EET SENIOR PROJECTS MANUAL

by

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STATEMENT OF INTENT

The faculty members of the Electronics Engineering Technology Program have instituted the Senior Projects Program to help facilitate the student's transition into industry. The Senior Projects Program has been designated as the capstone experience for EET. Each EET faculty member and many industrial advisors have made significant contributions over the years to make this program successful. Only the best ideas have been incorporated into the Senior Projects Program. Our Senior Projects students have been involved in number of significant engineering endeavors. To name a few:

1. Flying W is a programmable electronic circuit board used for outreach and as a promotional tool for the EET program.

2. Mobile Elemental Power Plant (MEPP) alternative energy portable power station consisting of two solar panels and a wind turbine mounted on a trailer that can provide power for applications in remote locations, disaster relief, military operations, or emergency medical situations.

3. Many of our students have designed and built circuits that have flown on WSU spacecraft as part of Weber State University Center for Aerospace Technology.

The typical senior project student completes an engineering design project for their employer. The highest starting salaries typically go to those students who have demonstrated their engineering skills to their current employers.

Your suggestions are encouraged. The only way to keep improving the Senior Project Program is to continually seek out new ideas, motivated students, and willing employers.

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1.0 PURPOSE OF SENIOR PROJECTS

The purpose of senior projects is to provide students with realistic development project similar to what may be expected out in industry. The senior project experience is divided into building skills in five major areas: (1) team building skills, (2) project management skills, (3) design and research skills, (4) documentation skills, and (5) presentation skills. Industrial advisors have designated these five areas as being very important to the success of an engineering technology employee.

Team Building Skills:

Development projects typically take place in teams, and a productive team will always be greater than the sum of its parts. Each member of a team must fulfill his or her share of the load, and ideally, improve the performance of other members of the team. Team members must help each other to accomplish the defined task of the team. Team building situations are created and students are evaluated in their effectiveness in a team situation.

Project Management Skills:

Delivering projects in a timely manner within budget is key to competitiveness in electronics and computer related industries. Careful planning and execution of a project plan are very important to controlling schedules, costs, and features for development projects. Successful employees have an understanding of project management and its importance to the organization.

Design and Research Skills:

Employees must be technically competent to design circuits and systems to solve problems. They must be able to perform research that leads to solutions. Proficiency in problem solving allows employees to quickly identify and solve problems. In addition, employees must be able to professionally build and package electronic prototypes and products. Basic knowledge of soldering, wire-wrapping, printed circuit design, and hardware skills are required for well-designed products.

Documentation Skills:

Employees must be able to clearly document their activities so others can easily understand what they have done. Products require sufficient documentation that allows the user to understand and modify the product for different applications. Schematics and block diagrams must follow industry standards. Circuit descriptions must be technically correct and easy to read.

Presentation Skills:

Employees must be able to verbally communicate with clarity and ease of understanding. Presentation skills are important for those in engineering positions working in team environments.

2.0 COURSE DESCRIPTIONS

The EET program requires completion of a capstone project for graduation. As part of the capstone project series of courses, students are expected to take a product of their choice from conception to a functioning proto type. This will be done in distinct stages that are associated with individual courses.

CEET 3090 Project Management

The Project Management course is designed to introduce students to the capstone experience. It addresses time management, budgets, teamwork, technical abilities, and technical documentation. Students prepare for the capstone project by identifying the purpose of their project, determining goals, and assigning tasks. An engineering logbook documenting all aspects of the project is mandatory.

Students are required to form a team and generate a formal contract for their project as the result of CEET 3090, which is approved and signed by all faculty members. The formal contract consists of the project description, commitment to delivery of a prototype at the conclusion of CEET 4010, and the final project description that will be delivered at the conclusion of CEET 4020.

Registration for CEET 3090 is dependent on successful completion of CEET 3010.

