

UNIVERSITY OF NORTH CAROLINA AT CHARLOTTE

Department of Electrical Engineering

EEGR 3251/2 - Senior Design I/II

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SENIOR DESIGN I/II

Introduction

The intent of this sequence of senior design courses is threefold: (1) it is to cap off the laboratory experience of the student with an “independent study” situation, where each student will be expected to determine the methodology and procedures needed to conduct an investigation; (2) it is to provide the student an insight into a myriad of demands imposed by a major design project; and (3) it is to provide the student experience in writing reports and making oral presentations.

The first requirement of this course is the formation of project groups. These groups consist of one to a maximum of three students and remain the same during the duration of the project. All activities related to this course are conducted as a group effort. The laboratory reports are to be submitted as a group. It is therefore incumbent on each member of the group to be sure that the report is representative of the quality that each would be willing to accept as their own work.

One of the requirements during the first semester of this sequence of senior design courses is that the project group must select nine (9) weeks of laboratory experiments with the advice and approval of their project advisor. These nine weeks must consist of a minimum of three (3) weeks from Group I with the remaining six (6) weeks coming from either Group I or Group II. Within Group II there is provision for two weeks of special experiments which the project advisor and the project group may wish to do in lieu of two weeks from the listed experiments. The two weeks of special experiments should not be part of the project group’s project but it may provide some background in support of the project.

The laboratory reports must contain:

- I. A Cover Page listing the name of the experiment, members of the group, date performed, and the faculty advisor.
- II. An objective.
- III. A description of the background research, derivations, and other pertinent information.
- IV. Experimental procedures and data taken, including appropriate drawings (not raw data).
- V. An analysis of the data and a discussion of the results relative to the objective.
- VI. Raw data and an equipment list to include sufficient information to permit a rerun of the experiment using the same equipment if necessary.

A second requirement during this sequence of senior design courses is for the project group to work with their project advisor in choosing and completing a project. This will include defining system requirements and design criteria, establishing design specifications, building the system, and testing the system against system requirements. The project group will be expected to use all available resources, such as but not limited to, the library, faculty, industry, and product information.

As part of the project, the project group will: (1) present oral progress reports indicating the current status of their investigation; (2) submit written progress reports indicating the current status of their investigation; (3) make an oral presentation of the final results; and, (4) submit a comprehensive formal final report. **Each and every student** will maintain an engineering notebook of their own, in which they will record all of their activities on the project.

All of the activities discussed above must be accomplished according to the schedule below.

LABORATORY EXPERIMENT SCHEDULE

- Task #1: A copy of the Laboratory Experiment Selection form initialed by the project group's project advisor submitted to the departmental office within the first two weeks of the fall semester.
- Task #2: Report(s) for at least three weeks of laboratory experiments submitted to the departmental office on or before the end of September, at least six weeks of laboratory experiments submitted to the departmental office on or before the end of October, and at least nine weeks of laboratory experiments submitted to the departmental office on or before the end of November.

PROJECT SCHEDULE

- Task #3: Initiate and maintain an engineering notebook on the project providing comprehensive documentation of all experimental test procedures, results, analysis, and pertinent comments. All entries shall be DATED and each dated entry shall be WITNESSED by someone outside the project group. This documented record of the project investigation may prove to be invaluable in case of patent application and defense.
- Task #4: An oral briefing (15 minutes) on project accomplishments to date scheduled with the course director in coordination with the project advisor around October 15th and March 15th. A completed Senior Project Description form signed by the project advisor will be submitted at the October meeting. Also, at both of these meetings, the engineering notebooks will be submitted for evaluation.
- Task #5: A 500-word minimum typewritten report on the status of the senior project to include progress to date and a "milestone" chart for the completion of the project submitted to the departmental office one week prior to the end of the fall semester.
- Task #6: DEPARTMENT OF ELECTRICAL ENGINEERING SENIOR PROJECT PRESENTATION! A 10-minute presentation followed by up to five minutes for questions and comments from the audience. Each member of the project group is expected to participate and good use of high quality, well-designed audio visual materials is expected (see scoresheet on page vii). A "full dress rehearsal" with the project advisor is highly recommended before the presentation. This presentation is usually scheduled during the last week in March or the first week in April.
- Task #7: Presentation of the five best projects to the Charlotte Section of the IEEE at one of their annual section meetings on the UNCC campus during the middle of April.
- Task #8: A demonstration of the completed project scheduled with the course director in

coordination with the project advisor at least one week prior to the end of the spring semester.

