- Complete the design and implementation work as scheduled in Phases 1 and 2
- Carry out verification and testing
- Prepare the final design review and final project report
- Prepare technical and user manuals

Deliverables

Pre-demo
Each group present their project in an ECE lab room to demonstrate, in an informal manner, the function and functionality of the system so far developed by the members. The group needs to book a time slot for the pre-demo.

Group Report
This report is a complete report of the capstone project. It covers the entire development of the project, not only the work done during the Phase III. In this report, the description of the system developed should be presented, and the results obtained and the analysis/assessment of the results should be highlighted. Generally, the following sections should be included in the report.

- Abstract
- Introduction (objectives and outlines of the project)
- Description of the project (design, development, problems encountered, solutions proposed, ...)
- Results obtained
- Conclusion
- References

The number of pages of the report should not exceed 50. The description should be concise. The results should be presented with enough details (e.g. conditions for the tests) so that one can understand easily how you got them and how to use your design/product. To make the report complete, the following points should be presented.

- Final product specifications
- Description of the design and test results. All the necessary schematics and diagrams should be included, but no need to include the whole listing of your software, unless it is required for better understanding of your system's functionality. A CD/DVD with the project-related materials could be attached, as appendix, to the report.
- "Sales pitch" of the design.
- Implementation of the design. The description of what you have done and discuss the reasons for any deviations from the initial schedule submitted in Phase 1 and the revised one in Phase 2 should be presented.
- Conclusions.
- Feedback on the lessons learnt
- Technical manual and the user manual of the system that you developed. They are to be attached as appendices.

As an option, you may attach materials relevant to your design, as appendices, to your report. However, an attachment of excessive material is NOT encouraged (e.g. do not attach complete datasheets). All the submitted materials should be bound together. No piece separated from the report will be accepted.

Presentation (final poster/demo session)

- All the members of each group are expected to be present at the poster/demo session, responding to questions from visitors, faculty, students, and examiners.
- The detailed scheduling of the sessions will be announced by mid-March.
- Each group will have a poster board of 4' by 8' (1.12m by 2.43m) (see *"Poster session plotting and preparation"*)
- The contents of the poster should cover, in a brief and concise manner, the following aspects of your project:
    - The objective(s) of the project
    - The development of the project
    - The problem(s) encountered and the solution(s)
    - The results obtained
    - The conclusion

Individual Contribution Report

- This report is to be submitted by every student.
- You are expected to rate the contribution of each of your group members, and provide your point of view to justify your rating.
- This report is compulsory and it will be used, at the end of your project, by your project supervisor to assess the individual members' contribution to the work of the project.

Final Capstone Poster/Demo Presentation

The final presentation takes place at the end of March or beginning of April, usually between March 20 and April 10, in EV building atrium.

Usually, there are two sessions: morning and afternoon. The tentative schedule for these sessions is, if not otherwise specified, as follows:

First (morning) session:	**Second (afternoon) session:**
Setup: 9:00-9:30	Setup: 13:00-13:30
Presentations: 9:30-12:30	Presentations: 13:30-16:30
Dismantlement: 12:30-13:00	Dismantlement: 16:30-17:00

What will be provided and what is available (if not otherwise specified):

1. By default:

   a. Table (32'x100' – Area_1 or 30'x60' – Area_2)
   b. Power connection (AC 110V@15A)
   c. Poster board (4'x6', HxW). You can place up to two 36"x24" posters on it.

2. Upon request: PC with standard ENCS lab software.

3. NO projectors and/or audio-video presentation equipment will be provided. If you wish to have it, please make necessary arrangements with IITS (Hall building, 4-th floor).

4. LAN. Only wireless network will be available. Make sure that you have a valid Alcor account. NO ENCS wired LAN will be available.