CEET 4010 Senior Project I

CEET 4010 Senior Project I is the second class, after successful completion of CEET 3090, in the series of three required for completion of the capstone project. The senior project experience is a capstone project that demonstrates mastery of EET coursework and should be completed in the senior year. Before a student is accepted into CEET 4010 or CEET 4020, a formal contract for a capstone project must be approved and signed by all EET faculty members. A departmental drop will be issued for students not meeting these requirements. CEET 4010 is a two credit hour class. The course requires the completion of the following significant milestones:

1. Preliminary design completed.
2. Hardware in-hand.
3. Critical concepts proven.
4. Preliminary Design Review (PDR) at the end of the semester.

It is also expected that students will contribute at least 10 hours per week for a total of 150 hours during the semester. Moreover, students are required to have regular formal meetings with each other and a weekly meeting with their project coordinator.

CEET 4020

CEET 4020 Senior Project II is the third course in the series required for completion of the capstone project. CEET 4020 is a two credit hour class where students are encouraged to work with minimal supervision to complete their capstone project. Enrollment in CEET 4020 is dependent upon successful completion of a

Preliminary Design Review in CEET 4010. The course requires the completion of the following significant milestones:

1. Contract obligations fulfilled
2. Completion of all documentation including a logbook, project documentation, instruction manuals, and any other documents associated with the project.
3. Final Design Review (FDR)

It is again expected that students will contribute at least 10 hours per week for a total of 150 hours during the semester. Moreover, students are required to have regular formal meetings with each other and a weekly status meeting with their project coordinator.

Course Outline

Through out the CEET 4010 and 4020 courses, students will be graded based upon the following criteria.

	CEET 3090 Grades
Team Building Skills	
1. Construction of a team	ABCDE
2. Completion of coursework	ABCDE
3. Meetings with Team Members	ABCDE
4. Meetings with Coordinator	ABCDE
5. Meetings with Advisor	ABCDE
Project Management Skills	
1. Contract approval with EET faculty signatures	ABCDE
2. Gantt Chart	ABCDE
3. Block Diagram	ABCDE
4. Weekly/Milestones Goals	ABCDE

	CEET 4010 Grades	**CEET 4020 Grades**
Team Building Skills		
1. Meetings with Team Members	ABCDE	ABCDE
2. Meetings with Coordinator	ABCDE	ABCDE
3. Meetings with Advisor	ABCDE	ABCDE
Project Management Skills		
1. Weekly/Milestones Goals	ABCDE	ABCDE
2. Budget and purchasing		
Design and Research Skills		
1. Research	ABCDE	N/A
2. Circuit Design	ABCDE	ABCDE

3. Problem Solving	ABCDE	ABCDE
4. Use of Advisor	ABCDE	ABCDE
5. Construction Skills	N/A	ABCDE
Documentation Skills		
1. Log Book	ABCDE	ABCDE
2. Schematics	ABCDE	ABCDE
3. Parts Lists	ABCDE	ABCDE
4. Manual	N/A	ABCDE
Presentation Skills		
1. Preliminary Design Review	ABCDE	N/A
2. Final Design Review	N/A	ABCDE
3. General Presentation		
4. Personal Demeanor	ABCDE	ABCDE
5. Visual Presentation	ABCDE	ABCDE
6. Technical Knowledge	ABCDE	ABCDE
7. Demonstration	N/A	ABCDE

3.0 TEAM BUILDING

It is rare in industry that a project will not have some interaction with various groups of individuals; consumers, technicians, engineers, and/or management. Team building is an important concept that all technicians / engineers must have and practice. Each team is assigned a faculty advisor to assist with team management skills. Outside advisors are also utilized to further improve relations between local industry and Weber State University while opening the door for future employment of the students.

Fulfilling Share of Load

Each member of a team must carry his or her share of the load. Weekly goals will be set by the student, approved by the faculty advisor. The faculty advisor will monitor progress and verify completion of weekly goals. Every member is expected to contribute a minimum of hours per week to accomplish the weekly goals. If a particular student is having difficulty contributing their share of the load, the senior project coordinator may assign a letter grade to the student that will be a relative indicator whether or not the student is carrying their share of the load. In addition, Students found not carrying their share of the load for more than one week may be removed from the team and issued a departmental drop from the course.