Task #9: A final typewritten project report written in the format of a conference paper, bound and submitted to the project advisor along with the engineering notebooks prior to the last day of spring semester classes. A copy of the report should also be submitted to the departmental office.

ORDERING OF PARTS AND SUPPLIES

It is VERY important that supplies, components, etc., to be used in the project be ordered AS SOON AS POSSIBLE. Orders should include anticipated sources, prices, and delivery dates, approved by the project advisor, and submitted to the departmental office.

CONFERENCE OPPORTUNITIES

Each year, several excellent opportunities are available to students to enhance their resume by presenting the results of their project at a conference. THIS IS HIGHLY ENCOURAGED!

One opportunity is in a statewide student competition held in the fall in conjunction with the North Carolina Symposium and Exhibition (NCSE).

Another excellent opportunity is in a southeastern regional student competition held in the spring in conjunction with SouthEastCon.

EEGR 3251 SENIOR DESIGN I

Student _____

Student _____

Student _____

SENIOR PROJECT ADVISOR _____

The above students have approval to perform the experiments initialed below:

Group I

- _____ 1. The Effects of Pole Locations - Systems (2 wks - x370988.lok)
- _____ 2. DC Power Supplies - Electronics (1 wk - x380988.lok)
- _____ 3. Servo-motors - Systems (3 wks - x390988.lok)
- _____ 4. Lamp Ping-Pong - Digital (2/3 wks - x400988.lok)
- _____ 5. Operational Amplifiers - Electronics (2 wks - x410988.lok)

Group II

- _____ 1. Synchronous Machines - Motors/Power (1 wk - x420988.lok)
- _____ 2. Compensation Networks - Systems (2 wks - x430988.lok)
- _____ 3. Power Transformers - Power (2 wks - x440993.lok)
- _____ 4. Three-phase Transformer Connections - Power (2 wks - x450993.lok)
- _____ 5. Rotational Losses in a DC Machine - Motors/Power (1 wk - x460993.lok)
- _____ 6. Nyquist Diagrams - Systems/Electronics (2 wks - x470890.lok)
- _____ 7. Induction Motors - Motors/Power (1 wk - x480993.lok)
- _____ 8. Phase-lock Loops - Electronics/Digital (2 wks - x490993.lok)
- _____ 9. PC Boards - Electronics/Digital (2 wks - x500993.lok)
- _____ 10. D A C's - Electronics/Digital (2/3 wks - x520993.lok)
- _____ 11. Transistor Amplifier Distortion - Electronics (1 wk - x530993.lok)
- _____ 12. Fabrication and Measurement of MOS Devices - VLSI (2 wks - Edwards)
- _____ 13. Digital Controller - Systems (2 /3wks - Kakad)
- _____ 14. PLC Controller - Systems (2 wks - Kakad)
- _____ 15. Special Experiment (2 wks - Project Advisor)

TITLE: _____

DEPARTMENT OF ELECTRICAL ENGINEERING
SENIOR PROJECT DESCRIPTION

PROJECT TITLE:

PROJECT ADVISOR:

PROJECT DESCRIPTION/DEFINITION/SPECIFICATION:

PROJECT ADVISOR'S ESTIMATE OF PROJECT DIFFICULTY LEVEL:

SIGNATURES

STUDENTS: _____ DATE _____

PROJECT ADVISOR: _____ DATE _____

DEPARTMENT CHAIRMAN: _____

SENIOR PROJECT PRESENTATION

Score Sheet

Group Number: _____

ORAL PRESENTATION	
Speaking Techniques The Presenter should not be unduly nervous or display annoying mannerisms. Speech should be clear and in good English.	25 points
Style Presentation of material should follow a logical course and should stimulate the thinking of the audience. Well-designed visual aids are a must!	25 points
Introduction and Conclusion Presentation should begin with a proper introduction. Background of the problem should be made clear before proceeding to the main body of the presentation. Conclusions should be briefly summarized.	10 points
Technical Presentation The speaker should exhibit a clear understanding of the topic, of the important related literature, and of the associated electrical theory. The presentation should be technically sound and the fundamental nature of the subject should be clearly described.	30 points
Discussion The speaker should display a reasonable knowledge of the subject by answering the questions adequately.	10 points
TOTAL (100 possible points)	

