I. Project Objective

Upon completion of the design project it is intended that the students will have successfully designed the hardware and software interfaces for a microcontroller-based system of their own specification, using any of the microcontroller boards available in the lab and the associated development tools (Rational Rose, PSPice, Logic Works, IAR Workbench, CodeWarrior, BDM, etc.). The system must include input and output devices, such as a keypad and a liquid crystal display (LCD), and must be fully operational. Designs must make use of most of the on-chip peripherals such as the ADC unit, timers, interrupts, etc. A very important part of this project is that you learn to work in a team in the design and development of a project that will be used to solve an Engineering problem and that you get to interact with experts and users from other domains. All work must be done in the Microprocessor Development Laboratory (MDS Lab) located in S-115 unless otherwise specified. It is very important that you use both software and hardware development tools from the moment your project design starts and this must be explicit in all the reports.

II. Team Construction Policies

Teams of three or four students will carry out the projects. It is usually a good idea for our female students to work in a group that has at least another female student. Please refrain from chaotic behavior such as choosing a student with past conflicts in case you are allowed to choose.

At the end of the semester, each student will evaluate each of his/her own teammates by means of a specified evaluation form to be submitted inside closed envelopes. A small (less than 6 inches) notebook with meeting notes must be filled in ink individually throughout the semester by each member so as to corroborate personal evaluation results, it is this one notebook which must be turned in. You must use a small notebook and write down date, hour, duration, and attendance of each member. You are free to add any other note you feel necessary. You must not allow anyone else to see what you are jotting down. Do not wait till the end of the semester to fill out your notebook. Failure to follow these guidelines will result in a 10% penalty on your overall class score.

III. Project Policies

A. Students may obtain advice from other students and/or faculty members, but if significant help is received, it should be acknowledged in the final report. Furthermore, all information obtained from literary sources should be cited in the bibliography section to avoid any unfounded suspicion of plagiarism. All of your references must be reliable, the fact that something is published on the Internet does not automatically mean it is reliable.

B. A 10% penalty per day will begin to accrue immediately after the deadline when the work is due. Try to work in advance of scheduled dates. Remember that Murphy is watching! Individual student’s attendance to the lab and to the class lectures will be taken into consideration to compute the final grade. Make sure you personally sign in and out the lab attendance sheet. Signing in or out for someone else will be considered fraud and any person who does this will receive F as the final grade. Doing nothing in the lab is not considered attending it nor is it using the web for purposes not related to the project. If you do not attend the lab regularly to work on your project you can only hope to obtain 10% of your project grade to be counted for your final grade. Every three (3) absences will drop 5% of your final grade. Being late to class and coming in and out will also be considered against your grade as each three will be considered an absence for final grade purposes. Your project must be fully operational in order to receive a grade above 89%.

C. You must not make connections to your hardware while the power supply is applied to the circuit. If, for example, you use the HCl2 EVB you must also make sure that you do not leave the jumper used for Flash EEPROM programming (burning) installed when you are not burning the Flash. Failure to follow these guidelines may result in some damage to the equipment and your project; you and your group will be responsible for replacing it in order to receive a grade in the class. You must not allow people who are not part of your group
to work on the project. You must not lend your computer account to any person since you are totally responsible for what is done with it. Make sure that you use a wet sponge to clean the solder tip of the solder gun both before and after each use. You will not damage the solder tip if you clean it too often, but you will certainly damage it if you do not do it often enough. It is also very important that you learn to run the wiring in your project: avoid creating arcs and placing wires where it will be easy to touch them unintentionally. Wires should be grouped and placed flat against the breadboard where it will be difficult to disturb them by mistake. Wire-wrapping is encouraged over using the digilab’s breadboard.

D. You must use software tools to check your circuit via simulations before building or adding it to your project. In this way you will find errors such as short circuits without damaging any components, tools, and or equipment.

E. Make sure you know how to connect and disconnect the power supply, voltmeter, etc. You should check that you do not have a short circuit each time before applying power to the circuit.