Advisors

The following criteria should be used concerning advisors:

1. Each team is responsible for selection of a technical advisor. The advisor must be an engineer with experience in the realm of the project. The advisor can either be an Engineering Technology faculty member or a representative from the student employer serving in an engineering or engineering supervisory position. The advisor must agree to provide technical assistance to the team, but must not get so involved that the student

learning objectives are compromised.

2. The advisor must be willing to attend the PDR and FDR senior project presentations. The advisor will become part of the evaluation team that grades the students.
3. Some teams will need to have more than one technical advisor to accommodate for the diverse requirements of a project.

Meetings

It is expected that the following meetings will occur weekly:

Team meeting: The team members are expected to meet regularly to set goals and accomplish common tasks. This is not when the majority of the work is done. Instead team meetings are to make sure that all members are fulfilling their part of the project. Students may be removed from a team and may receive a departmental drop from the course after missing more than one team meeting.

Project Advisor meeting: Each team, as a whole, will meet with the senior projects faculty Advisor for a half hour, to keep the advisor informed as to the progress of the team. This is also a time for the team to get advice on milestones, goals, and major difficulties that there are facing. The project advisor will review logbooks and goals for every student team member each week during this meeting. Any student who misses more then one meeting may be dropped from the team and may receive a departmental drop from the course.

It is also expected that the following meeting will occur as needed:

Technical Advisor meeting: Advisor meeting should occur as often as required by the advisor or when the team needs additional technical assistance. Advisors should be treated as supervisors who only have a limited amount of time to devote to team concerns. Advisors should generally be utilized for no more than 30 minutes each week. The students should have the appropriate questions written down in advance before the advisor is contacted. The students should be very careful not to abuse the advisors willingness to help.

Other meetings: This would include telephone conferences or face to face with suppliers or sponsors. It may also include local, region, national, or international conferences.

Teamwork using subsystem techniques

In industry, large projects are often divided into subsystems, each with an expert / lead. Most senior projects can also be divided up into equal parts. It is recommended that the senior projects be divided up with every team member taking a specific subsystem that they will become the expert at. This does not mean that a team member will not work on a different subsystem under the direction of the other lead, but it guarantees that every team member is carrying some part of the work load.

Important issues that must be addressed when dividing up a project:

1. A master specification list must be maintained so that each subsystem lead knows how to

interact with the larger project.

2. Any change to the master specification list must be approved by all involved subsystem leads.
3. Use natural breaks in the project to divide the larger picture into subsystems. i.e. Power supplies, Microcontrollers, and User interface.
4. Each subsystem should have a block diagram and Gantt chart outlining the subsystem specific deadlines and objects.
5. Every team member must remember that there may be times when they may be needed to perform a task in a different subsystem to meet a project deadline
6. Each subsystem lead should be responsible for the documentation and presentation on their part of the system. Writing the manual and/or designing the presentation are NOT subsystems.

4.0 PROJECT MANAGEMENT

Deadlines, budgets, and managing of personnel issues are factors in team projects. Careful planning and execution of a project plan are critical in controlling schedules and costs. As such, all senior project teams will write a project contract, develop a Gantt chart, design block diagrams and flow charts, track budget items, outline specifications and set milestones.

Contract

Each team must have a contract or proposal that clearly outlines what is expected of the students. It should clearly state what is to be done during the senior project capstone experience to prevent any misunderstandings from occurring between the faculty and students. Students should not finalize designs or purchase parts until after the contract has been signed by all faculty members and outside technical advisors.

All contracts must include the following:

1. A list of all team members and contact information.
2. Identify the technical advisor with contact information.
3. Explain the background and need behind the project.
4. Explain the theory of how the problem is going to be solved.
5. Describe the hardware and/or software or product that will be delivered at the conclusion of the PDR, CEET 4010 course presentation.
6. Describe the hardware and/or software or product that will be delivered at the conclusion of the FDR, CEET 4020 course presentation.
7. A high-level block diagram and/or flow chart of the project.
8. A high-level Gantt chart outlining the schedule for the project.
9. A faculty signature page including all EET faculty members and the ET department chair.