College of Engineering

Electronics Shop Checkout Policy (F94-1)

- A. Equipment and electrical components may be checked out from the Electronics Shop by any student who can provide a valid barcoded UNCC ID card and a course number and by any faculty or staff member who can provide a valid UNCC ID card. Students who wish to check out equipment but are not on a class list must have a special permission slip from an appropriate faculty member. The use of equipment in scheduled laboratories takes precedence over all other requests for equipment. Any questions concerning the checkout of equipment, components, etc., that cannot be satisfactorily answered by the Electronics Shop should be addressed in writing to the Electrical Laboratory Committee.
- Equipment is normally checked out on a daily basis. Longer checkout periods are possible **with the approval of the appropriate faculty member. The length of the checkout period will be noted on the checkout slip.** All checkout slips will be signed by the individual checking out the equipment at the time the equipment is checked out. When the equipment is checked in, the individual will be given a checkin slip indicating that the equipment has been turned in. In case of a dispute over whether a piece of equipment has been checked in or not, the individual must show the checkin slip. If a checkin slip is not available, the individual must submit a written appeal to the appropriate course instructor.
 - All electrical components such as ICs, resistors, capacitors, etc., checked out by individuals are subject to return; good or bad! Students needing parts that are not available in the Electronics Shop are encouraged to coordinate their acquisitions through the Electronics Shop whenever possible. Parts requisitions should be submitted through the appropriate department.

Students will be assessed one dollar (\$1.00) for each day a piece of equipment is overdue **except there will be no charge for any day the Electronics Shop is not officially open.** If a student fails to return a piece of equipment/components, then the student will be billed for the equipment/components at replacement cost. Payment should be made by check to UNC-Charlotte as per instructions on the checkout slip. Any student not in compliance with the above procedures will have their name turned over to the appropriate faculty member who will give the student at least an incomplete in the appropriate course until the issue is resolved.

College of Engineering

Electronics Shop Checkout Policy (S94-1)

- B. Faculty who wish to have students in their courses check out equipment from the Electronics Shop must provide a class roster to the Electronics Shop with a list of restrictions and/or instructions, if there are any, and provide a copy of Part A of the Electronics Shop Checkout Policy to every student in the course. For courses where there is no required laboratory fee and the students need components/supplies, then the faculty member must also provide an account number to which the components/supplies can be billed.

Students who are delinquent in returning equipment/components will have their names forwarded to their department chairman and to the faculty member who is responsible for the course. The faculty member will immediately inform the students that they are delinquent and that they will receive (at least) an incomplete in the course until the delinquency is resolved.

All concerns, comments, suggestions, and/or complaints concerning the operation of the Electronics Shop should be addressed in writing to the College of Engineering Laboratory Manager with a copy going to the appropriate department chairman..

COLLEGE OF ENGINEERING

LABORATORY POLICY

Laboratory apparatus and furniture shall not be removed from laboratories or rearranged in laboratories without prior approval from the Faculty Associate for Laboratory Development or the technician responsible for maintaining the facility.

Students may use laboratories for the purpose of conducting scheduled experiments, assisting with research activities, or working on senior projects when a faculty person agrees to assume responsibility for their safety and for the nature of the work being performed. However, apparatus set up for scheduled experiments and equipment stationed in laboratories for scheduled experiments shall not be used for research, senior projects or other purposes without prior notification of the Faculty Associate for Laboratory Development or the technician responsible for maintaining the facility so as to avoid potential conflicts. Also, the technician responsible for maintaining equipment in the laboratory shall be notified before any laboratory is used for activities other than experiments that have been previously scheduled as part of a lab course. Similarly, the Faculty Associate shall be notified prior to the use of laboratory facilities for group or individual study or for office work. Failure to provide appropriate prior notification may result in immediate termination of use of equipment or facilities.