F. All work must be made available on the World Wide Web. Follow the instructions given by the lab attendant in order to prepare the electronic copy of your reports.

G. The performance of each student in a design team will be peer-reviewed by his/her teammates. The final project grade of a student will be the group’s project grade scaled by the corresponding student’s peer evaluation and the class instructor’s evaluation. For example, if a student’s project reports receive a score of 95 (A) from the professor, but the student receives a poor evaluation from his/her teammates of 65% and a lab evaluation by the professor of 60% because he/she never showed up to the lab among other things, the student’s final grade in the project would be $95\times(0.5\times0.65 + 0.5\times0.60) = 59.375(F)$. Hence, all students are strongly encouraged to contribute to all aspects of the project.

H. Dishonesty acts will be penalized with F in the final class grade. These include, but are not limited to, vandalizing your own or other people’s project, stealing or damaging equipment, fraud, plagiarism, using somebody else’s computer account, etc. Understand that you are being prepared for real life and that there is no reason you should be doing any dishonest act.

I. You must not use the computer, tools, materials, components, etc. assigned to some other group. Otherwise, you may incur in vandalism and may be penalized with an F in the project.

J. You and your group will receive a grade of incomplete with F (IF) if your group does not return the tools and or material in working conditions.

IV. Typical and Possible Projects

The following is a brief, general sample list of projects that you may consider to pursue. These are simply meant to provide an initial starting point for your design conceptualization process. Examples of previous course projects are available through the course’s homepage. Please feel free to propose your own ideas.

Web based devices
Highway traffic controller
Home or automobile security system
Home appliance controller
Automobile function controller
Dedicated instrumentation device
Consumer electronics gadget
Robotics
Remote control of appliances/devices

V. Project Guidelines

In order to ensure steady progress in the development of the hardware/software interfaces, the design cycle will be guided by a series of project deliverables. These deliverables include a project proposal, status reports, a project demonstration (happy hour), a written final report, a two-page paper, and a slide presentation. Grade will depend greatly on technical writing skills. These deliverables are described below. Written reports must be single-spaced. DO NOT use previous semesters projects as guidelines. If any questions remain, please don’t hesitate to ask the professor.
Each team will provide a clear and fair breakdown of the work assigned to and actually performed by each member along with information indicating how much work have been completed. The work assigned to each team member must include both software and hardware. For each report that is turned in, each team must also specify, at the end of the report, which parts were written by each member. Failure to provide this information will be penalized with 30% of the final grade.
Project Proposal (10%) Due Date: Friday August 29, 2003 at 11:00AM.

The project proposal will consist of a formal report not to exceed 7 pages that will count for 10% of the final project grade. The proposal should be e-mailed to the lab assistant and a hard copy must be handed to the class instructor during the first 10 minutes of the class on the due date. The proposal will be made available through the design group's project homepage. The proposal should include the following information:

First Page (center each item, do not use bullets, and follow the order specified below)
- Project title.
- Group number, group member names and section (no student numbers, but do include your assigned roll book number in all hard copies only).
- The following statement verbatim: A Proposal Submitted as a partial requirement of the Microprocessor Interconnection course INEL4217
- Submission date (do not write these words just the actual date, e.g. August 29, 2003).
- Abstract (centralize this word but not what follows it) A brief, general description of the proposed "product" (one or two paragraphs). You are strongly advised to go check an abstract from a published technical article. You must specify in the report the article you checked.

Remaining Pages
You must follow the order shown below. Include section (Roman numerals) and subsection numbers as well as page numbers. Make sure you understand how to present figures and tables, how to number them, and how to write their captions. Figures and tables must be numbered sequentially starting with number 1, i.e. Figure 1. You must mention them in your report before they show up.

Table of contents: List must include section and subsection numbers with their respective page number. Make sure things are properly lined up. Begin to number pages starting with i (this is not 1).