Contracts should be written such that:

1. The contract uses proper English and is error free. The students will be asked to correct any errors that are found on the contract and will not be approved until all corrections are completed.
2. The complete contract should include the project description and product delivery commitments, block diagram, Gantt chart, and signature page.
3. The main body of the contract should be divided into three paragraphs. The first paragraph should define the problem to be solved and explain the theory of how the problem is going to be solved. The second paragraph should explain exactly what will be provided or demonstrated at the PDR. The third paragraph should detail exactly what the final product will be for delivery at the FDR including all documentation for the project.
4. The contract completely describes the work with no additional resources or discussion required.
5. It should clearly describe the team commitment to the project so as to avoid later confusion. Do not over estimate the final product you intend to deliver.

Once completed the contract must first be approved and signed by the EET Program Coordinator prior to submitting it to the remaining faculty. Any one faculty who feels the project is either to easy or to difficult

for the requirements of the course can refuse signing. Only contracts will all faculty signatures will be considered for completion of the course.

The original copy of the contract with all signatures must be given to the senior project advisor. The students should make a copy for their personal files before giving the original to the senior projects coordinator.

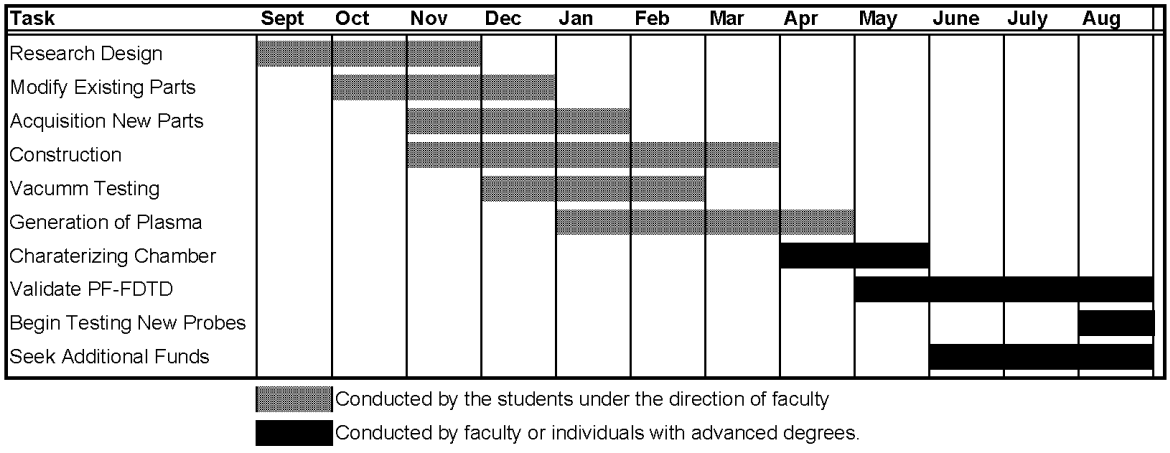
Gantt Charts or Timelines

Gantt charts or timelines are a useful tool used to manage deadlines and achieve milestones. Major stages or milestones in a project are tasks that must be completed by a specific date. Sub tasks related to the major milestones are listed under the major milestone. Completion of the sub tasks is necessary in order to meet the major milestone.

- Research is an important aspect of any project. Research can help shorten the design time of your project by investigating various solutions to a problem.
- Allow plenty of extra time for system integration to debug, test, and rework the sub systems.
- Allow adequate time to acquire components. Shipping and backorders will add significant delays to a project.
- Documentation should be a continuous process. Develop a system to store all pertinent documents throughout the course of the project. The more documentation that is done during the process the easier it is to complete the project manuals.