The following information should be provided by the team leaders:

1. Team's availability for the both sessions. Indicate the number of students available for each session. (You have to do it, even your team has conflict with only one session.)
2. If one or more team member(s) is(are) NOT available for a session, reasons **must** be given for each team member unavailable at the specified time(s). Note that only academic conflicts will be taken into consideration. In such case, please specify the course number.
3. Equipment requirements. You can request ANY equipment from H-857, including the PC assigned to your team. (Please specify: model number and the ENCS tag number).
4. Space requirements. If you need extra space (ex.: ground for robots), please specify desired size and shape, and justify the need.
5. Location requirements. If you wish to have a nice view from the window behind you, please specify the desired location and justify the need (ex.: bulky equipment located on the street, a camera pointed at the specific point, etc.). To get an idea of what is available see the detailed floor plan (Fig. 1).
6. If you will be using your own laptop, you can ask for an LCD monitor.
7. LAN. If you request a desktop PC, and you are planning to connect it to the network, please indicate it. Otherwise you will not have a wireless LAN card installed in your PC.

Any other requirements will be considered on per-case basis. Such requirements must be approved **before** the deadline.

Poster session plotting and preparation

The poster session is coming up and the projects will soon have the final presentation performed.

There will be an announcement for the scheduling of plotting during the last two weeks before final presentation. There will be approximately 150 groups trying to plot their

posters at the last minute. It is recommended that you try to avoid the rush time by doing what you can before these two weeks. No project drawings will be allowed during these two weeks except by special permission. Poster size is recommended to be 24" X 36" and saved as a PDF file.

Also, remember that Capstone students have access to reserving room H821 for practicing and working on their presentation with a projector. You can request that the room be exclusive to your group during the reservation time. So far the room has not been heavily utilized by Capstone teams but I expect the request will be more forthcoming as the due dates near. Contact me to arrange the reservation time. The available times are posted outside the door.

Capstone Plotters Booking Procedures

Since usually we have 60-90 teams and want to advantage all teams, we need to place limitations on plotting times and sizes.
The plotters are managed by the AITS. Please follow the procedures described here:

http://www.encs.concordia.ca/helpdesk/resource/capstone_490.html

Please note that the plotters get very heavily booked a day or two before the presentation date. So, make sure to make a reservation in advance.