I. Introduction Describe your product and its overall functionality. Not the same as the abstract. Begin to number pages starting with 1.
II. System Block Diagram High-level system block diagram with a brief description (include part names if known). All major control signals and system buses (if operating in expanded mode) should be included. Do not forget proper direction.
III. Specifications Detailed, high-level project specifications
   A. Software Memory requirements, subroutines to be implemented, etc. Make sure you know how to use flowcharts.
   B. Hardware Control Signals, Input and Output Peripherals, hardware requirements.
IV. User Interface Schematic representation and brief description of user interface (e.g., control panel). Make sure it is user friendly.
V. Market Description An overview of the target market for your product and a description of at least one commercial product currently available that is similar to your proposed product, their specifications and cost if available. Brief comparison between the functionality of your proposed product and that of those identified as being commercially available.
VI. Project Time Table Timetable (use a Gant Chart) indicating projected completion dates for the major tasks associated with the design cycle. The tasks should include:
   A. Problem definition and specifications
   B. Block-level system design
   C. Software design and code
   D. Hardware design (device selection and interface between devices)
   E. Prototype implementation
   F. Final report preparation
VII. Professional Component Here you have to explain how the following issues are taken into consideration in your work:
   A. Economic
   B. Manufacturability
   C. Ethical
   D. Social
   E. Political
   F. Sustainability
   G. Health and Safety
   H. Environmental

You also need to include as part of your project the opinion of experts from other domains and users.

VIII. References Numbered list of all references (including WWW links) consulted for the preparation of this report. References must actually be used as needed throughout the report.

IX. Appendices
   A. Work distribution table for the project (SW, HW). The name of the team members must be in the rows.
   B. Lab Attendance per week. The name of the team members must be in the rows and the weeks must be in the columns. This part will probably have to be in landscape mode.
   C. A copy of the first page of a technical article.

Status Report (15%) Due Date: Friday September 12, October 3, October 24, 2003

The status reports will consist of a formal report not to exceed a total of 200 (oral report) pages that will count for 20% of the final project grade. The status report should be e-mailed to the lab attendant and made available through the design group's project homepage before the specified due date. The first page will be identical to that used for the proposal, except that the header should read STATUS REPORT instead of PROPOSAL. The following information should be provided in the remaining pages.

Table of contents: List must include section and subsection numbers with their respective page number. Make sure things are properly lined up. Begin to number pages starting with i (this is not 1).
I. Refined set of project specifications and a detailed explanation for any substantial deviations from those originally proposed. Begin to number pages starting with 1.
II. Refined schematic representation of user interface (control panel, software window, etc.) and a detailed description.
III. Detailed system block diagram with major component devices and signals identified (microprocessor/microcontroller, A/D and D/A converters, peripherals, etc.)
IV. Professional circuit schematics of your system (e.g., you can use the PSPICE Schematic Editor).
V. Flowcharts/pseudocode listings of the necessary control software for your product application. All operational modes should be clearly described.
VI. Updated timetable indicating projected completion dates for the major tasks associated with the design cycle.
VII. Professional Component Here you have to explain how the following issues are taken into consideration in your work:
   A. Economic
   B. Manufacturability
   C. Ethical
   D. Social
   E. Political
   F. Sustainability
   G. Health and Safety
   H. Environmental
You also need to include as part of your project the opinion of experts from other domains and users.

VIII. References
Numbered list of all references (including WWW links) consulted for the preparation of this report. References must actually be used as needed throughout the report.

IX. Appendices
A. Work distribution table for the project (SW, HW). The name of the team members must be in the rows.
B. Lab Attendance per week. The name of the team members must be in the rows and the weeks must be in the columns. This part will probably have to be in landscape mode.
C. A copy of the first page of the technical article from the literature used as a guideline for writing the abstract.

Demonstration (35%) Due Date: Friday November 14, 2003

As part of the project evaluation, each design group will schedule a 20-minute demonstration of their microcontroller system prototype. All members of the design group must be present and be ready to answer any questions that may arise with respect to the system design and implementation. The project demonstrations will correspond to 25% of the final project grade.