Sample Timelines:

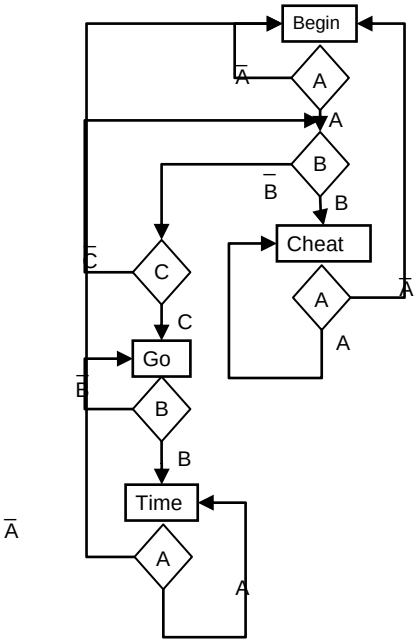
	2007			2008				2009				2010
Milestones	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
Complete interpolation technique	X											
Develop inverted model	X											
Verify quality of flight data sets		X										
Apply inverted model to E-Winds electron PIP data set					X							
Apply inverted model to Equis II dipole data set						X						



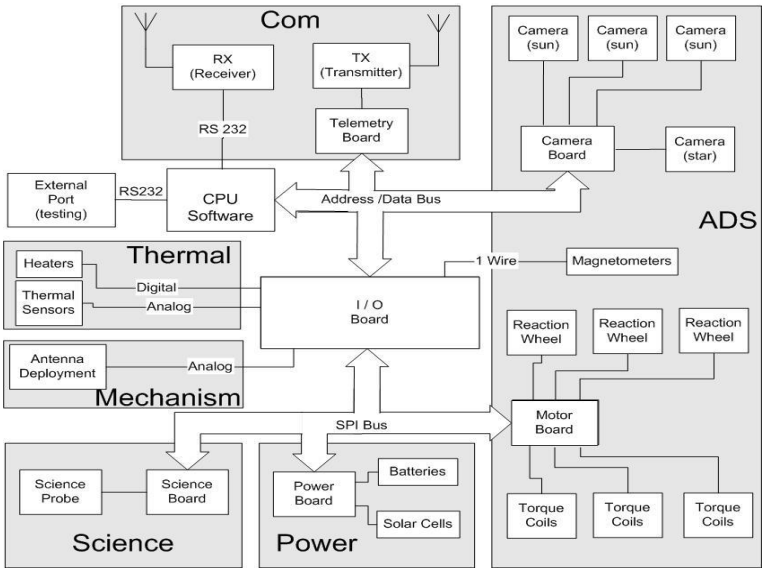
Block Diagram / Flow Chart

Block diagrams and flow charts are an important tool used to understand the relationship that every part has on the rest of the project. Block diagrams show how individual subsystems relate to each other and can aid in outline the specifications used to interface the components. High level diagrams do not deal with individual parts, but are used to specify for example, the required voltage from the power supply and the filtering that is needed prior to the final stage. Low level diagrams in detail are considered a schematic.

Examples:



Flow Chart of a Reaction Game



Block Diagram of a Satellite

Specifications

Specifications are used to define how a device interacts with other devices and users. Every project will include a specification section listing all components.

Traditional specifications include:

1. Power supply requirements
2. Input / Output impedance values
3. Signal to Noise levels at the input and output terminals
4. Frequency response of the input and output terminals
5. User interfaces

Example:

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply Voltage	V_{CC}	-	4.5	-	16	V
Supply Current (Low Stable) (Note1)	I_{CC}	V_{CC} = 5V, R_L = ∞	-	3	6	mA
		V_{CC} = 15V, R_L = ∞	-	7.5	15	mA
Timing Error (Monostable) Initial Accuracy (Note2) Drift with Temperature (Note4) Drift with Supply Voltage (Note4)	ACCUR Δt/ΔT Δt/ΔVCC	R_A = 1kΩ to100kΩ C = 0.1μF	-	1.0 50 0.1	3.0 0.5	% ppm/°C %/V
Timing Error (Astable) Intial Accuracy (Note2) Drift with Temperature (Note4) Drift with Supply Voltage (Note4)	ACCUR Δt/ΔT Δt/ΔVCC	R_A = 1kΩ to 100kΩ C = 0.1μF	-	2.25 150 0.3	-	% ppm/°C %/V
Control Voltage	V_C	V_{CC} = 15V	9.0	10.0	11.0	V
		V_{CC} = 5V	2.6	3.33	4.0	V
Threshold Voltage	V_{TH}	V_{CC} = 15V	-	10.0	-	V
		V_{CC} = 5V	-	3.33	-	V
Threshold Current (Note3)	I_{TH}	-	-	0.1	0.25	μA

Weekly Goals

Each team must submit a Weekly Goal Record to outline their progress when they meet with the senior projects coordinator. The sheet should be filled out before the meeting with the coordinator and should correlate to the overall project Gantt chart and milestones.