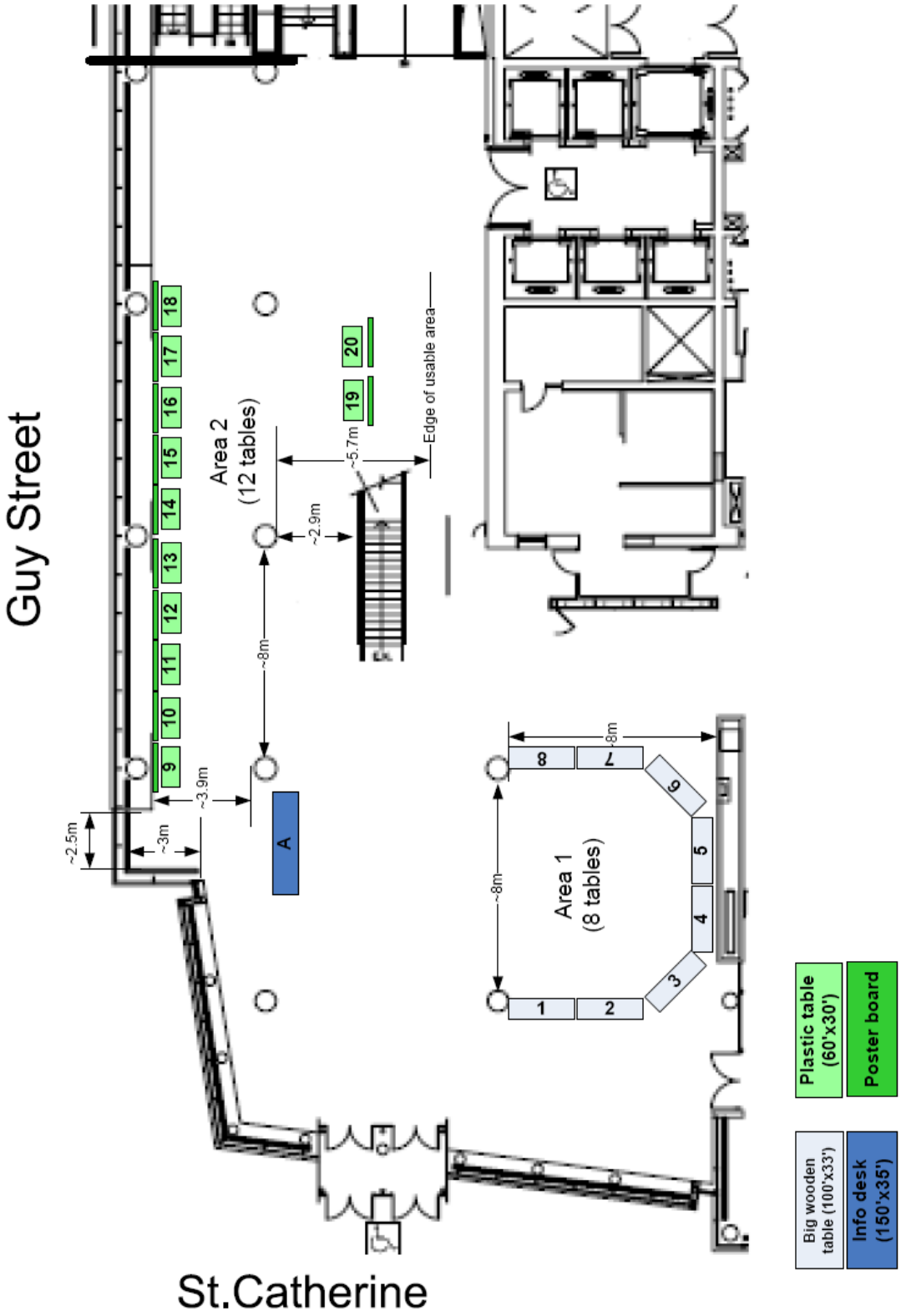

Figure 1: Tentative sample of final presentation floor plan
Usually, ECE occupies “Area 1”.

Resources

Tech support structure

Technical Coordinator
Rozhdestvenskiy, Dmitry
Specialists:
Li, Dan – real-time, control and embedded systems, web
Obuchowicz, Tadeusz – digital systems, VHDL, VLSI
Qin, Shiyu – analog systems, microelectronics. Safety officer.
Patel, Bipin – software, including Android
Technicians:
Guenole, Christian – general inquiries, parts, tools, equipment
Landry, Jeffrey – RF, microwave, telecommunication
Brikho, Chafic – power labs
Capstone technician:
Bruton, Raymond – H-961 area administration, lockers, PC accounts, general inquiries

Laboratory Consulting Services

The Technical Coordinator will be available for consulting services. Students should bring their project description, block diagram, electronic schematic and any other documentation related to their project.

Laboratory Resources

The Department's labs associated with the 490 project:
H857
Main Capstone Hardware Lab. Available to all teams. Lots of equipment and tools. Access to the PCs in H857 will be available upon request only. ENCS password will NOT work.
Materials listed as "available upon request" will only be installed in the lab as needed. To obtain this equipment, please contact the Technical Coordinator specifying the equipment required and a description of its use. Appendix 6 contains the request form.
H805-1
Available for students doing projects with lots of or bulky hardware (1 team capacity).
H1029-5
Available for students doing projects with lots of or bulky hardware (1-3 teams capacity).

H-961 Capstone Project Area
PC and presentation rooms

General Purpose Teaching Labs H913, H915, H917, H919, H921, H831

Software available in Windows on the User-Managed Desktop:
http://aits.encs.concordia.ca/aits/public/desktop/USER_Managed_Desktop/Windows/Software/User_managed_software.html

For students who need word processing, you can use the word processing lab (H509) that the university offers to all students.

The list of computer labs is available from
http://www.encs.concordia.ca/encsit/public/top/labs/index.html

If a borrowed equipment or material is lost or damaged the University has the right to ask for re-imbursement.

Lab access

H857 access, PC and Locker Resource Request Procedure

In order to get access to H-857 you have to complete the form in Appendix 9.

Filling-in instructions[5]

Group Members
All members should be listed and the email addresses should be the normal ones you use. This is important so that all members will receive any communications concerning your resources.

Computer Request
There are 4 shared and 7 private dual boot computers. The rule for the room is “one computer per group”, a group using the shared computers can access any one or more of the 4 computers depending on the activity in the room but the private computer groups can use only their assigned computer.
The computers are user managed, so the team has administrator privilege on them. All the teams using the shared computers must be extra careful not to cause problems as this could affect the other teams as well. The shared computers are meant for groups that have occasional need for a computer while in the room, for activities such as browsing or downloading code into a microcontroller. Any modifications to the supplied software or installation of new software should be approved in advance.
The private computers are assigned to one group only for teams that need to do extensive work using a computer and that need to install software and do constant testing of their project. Adding administrator users, changing administrator passwords or changing CMOS passwords should be indicated. The teams are responsible for doing their own backups of their files and are strongly advised to do so. Do not eliminate or damage the operating system, even if you do not use it, during the poster presentations your computer may be used by another project group on the alternate presentation session.