Presentation and 2-Page paper (15%) Due Date: Friday November 28, 2003

All design teams will be allotted approximately 20 minutes to present their projects to the rest of their class and answer any questions that may arise during the presentation. Also, at this time the design teams will be required to present their audience with a two-page paper that describes the work performed. Details regarding the presentation and two-page paper formats will be made available sufficiently prior to the scheduled dates. The presentations will be peer evaluated and, in conjunction with the two-page paper, will carry a total weight of 10% of the final project grade.

Final Report (20%) Due Date: Friday December 5, 2003

The final report will consist of both an oral and a formal report not to exceed a total of 30, 10 pages (excluding appendices) that will count for 30% of the final project grade. The first page should be identical to that used for the proposal, except that the header should read FINAL REPORT instead of PROPOSAL. This report must be bound with cardboard covers. The cover should contain the same information required on the first page. This report should be a superset of all previous reports and should be structured as follows. Some of the sections from previous reports are subsumed within new sections.

Title Page
Executive Summary (approximately two pages numbered i and ii)
Table of Contents (page numbered iii)
I. Introduction (pages start to be numbered with 1)
II. Background Information (Theory including Market Description)
III. Hardware Design (Including Detailed System Block Diagram, Peripherals, and Circuit Schematics)
IV. Software Design (Including User Interface, Memory Requirements, and Flow Charts)
X. Professional Component Here you have to explain how the following issues are taken into consideration in your work:
University of Puerto Rico  
Electrical and Computer Engineering Department  
INEL 4217 Microprocessor Interconnection  

A. Economic  
B. Manufacturability  
C. Ethical  
D. Social  
E. Political  
F. Sustainability  
G. Health and Safety  
H. Environmental

You also need to include as part of your project the opinion of experts from other domains and users.

V. Conclusions (go check this section in a published technical article before writing your own)

XI. References  Numbered list of all references (including WWW links) consulted for the preparation of this report. References must actually be used as needed throughout the report.

XII. Appendices  
A. Work distribution table for the project (SW, HW). The name of the team members must be in the rows.  
B. Lab Attendance per week. The name of the team members must be in the rows and the weeks must be in the columns. This part will probably have to be in landscape mode.  
C. A copy of the first page of the technical article from the literature used as a guideline for writing the conclusion.  
D. Software code.  
E. Rare IC datasheets.  
F. Any other relevant information.

The previous sections should, at a minimum, provide:  
- a clear description of the project  
- a clear description of all hardware and software issues (including final circuit schematics and microcontroller source code)  
- all supporting information (including device specifications, technical drawings, and data sheets)  
- suggestions for continuation of the project through prototype implementation.

Discipline and Maintenance (5%)  
Due Date: Friday December 5, 2003

Each design team will be responsible of a PC Computer, Evaluation Board and miscellaneous development tools such as a Digital Lab, HP Logic Dart Probe, breadboards, wires, hand tools, etc. All the equipment borrowed will be returned at or before the date specified or a penalty will be incurred (1%). Damaged equipment must be reported as soon as it occurs (1%). Team members will be responsible of any missing or damaged equipment (Incomplete with F). The lab area must be cleaned and organized at or before the due date (2%).

Remember this: You break it, you buy it.

Note: I have tried to provide you with as much information as possible to give you some clear guidelines about how to write your reports and what your demeanor be as a team. There is no way I could write everything needed by each one of you to avoid making mistakes. You must learn by yourself what a neat, nice, and complete presentation is, how to indent and when not to do it, how to separate a paragraph from another, how to use punctuation, how to present a clear, complete, and easy to read figure and table, etc. The only way you will learn all this is by spending time reading what other people have done and that is the reason I have advised you to check the
literature (DO NOT USE PAST SEMESTERS REPORTS AS YOUR GUIDELINES). Did you know a space must follow a comma and two spaces must follow a period? Do you know how to place a page with a figure and or table in landscape in your report? Should it be facing inward or outward? Do you know you should not use superscripts for your references? The real question should be: Should you as an engineer care about any of this?