The following items should be included on the Weekly Goal Form:

1. List all team member names.
2. List the week that the goal record is turned in to the senior projects advisor.
3. List the date that the goal record was turned in to the senior projects coordinator.
4. Goals for team members.
    a. Number and list the goals for each team member.
    b. The goals listed should be what the team wants done for the week. <u>These are team-generated goals, not senior project coordinator directed goals.</u> Do not use the words "research", "write", or "troubleshoot" without clearly describing what you are going to research, write, or troubleshoot.
5. Goals should be measurable and attainable. Write a brief summary of how an objective observer can identify whether the goal is accomplished or not.
6. List the number of hours that you plan to spend on that particular goal.

Sample Goals:

Team Member #1

Goal 1: Research three types of microprocessors and obtain the data sheets, pricing, and vendor. Select one to use for the project. (3 hrs)

Accomplishment Criteria: Copies of data sheets in hand. Rationale for choice documented in logbook.

Goal 2: Draw a rough schematic of the microprocessor, RAM, and ROM sections. (4 hrs)
Accomplishment Criteria: Schematic documented in logbook
Goal 3: Write C code for the serial port communications. (8 hours)
Accomplishment Criteria: print out of the C code file and demonstration of the process.

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5.0 DESIGN AND RESEARCH SKILLS

Design and research skills are a culmination of all of your previous course work. It is at this point that the technical merit of the project begins. This skill set can be broken down into five key areas: Research, Circuit Design, Problem Solving, Use of Advisor, and Construction Skills.

Research

Each team member should conduct basic research into the feasibility of the project before the completion of the contract. This will aid the students in learning common terminology and understanding exactly their part in the project. Significant results should be presented during weekly meetings with team members and the senior projects coordinator during the CEET 3090 Project Management course.

Circuit Design

Each member of a team must display good design techniques on applicable projects. However, it is not expected that all circuits will be original. In fact, most original circuit designs may not be the best for the job. As team members proceed through the design process, they should conduct additional research into current technologies used in similar problems.

The majority of completed projects have used different combination of many existing circuits with original designs interfacing them. Any use of other designs must be brought to the attention of the senior project coordinator and credit given to the original designer. Whether a design is original or not will not be the issue. The issue is whether or not the students understand the circuit well enough to have designed it themselves.

Problem Solving

Each member of the team and the team as a whole must present good problem solving techniques. During the course of the project many problems will arise that must be solved by the team. Problem solving techniques will be observed and graded by the senior projects coordinator.

Use of a Technical Advisor

The team must also effectively use technical advisors. Advisors are essential for successful completion of senior projects. Most of the external specifications will be dictated by the advisor.

Construction Skills

Construction skills are practiced and evaluated in an attempt to improve the student's ability to construct quality projects.

Soldering and Wiring

Soldering skills are practiced and evaluated in an effort to improve the student's ability to build quality projects. All solder connections must be made correctly. Overall functionality of a project depends on excellent wiring skills. A project must be wired properly, using skillful wiring techniques. Projects will be inspected for tight connections, connectivity, proper wire sizing, wire routing, and wire labeling.

Hardware

1. All projects must be packaged appropriately, unless the project is a circuit card that fits inside an existing cabinet.
2. Switches, controls, and indicators must be labeled on the cabinet front panel.
3. All 110 VAC operated devices should be fused with inline fuse holders.
4. All 110 VAC connections must be well insulated to prevent a shock hazard. Use heat shrink tubing on all exposed connections.
5. Any wires passing through the case must have strain relief devices to prevent the wires from shorting to the case.
6. Mechanical bolts and nuts should have lock washers installed. Bolts should extend through the nuts more than one thread but less than five threads.
7. All wire routing should be bound with cable ties.