Project Description
Include details of any resources you expect to need.

[5] Prepared by R.Bruton

Inform me if you wish to install another version of LINUX than what is supplied. This will require an addition hard disk to be installed. Also inform me of any hardware you plan to have installed.
Locker Request (there are 8 large ones, that you may have to share, and 8 small boxes with a combination lock for one group per locker.)

IMPORTANT: Access to any project room will be given only after the whole team successfully passes the Safety test on the Moodle. The passing grade is 100%. The test will include questions from the University's policy VPS-6 "POLICY ON WORKING OUTSIDE THE HOURS OF OPERATION OR IN ISOLATION".

Time

- 9:00-23:00 – when the University is open (normal hours of operation): by default, sign up for a workbench is required to access certain labs.
- 9:00 - 23:00 – every day: upon team's request sent directly to me. This type of access covers statutory and other holidays when the University is closed. Check out the Academic Calendar for the dates.
- 24/7: NOT AVAILABLE.
- Deadline for the requests: February 28, 2018.

The request template is available on Moodle. Fill in your names and student IDs only.

ENCS and University policies

Remember that the labs are subject to the following ENCS and University policies.
AITS Policies summary:
http://www.encs.concordia.ca/helpdesk/policy.html

ENCS Lab Policies (including DOs and DON'Ts):
http://www.encs.concordia.ca/helpdesk/policy/lab_policies.html

ENCS Account Policy
http://www.encs.concordia.ca/helpdesk/policy/account_policy.html

POLICY ON COPYRIGHT COMPLIANCE:
http://vpexternalsecgen.concordia.ca/documents/policies/VPERSG-2.pdf

POLICY ON COMPUTING FACILITIES
http://vpexternalsecgen.concordia.ca/documents/policies/VPS-30.pdf

POLICY ON WORKING OUTSIDE THE HOURS OF OPERATION OR IN ISOLATION
http://www.concordia.ca/vpirsg/documents/policies/VPS-6.pdf

License Agreements

Students are obligated to respect all the license agreements and copyright agreements concerning all the materials they use for the capstone projects, regardless the ownership of the materials.

Components Request Procedure

1. Finish your design. Draw the complete system block diagrams and schematic(s).
2. Present them to the Technical Coordinator, justify your solution and get his approval of your schematic.
3. Fill in the BOM and submit it to the Technical Coordinator.
4. Submit the signed by the Technical Coordinator BOM to the technician (Christian Guenole, H-941).

Components Available from ECE

The Department maintains a supply of commonly used electronic components such as op-amps, LEDs, transistors, and standard value resistors and capacitors. There is an inventory of materials that were used in the past Capstone projects.
Other components are available at H-941 upon approval of your request.
If the components are available at the Department, the technician will prepare them for you. If the components are not available, see the Components Purchase Procedures below.

FAQ (design/schematic presentation):

1) Q: What kind of documentation should we bring to the meeting?
A: ANY materials that will help you to explain to me how the system works and justify your choice of components. Usually, you'll need:
- full schematic of the system with properly labeled components
- parts list
- datasheet(s) //necessary pages//

2) Q: Is formal presentation required?
A: No. It's a Q&A session.
3) Q: What are the requirements to the drawings (diagrams, schematics)?
A: They must be legible and comply with the standards. Pencil sketches are OK.
4) Q: Is it necessary that the whole team is present at the meeting?
A: No. Ultimately, one team member with the consent of the team leader can do the job. However, I can better assess each team members' contribution if they participate in the defense.
5) Q: What are the typical questions you ask?
A: All type of questions that will unveil the level of your understanding of what you have done. Examples:
- What alternatives did you consider and analyse while you were choosing this component, module, etc.?
- What is the function of this (I point at a specific component) part in your system?
- How did you get this specific value of the parameter of the part?
- What will happen if I increase or decrease the value by 10 times?
- If you connect an oscilloscope here (I point at a specific point), what will you see (the shape of the signal and the boundaries for a "good" signal)?
- When you measured signal here, you got xx value. Is this value good or not? Justify.
- What might be a cause of the wrong value/shape?
- Briefly describe how you are going to debug and troubleshoot the system (hardware and software, test cases).