The faculty person responsible for the experiment or other project in a laboratory is responsible for reporting unsafe or malfunctioning equipment to the shop technician or the Faculty Associate for Laboratory Development.

Experiments scheduled as part of a laboratory course shall have first priority for laboratory facilities and equipment. A proposed schedule of experiments shall be submitted to the Faculty Associate for Laboratory Development not less than one week before the semester begins. The Faculty Associate for Laboratory Development will review all proposed schedules and, in conjunction with appropriate faculty, will reassign dates for experiments in the event of conflicts, and document all scheduled experiments to be performed during the semester.

All locks in laboratories shall be issued by shop technicians. Shop technicians will remove all unauthorized locks. The Faculty Associate for Laboratory Development determines the need for locks in laboratories.

Requests for upfitting laboratory facilities shall be directed to the Faculty Associate for Laboratory Development, who will present them to the appropriate laboratory committee for prioritization.

COLLEGE OF ENGINEERING

SMITH SHOP POLICY

College policy prohibits entrance into a college shop except by permission of the shop technician or other authorized shop personnel.

Access to the College shops **afterhours** shall be **limited** to the purpose of **replacing malfunctioning equipment during a scheduled experiment**. When replacement equipment is removed afterhours, the manufacturer, model number, serial number (or inventory number) of the equipment and the name of the faculty person removing the equipment from the shop shall be recorded on a sheet of paper and left in a prominent location on the technician's desk or in the technician's mailbox. Students **shall not** be permitted to enter any college shop afterhours **unless specifically authorized by the shop technician**.

Equipment and materials shall be requisitioned from the shops during normal working hours when a technician or other authorized shop attendant is available to document the transaction. Except for replacement of equipment as noted above, equipment and materials shall not be removed from a college shop without prior authorization from the shop technician. Each shop has a procedure and appropriate forms for checking out equipment which are available from the shop.

Consumable supplies, e.g., recorder paper, hardness specimens, cement, personal safety items, etc., will be issued by the shops with the understanding that these supplies will be restocked with account numbers furnished by the departments requesting the supplies. Lost or missing equipment as well as items that have been damaged during experiments, e.g., oscilloscope probes, will be replaced and charged to the appropriate lab equipment budget.

All requests for fabricating machined parts should be directed to the college machine shop located in the C. C. Cameron Applied Research Center. The technician's shop in Smith Building is part of the mechanical shop and therefore falls under a part of the mechanical shop technician's responsibilities. The technician's shop is for the purpose of directly supporting repair and fabrication projects that have been assigned to the technicians by the shop supervisor.

It is recognized that there may be occasions when repair parts or consumable items will be needed immediately in order to support a scheduled experiment. Requests for technicians to purchase materials off campus should be accompanied by:

A purchase order number (which can be supplied by the Purchasing Department)

A signed Travel Authorization form with account number so that the technician can be reimbursed for expense of operating a private vehicle.

ENGINEERING MACHINE SHOPS

DESCRIPTION AND OPERATING PROCEDURE

DESCRIPTION

The machine shop is now in the C.C. Cameron Applied Research Building. The manual part of the shop consists of much of the equipment from the old Kennedy shop with the addition of a new surface grinder, new cutoff and band saws, a new milling machine, a new lathe, new welding equipment and an assortment of new smaller tools and machines. This shop is now augmented with a CNC area consisting of a horizontal spindle machining center and a CNC lathe. More CNC machines are expected in 1993 as well as additional grinding and lapping equipment.

The shop technician/instructor is the manager of both the CNC and the manual shop and is under the supervision of Bob Hocken (x4863). The manager will train students and faculty in the use of the machines and assist faculty, technicians, and students in the design and construction of mechanical apparatus using this equipment. He is also available to perform machining tasks on a case by case basis, although in general it is preferred that the students do their own machining (where complexity permits) as part of their general education. Finally, he is in complete charge of all shop safety and has the authority to halt any operation and suspend the shop privileges of any person performing an unsafe or improper act.