6.0 DOCUMENTATION

Each team must provide documentation that supports their project. The documentation is divided into four areas: Log Book, Schematics, Parts Lists, and Manuals.

Log Books

Each member must keep an accurate log of his or her activities during the senior projects classes. Class meetings, team meetings, phone calls, conversations, commitments, ideas, trips, and sketches should be entered in your logbook. These entries are to be made in a bound notebook in chronological order. Make your entries in pen. Do not write on the back of the page (left side).

The student should make a five-minute entry for each hour contributed to senior projects. The amount of time spent on the project each day should be entered at the end of that day entry. The average size notebook (60 pages) should be half full by the end of CEET 4010 and completely full by the end of CEET 4020. The logbooks will be evaluated at the end of each semester. Follow the guidelines specified.

Usage

Project must be documented in a bound logbook. Indicate initial date on the inside cover of the logbook. Only one book is to be used at a time for project documentation on research, development, design, prototype, test, and final design.

Entries

Entries must be made on consecutive pages to establish chronological order. Do not remove pages from the bound logbook. Any blank pages should have the statement "This page left blank intentionally" written across the middle. All entries must be in ink. Do not erase or modify an entry. Strikethrough errors and make the correction. If the correction occurs at a different date, indicate the current date and initial the entry.

Each entry should end with a line across the page below the entry, initialed and dated. Use the left side page for sketches, schematics, phone numbers, or quick reference information.

Content

Logbooks should contain calculations, designs, recorded data, class activities, team meetings, phone conversations, commitments, ideas, trips, and sketches.

Format

Each entry is to be dated and initialed or signed at the bottom right. Do not use the left page for normal entries. The left page should be reserved for sketches, schematics, phone numbers, or quick reference information. All entries must use proper English and be constructed with complete sentences.

Recording Time

Students should make a five minute entry for each hour spent on the project. The amount of time on each activity should be recorded at the end of the entry. Entries should be made on the day of the activity being recorded. Students should log 150 hours each semester of Senior Projects.

Schematics

Schematics are required in support of senior projects documentation. Schematics are required to be turned in each semester.

The following criteria should be used for CAD drawings:

- Notes should be drawn in the lower left corner. Only two notes are needed if you have resistors and capacitors in your circuit. Avoid using the notes sections to describe parts. Use the following format for the notes:
    - NOTES:
- All resistance values are in ohms, (i.e. 1/4 W, +/- 5%), unless otherwise noted.
- All capacitance values are in microfarads,unless otherwise noted.
- Unused gates should be drawn on the bottom of the drawing between NOTES and LAST REFERENCES USED sections. Each unused gate should be drawn showing all IC numbers and pin numbers. Each unused input should be tied high or low to prevent any inputs from floating. This section documents that the unused gates have been taken care of to avoid noise and oscillation problems. The unused gates section becomes a directory of the gates that could be used in future design changes.
- The last reference used for each type of component needs to be listed in the LAST REFERENCE USED section. This list documents the last reference used to reduce the possibility of using a reference designator twice. Use the following format when listing the last references used.

    - LAST REFERENCE USED:
        - C12
        - D4
        - R12
        - U15

- Each component should have a reference designator printed next to it. A reference designator is a single letter abbreviation for that component along with the number.
  For example:

Device	Letter	Examples
Capacitors	C	C1, C2, C3, ...Cx
Diodes	D	D1, D2, D3, ...Dx
Resistors	R	R1, R2, R3, ...Rx
Transistors	Q	Q1, Q2, Q3, ...Qx
IC's	U	U1, U2, U3, ...Ux

- Each component should also have the value printed next to it. The values for resistors and capacitors do not include the ohms symbol or the microfarad symbol because the notes eliminate the need. All diodes and transistors require the 1N or 2N number. All reference designators and values go to the right or on top of the symbol.