Components Purchase Procedure

All materials can be requested only after the complete system has been designed and the design has been approved by the Technical Coordinator.
If materials are NOT Available at ECE, student should procure them following the procedures described below.
The deadline for the initial purchasing of any materials is January 31st; there will be no exceptions.
Students are responsible for determining the supplier, quantity, price, availability, parts and catalogue number for the components that they want. **{3.3.1, 3.3.6}** If the information is incomplete, or the Supervisor's or Coordinator's signature is missing on the BOM, the order will not be processed.
Students can visit the sites below to determine the availability of the components that they need.

General materials purchase (Cost < $1000)

These are preferred suppliers and web pages for components purchase:
Digikey: http://www.digikey.ca
Newark: http://canada.newark.com
Electrosonic: http://www.e-sonic.com

Procedure

1. Search the preferred suppliers for the component and obtain the price, availability, parts and catalogue number.
2. Once all the information is obtained, fill out the BOM (see Appendix 9: How to: Bill of Materials).
3. Have the BOM signed by the supervisor.
   The supervisor confirms that the materials are required for your project and will be used without implication.
4. Have the BOM signed by the Technical Coordinator. This will imply that the purchase can be made within the current budget.
5. Proceed with your parts order. You will be reimbursed afterwards. Make sure to keep the original invoice and the bill marked PAID. If you pay by credit card, keep your credit card statement. Please read **Purchased components reimbursement request instructions** before ordering materials to avoid possible problems with reimbursement. The reimbursement may take from 4-6 weeks after the claim is submitted. The claims are to be submitted after the final presentation.

High cost materials purchase (Cost > $1000)

This refers to all components whose cost is more than $1000.
For these items, the purchase **must** to go through the University, which will issue a purchase order. Students CANNOT use credit cards or any other mean of payment for any purchases of total amount of $1000 and more. They also CANNOT split the transaction in order to mitigate this rule.

Procedure

1. Search suppliers for the component. You will be required to submit more than one price quotation, unless you are dealing with a sole source supplier.

2. Obtain the quotes. Attach the quotes to the approved BOM. Note that the quotations from at least **two vendors** are required.
   Make sure that you have:
   - Full address of the supplier
   - Contact person
   - Telephone and fax number
   - Email address
   - Web site info

3. Have the BOM by one of your supervisors.
   The supervisor confirms that the equipment is required for your project and will be used without implication.
4. Have the BOM signed by the Technical Coordinator.
   This will imply that the purchase can be made within the current budget.
5. The Technical Coordinator will undertake the appropriate steps to fill out a purchase order.

Students are asked to be patient for these items, as the entire process for purchase orders might take up to 4-5 weeks and even longer.

Purchased components reimbursement request instructions

The BOM(s) signed by the Project Supervisor and the Technical Coordinator must be provided. **Note:** ***the signing date must be PRIOR to the date on the bill. The Department reserves the right not to reimburse non-approved expenses.***

1) Fill in Claimed Materials Receipt Form (Appendix 6).
2) Transfer all claimed parts and materials to Christian Guenole (H-941). DO NOT dismantle your gadgets[6]! Ask Christian to sign the abovementioned form. Also make sure to return ALL tools and materials borrowed from the University. (Note: *claims WITHOUT Christian's and Raymond's signatures WILL NOT be processed*).
3) Get the "Expense Report Reimbursement Form" and an envelope for internal mail from the Department's front desk (EV 5.139).
4) Fill in the "Expense Report Reimbursement Form". You can claim reimbursement only for the materials returned to the University.

Filling-in instructions:
"Itinerary:" Capstone
"Employee ID#": your student ID# (if you have your employee ID, use it)
The table:
"Date" – date of PURCHASE as per the proof of purchase
"Description" – if you have many components that were paid at once, write what the order is about and include its number. (Ex.: "Electronic components as per Digi-Key invoice #12345")
DO NOT fill in: "Fund", "Account Code" and "Activity #".