TOOLING AND MATERIAL

The shop currently stocks a limited amount of material and tooling, a large portion of which has been purchased out of Precision Engineering funds. The College currently allots only a small amount for such items and for equipment repairs. There is also a subsidiary small allowance for materials for student projects. We, therefore, always need to replenish and, hopefully, increase our stock of material, tooling, and fasteners. We therefore request that those professors that are working on grants supply their own tooling and materials. If there is a time crunch, material and tooling in inventory may be used but replacements should be made. We ask all of you to be very aware that tools wear and there is really no other money to replace worn tooling. Students working on senior projects should get the funding for material and special tools from their departments.

TRAINING

Before using the shop each person must be checked out by the shop manager on any machine to be used. There is a required form (attached), that is to be used for insuring that through oversight this procedure is not neglected. Those professors and students that have "significant" machine shop experience may substitute a resume and an oral examination by the shop manager for this "checkout". Further, every shop user will be required to sign an appropriate "release form" (attached form PE-001) before commencing work which includes the statement that they have read this document, the rules and regulations document, and voluntarily will comply with the rules and procedures therein.

CLEANLINESS

Each and every person using the shop is responsible for cleaning up their own mess. Machines, floor, tools, etc., are to be cleaned and, where appropriate, returned to their correct location. Persons violating this rule will be warned once; failure to comply will result in a suspension of shop privileges.

SAFETY

Safety is of utmost importance in a machine shop. The rules must be followed at all times. Failure to follow the rules will result in the suspension of machine shop privileges. The safety procedures are attached as part of shop rules and regulations.

PROPER SHOP PROCEDURE

The shop is equipped with a copy of the "Tool and Manufacturing Engineers Handbook", Volume 1, "Machining". This handbook contains general instructions on the use of most metal removal machine tools as well as tables of appropriate machining parameters ("feeds, speeds, and depths of cut, etc.") for all common tools and materials. Shop users are expected to consult this volume to obtain the correct parameters for their job. This will assist in preventing damage to the parts manufactured, the machines, and of course, to shop users. Under all situations the shop manager has authority to stop any operation he deems is unsafe or improper.

DAMAGE TO EQUIPMENT

In spite of all precautions, machines do break down and require maintenance. Further accidents ("crashes") do occur. Breakages and all accidents that have or may have caused machine damage are to be reported to the shop manager including the reason(s) for the accident. We are aware that accidents and mistakes do occur, and, except in cases of malicious mischief or gross carelessness, will attempt to pay for repairs out of our limited operating budget. Deliberate misuse will be treated on a case by case basis.

OTHER

Machining tasks that are to be performed by the shop manager must, in general, be incorporated in writing. For example, descriptions, part name, quantities, materials, dimensions, tolerances and notes, where appropriate, would appear on drawings of the part(s) to be fabricated. It is expected that part drawings generated be in accordance with American Standard Drawing Practice, i.e., ANSI Y14.5. Detail and assembly drawings shall be provided when different pieces must be fabricated in order to make an assembly. If it is expected that material and/or tooling will be ordered by the shop manager, a bill of materials should be included with the drawings as well as an appropriate cost center for the procurement. For fabrication performed for a specific research contract the shop manager will estimate the time required for completion and, with the concurrence of the principal investigator of that project, charge the project \$30 per hour for the actual time spent. In no case will the charges exceed the estimated amount without the prior written approval of the principal investigator. Funds obtained in this fashion will accrue in a general machine shop cost center to be used for equipment repair, shop modernization, general use perishable tooling, and mechanical supplies such as fasteners, welding rod and the like.

PRIORITIES

In general, work to be done by the shop technician or on shop equipment will be performed or scheduled on a first-come, first-serve basis. In cases where such scheduling cannot meet the required schedule, the following priorities will apply.

1. Repairs to equipment immediately required for formal laboratory courses currently in progress.
2. Construction of laboratory apparatus for laboratory courses.
3. Construction or repair of apparatus for sponsored research projects.
4. Senior projects or other authorized educational projects.

5. Work performed for persons outside the college or the CARC.
- COLLEGE OF ENGINEERING MODEL SHOP AND
PRECISION ENGINEERING CNC SHOP**

RULES AND REGULATIONS

=====

General

The Precision Engineering Program has now taken responsibility for the College of Engineering Machine Shop and is updating this Shop and integrating it into the CIM Laboratory, which currently contains three CNC machine tools, as well as a jig borer. The College of Engineering Machine Shop has five main machines (two mills, two lathes, and a surface grinder), as well as a variety of other supporting equipment. It is our current policy that these shops should be readily available to students who want to learn to use the equipment and work on various projects. Students, staff and faculty in Engineering, or other programs on campus who desire to use this equipment for educationally-related or research-related activities are required to abide by the following rules and regulations.

Rules and Regulations

1. Students are not allowed to use the Shops without going through a program in safety training, checkout on each of the machines to be used, and completion of the "Student Request for Machine Shop Use" form. An example form is attached. Bill Edwards, the Shop Instructor, will be responsible for administering this training and check-out. A copy of the form ("Student Request for Machine Shop Use"), with appropriate approvals, must be presented to Bill Edwards for his files, before shop work commences.
2. Persons requiring the use of any of the major machine tools (currently the manual lathe, milling machine, and jig borer, and the CNC lathes and milling machine) must sign out for the machine by date and time. In times of increased machine usage, such as when senior projects are due, usage will be limited to three hours at a time, unless special requests are made.
3. Persons using machines must obey all safety restrictions, either posted or made part of this document. Major restrictions are:
 - o Safety glasses must be worn at all times (safety glasses can be obtained from Mr. Edwards).
 - o Long hair and loose items of clothing, jewelry, etc., shall be constrained so as not to be a hazard near rotating or otherwise moving machinery.
 - o All safety features of the machinery shall be properly utilized. For example, covers on the CNC lathes and machining center shall be closed, where applicable.
4. No one is allowed to use the machinery alone. If the instructor is not in the Shop, users are required to work in pairs. This is particularly important when using the machines after normal working hours.
5. A person using a piece of machinery shall have read the operator's manuals and be checked out by the Machine Shop Instructor before using any piece of equipment.

6. The user of a machine shall be responsible for cleaning each machine after use, including the floor area, and returning all tools to their proper locations.
7. All tools or equipment taken from the Shop area must be signed out for and returned promptly after completion of the job.
8. The Shops are not depositories for junk. Any project or other material left in the Shop for more than two weeks will be discarded, unless special permission is obtained from the Shop Instructor.
9. Shop users are responsible for their own tooling. Although the Shop contains certain standard tooling (drills and mills, etc.), as a general rule a person working on a project should be prepared to purchase his/her own tooling, as required. If tooling belonging to the Shop is broken, the user is required to replace same at his/her own expense.
10. Shop users are responsible for their own materials. Although there is a limited stock of materials in the Shop area, it belongs, in general, to specific projects. This stock may only be used with the explicit approval of the Shop Instructor.
11. Shop users are required to follow all instructions given to them by the Shop Instructor or other authorized individuals.
12. Any person found misusing equipment will be subject to disciplinary action.

Students violating any of these rules will have their Shop privileges revoked for a period of at least two weeks. Longer periods may be assessed, depending upon the judgment of the Shop Instructor and Precision Engineering Laboratory Director.

**STUDENT REQUEST FOR MACHINE SHOP USE
(Form PE-001)**

NOTE: **This form is to be completed and submitted to the Shop Instructor before Shop use commences.**

1. Job Number _____
2. Job Title _____
3. Student Name _____
4. Date _____
5. Course Number or Project Description _____

6. Instructor or Advisor Name _____
7. Bill of Materials _____

8. Tools to be Used _____

9. Schedule (approved by Shop Instructor) _____
10. ***Certification: I hereby certify that I am competent to carry through this project with minimum supervision and have been appropriately instructed on the usage of all machines required to complete this project. I further certify that I have read and understand the Rules and Regulations governing the Machine Shop (Form PE-001) and will follow these procedures and safety regulations. I will in no way hold UNCC or its officers liable for any injury that results from my improper use of equipment or negligence.***
- Student Signature _____
11. Approval: Account Number _____
 Supervising Professor Signature _____
 Shop Instructor Signature _____