[6] We are going to build a permanent Capstone Projects exhibition. Your successful projects with your names on them and, probably, photos will be part of it.

"Other currency" – if the invoice shows other currency than Canadian dollar, write the amount there and specify the currency (Ex.: "USD 20.00"). If the invoice is in CAD, do not fill in this cell.

"Exchange rate" – if you filled in "Other currency" cell you have to indicate the exchange rate that was applied to the transaction. The best way to find it is your credit card statement.

"Canadian Currency" – if your invoice is in CAD, simply write the amount there. If you filled in the "Other currency" and "Exchange rate" cell – do the math.

If you ask for partial refund of goods on the invoice, clearly indicate on the invoice, which items are included in the claim, and recalculate the total amount accordingly. The total amount should include all applicable taxes (total=[price*1.05]*1.095).

It is important that your mailing address is complete (don't forget the postal code!) and legible: the cheque will be mailed there.

5) Using scotch-tape, **attach your cash register receipts and all other documents that are NOT letter-sized to letter size sheet(s) of paper**. You can place more than one receipt per page as long as they do not overlap. (The rationale of this requirement is to make the documents scannable.)

6) Put the documents according to the check-list in an envelope for internal mail.

7) Hand the envelope to the Technical Coordinator (H-851-2). **DO NOT bring them to the Department!**

Check – list

	Document	
1.	Material and/or resources request form(s)	☐
2.	Claimed Materials Receipt Form	☐
3.	Expense Report Reimbursement Form(s)	☐
4.	Proof(s) of purchase (**<u>original(s)</u>**)	☐
5.	Proof(s) of payment (if applicable)	☐

Acceptable proofs of purchase/payment:

- cashier receipt
- store or company invoice stamped "PAID" ("PAYEE")
- credit card statement (Paypal, web purchases and all other invoices)

When you attach your credit card statement, please white/black out all irrelevant to the purchase information, e.g. other transactions, credit card number, balance, etc. What should appear on the statement is:

- your name and address
- transaction record and details (ex: exchange rate)

Note: Claimant's name on the Expense Report **MUST match** the one on the receipt(s). If more than one team member purchased materials in his/her name, each of them should fill in the Expense Report. Cash receipts and any other proofs of payment that DO NOT carry payer's name can be claimed by any team member.

Appendix 1: Sample TOC for technical manual

1. Intro
2. Objective
3. Specifications
4. System block diagram + description of operation
5. Hardware
    a. Components/blocks/etc. (i.e.: chassis, motors, etc.)
    b. Schematic (DO NOT FORGET to ANNOTATE it!!!)
    c. Components functions and parameters description
    d. Debugging/troubleshooting (schematics, low level)
6. List of components/Bill of materials (see “How-to…”)
7. Calibration/verification/testing (refer to the specifications)
8. Software
    a. Flow chart
    b. Description

Take a look at the posted example (Moodle) – it’ll give you good ideas on how to word your descriptions and what to put in the document.

Appendix 2: How to estimate the final cost for the items shipped to Canada

When you order parts abroad, keep in mind that the final price will be quite different from what you see in the quote. You will be charged custom duties, taxes and a brokerage fee.

How to estimate the final price:

1) Convert the invoice item price to CAD. Do not include shipping charge!

2) Go here:
http://www.cbsa-asfc.gc.ca/trade-commerce/tariff-tarif/2009/01-99/tblmod-1-eng.html
and find the custom tariff for your item.
Most of items of our interest will fall into this category:
http://www.cbsa-asfc.gc.ca/trade-commerce/tariff-tarif/2009/01-99/ch85-eng.pdf

3) Add percentage shown in "MFN tariff" column to the value calculated in (1).

4) Add GST (5%)

5) Add QST (7.5%)

6) Add brokerage fee:
- Canada Post usually charge flat rate $5+tax
- USPS – does it through Canada Post ($5+tax)
- UPS[7] – based on the item's value (<$20 – free; $20.01 to $40.00 - $7.00; $40.01 to $100.00 - $19.45; $100.01 to $200.00 - $29.00; $200.01 to $350.00 - $44.25).
- FedEx – give them a call 1-800-GoFedEx (item's value-based charge)
- DHL and other carriers – in most cases, the charge is based on the item's value, and could be as high as 30% of it; it might be quite high. Make sure you check with the company PRIOR to purchase.

Note that taxes apply to the item price PLUS custom tariff (duty)!

There are a few exceptions from this rule (ex.: low priced (<$20) items; items of value <$60 (TBC), declared as "gift").

Here is a nice final cost calculator:
http://www.thefinalcost.com/shipments/calculate/

[7] As of August 22, 2011. For up-to-date rates please visit www.ups.com

Appendix 3: Typical design roadmap

1. Assess the Customer's Needs (Voice of Customer, VoC) {3.1.1}.
2. Do a feasibility study. //Some customer's needs might be not feasible due to various constraints and contradicting requirements.//
3. Write down the initial/target design specification based on VoC. //Alice should know where she wants to get to!//Note: it is NOT a guessing game. There is no room for ambiguity and such things as "by default" and "based on common sense".//
4. Present these specifications to the customer and get his approval. //Get confirmation that you've addressed all customer's concerns.//
5. Establish the "Big Picture": Define the main problem. //"BIG Black Box", inputs/outputs, etc.//
6. Break it down to smaller tasks that you think you could come up with solution for. Consider alternatives for the break-down (system architecture) //Block diagram//
7. Derive from (3) specifications for each smaller task, sub-system, module. //BEFORE you make your choice, you have to understand your needs. It applies to system/sub-system architecture as well.//
8. Find 2-3 alternative solutions for each "smaller task". //Alternatives must be REAL alternatives, i.e. they should be suitable to a certain degree for the job. Do not compare flies to elephants!// {3.1.2}
9. If you cannot find a solution for a task - break it down to smaller tasks and try to solve them. //
10. Look for existing solutions and think if you can use them as the "building blocks" of your project. //Don't reinvent the wheel!//
11. For each of these solutions compile a list of "pros" and "cons", and assign a weight/importance coefficient to each parameter. Note that the use of the same resources (ex.: a piece of equipment) for more than one task could be considered as a "pro". Don't forget to estimate the cost of each solution.
12. Pick up the best alternative - it is your final solution candidate - you are ready to defend it.
13. Defend it (meet with me and your project supervisor). Prove that you solution is the best fit for customer's needs.
14. If any improvements are suggested - consider them.
15. Repeat 7-14 for the next task.
16. Integration: When you are considering a solution for each task – keep in mind that you have to put the things together and see how well your solutions fit one another. //Here you'll see if (7) was done properly.//
17. If necessary, make adjustments.
18. Make a list of required parts and equipment.
19. Trade-off assessment: Deal with constraints in your parts/equipment request.
20. Implement your solution!

Appendix 4: Claimed Materials Receipt Form

Group# and Project Name: _____

Claimant name: _____

Claimant's contact information: (e-mail, phone #): _____

Supervisor(s):_____

#	Material (component, module, device, etc.)	Unit Price	Quantity	Total price	Decision

Tools and materials borrowed from H-941 have been returned

Yes	No

_____ _____

Christian Guenole Date

H857 locker is cleared and the key(s) has been returned

Yes	No

_____ _____

Raymond Bruton Date

Appendix 5: Sample Title Page

Phase 1 Report: Project Proposal

Cable Modem Performance

Team # 1

A Report
Presented to
The Department of Electrical & Computer Engineering
Concordia University

In Partial Fulfillment
of the Requirements
of ELEC/COEN 490

by

John Stone	ID: 1231231
George Clement	ID: 3213212
Elaine Bourne	ID: 4564566
Chris Kramer	ID: 7897899

Project Supervisor(s)
Dr. Newman

Concordia University
October 2012

Appendix 6: H857 Access, PC and Locker Request Form

Date: _____

Team# _____ /Project Name: _____

Supervisor(s): _____

Authorization from Dmitry: _____

Team Members

Name (#1 - team leader)	ID Number	e-mail commonly used, phone number

Computer Request

WIN7	LINUX	Other OS	Other Software	Hardware	Extra Table Space
☐	☐	☐	☐	☐	☐

Test equipment request (oscilloscope, DMM, etc)

Project Description (include details of any resources you expect to need)

Locker Request (there are 8 large ones, that you may have to share, and 8 small boxes with a combination lock for one group per locker.)

Bring the completed form to Raymond Bruton (H961-9)

Appendix 7: How to Bill of Materials

"A bill of materials (BOM) is a list of the raw materials, sub-assemblies, intermediate assemblies, sub-components, components, parts and the quantities of each needed to manufacture an end product. No physical dimension is described in BOM"[8].

The BOM's header should contain the following:

1. Company's name
2. Project name
3. Design module/subassembly name
4. Designed by (team's or individual's name)
5. Revision number
6. Date

There are a few **levels of BOM**s; two of them are widely used: **system level** BOM and **sub-system** (assembly, board, sub-assembly, module) BOM. A lowest-level sub-system BOM consists of only purchased components or sub-systems manufactured by external companies. A top level system BOM includes all materials (components, modules, sub-assemblies, etc.) that the system is built of. In the system level BOM a sub-system appears as a single BOM item; there is no need to expand it. If it is an item that your company manufactures, it is up to you to assign a part number (ex.: module ABC123). The "unit cost" should include all expenses (e.g. components, labour, shipping, storage, etc.) associated with the item. (see the example of a BOM on the Moodle)

While BOMs are usually customised for the company's needs, there is a number of fields that should be present. Below are the fields normally found in the BOMs of the electrical and computer engineering projects.

1. **BOM Item number**: a consecutive number that represents the part's position in the list, i.e. 1, 2, 3 … Later at the assembly stage the part could be referred by this number rather than the design reference number.
2. **Design Reference**: it's the component's label/reference from your schematic. You can group the components of the same value and other parameters. Ex.: R45-R75; D4, D7 …Usually, the components are sorted in alphabetical order by the design reference number.
3. **Description**: A summary of the component's most important parameters. Ex.: "Carbon film resistor, 5%, 0.25W, through-hole"; "BJT transistor, NPN, 1A, 50V, 2W"
4. **Value**: value of the component. Ex.: "47 kOhm", "2N3456" respectively.
5. **Quantity**: Total number of parts listed in "Design Reference" column.
6. **Unit (<u>of quantity</u>)**: "pcs", "ea", "m", "kg", etc… (Common mistake: use of unit of value, e.g. uF or kOhm)
7. **Manufacturer**: refers to a component <u>manufacturer</u>. This and the following column **must be included** in the BOM.
8. **Manufacturer part number**: a component manufacturer part number, NOT a supplier part number(!!!).

The following columns are necessary for calculating the final cost.

9. **Supplier**: The part's supplier. (Ex.: Digi-Key)

[8] Monk, Ellen; Wagner, Bret (2007). Concepts in Enterprise Resource Planning. Course Technology Cengage Learning. pp. 97–98. ISBN 1-4239-0179-7.

10. **Supplier P/N**: Part number according to the **supplier's** inventory list. (Ex.: "ATMEGA8L-8PU-ND", "P100BATB-ND"). Often, it is different from the Manufacturer part number.
11. **Unit cost**: Cost per unit. Note that unit cost might vary depending on the number of units of the BOM item, e.g. one resistor can cost 13 cents, 10 resistors – 17 cents (0.017 cent each), 100 resistors – 67 cents (0.0067 cent each)[9].
12. **Extended (or Total) cost**: "Unit cost" multiplied by "Quantity". Very bottom cell of this column should contain the total cost of materials.

Other fields you might find in BOMs are:

- For PCB manufacturing, "Footprint" column is often found in BOMs, e.g. TH (through-hole), 0805, LQFP64, etc. (the items that should NOT be installed must be marked, usually "DNS")
- Revision number
- Stock/warehouse reference number (for YOUR company)
- Internal reference number
- Reference to the specific drawing or schematic
- Alternative Supplier
- Comments

Since there are many columns in the BOM, you might want to choose "landscape" page orientation and even stretch it over two or more pages.

Often, for calculating the PCB manufacturing cost, the board summary is generated. It includes:

- total number of BOM items
- number of BOM items to be installed
- total number of components
- total number of surface-mount components
- total number of fine-pitch components
- total number of through-hole components
- total number of surface-mount components to be installed
- total number of fine-pitch components to be installed
- total number of through-hole components to be installed

[9] http://www.digikey.ca/product-detail/en/MCR01MRTF1002/RHM10.0KCDCT-ND/2796414