- Each integrated circuit needs a pin number and pin function by each pin connection. The pin number goes outside the box above or to the right. The function of that pin should be abbreviated and located inside the box.
- Reference designators should be assigned on a drawing from the left to right and from the top to the bottom.

- Avoid four way interconnections. The only exceptions are for transistor biasing circuits and data lines.
- Schematics that use more than one drawing need an accompanying block diagram to clearly illustrate the interrelationship between the schematics.
- Submit only photocopies of the drawing for evaluation. Keep the original drawings away from the senior project coordinator because he will destroy them with red ink.
- Schematic evaluations will be evaluated for correctness and balance.

Parts Lists

Each schematic or sets of schematics needs to be accompanied by a complete parts list. The parts list must include the following information:

- Project Title
- Team Members Names
- Date: Every time an item is changed on the parts list, be sure to put a new date on the parts list.
- Reference Designators: List the parts in alphabetical order by the reference designators.
- Parts Descriptions: Parts descriptions should describe the part in detail. For example: Capacitor entries need the value, tolerance, type of capacitor (electrolytic, mylar, etc.), voltage rating, axial or radial lead, and lead distance.
- Name of Manufacturer: List the company that actually made the part. Some parts (Radio Shack) are sold without the manufacturer printed and should be listed as unknown.
- Manufacturer's Part Number: List the actual number that would be used to order the part.
- Vendor: List the company or source where the parts were purchased or obtained.
- Cost: List the cost that was paid for the part.

Sample Parts List:

Project Title:_____ Date:_____
Students Names:_____, _____, _____

Ref #	Part Description	Manufacturer/ Part Number	Vendor/ Cost

Manual

Each team must complete a Project Manual for their senior project. The manual should be a professional product in that the main body could be submitted to a technical journal, including Weber State University ERGO (a journal of undergraduate research at WSU). It is required that the student completes a rough version of the main body by the end of CEET 4010, and that the final version be given to the project advisor at least one week prior to the Final Design Review for inspection and feedback.

The manual should be a professional product that reflects the best possible effort of the students and should meet the following criteria:

- Spiral bound using a card stock cover or a 3-ring binder with the cover page information printed on the cover.
- Dividers with labels that separate the major sections of the project.
- All drawings and graphs must meet department standards.
- All figures and tables must be referenced in the body of the text.
- All pages numbers referenced to Table of Contents page.
- Punctuation and spelling must be correct.
- References and Bibliographies should match IEEE standards.

Write the complete manual at the level of a senior CEET student. Assume that the reader has had the same set of course that you have, but has not specialized in this project.

Frequently share the manual with the senior projects coordinator throughout the project. It is appropriate to bring in sections of the manual during the weekly meetings with the senior projects coordinator for discussion.

The major divisions in the project manual should include the following sections:

- Title page as the first page
- Table of Content page
- Introduction / Background
- Theory of Operation (include the following items)
    - High Level Block Diagram
    - High Level Flow Chart
    - Photo or drawing of finished project
    - Explanation of all of the above
- Conclusion / future work
- References and Bibliography
- Appendix
    - Specifications for system and subsystems
    - Detailed Block Diagram
    - Detailed Flow Chart
    - Detailed Schematics

- Parts Lists
- Benchmark Tests with circuit descriptions, waveforms, and timing diagrams
- Technician Troubleshooting Flow Chart / guidelines
- Software Hardcopy
- Significant Parts Data Sheets
- Final Gantt chart
- Copy of Contract
- Resume

Introduction / Background
Include everything for a technical individual to comprehend the purpose and science associated with the project. It should be a clear concise description of the project.

Theory of operation
This section should completely describe all of the states and functions of the project. This section should be written so that the project can be reproduced without additional input.

Conclusion / Future Work
Summarize your learning experience and explain how this project can be advanced by future students.

References and Bibliography
Use IEEE journal standards for all references and bibliographies.

Appendix: Specifications
List the specifications for any external connections. At the discretion of the team, list any and / or all of the internal subsystem specifications.

Appendix: Detailed Block Diagram
Include all systems and subsystem in a complete block diagram indicating how the various components interface.

Appendix: Detailed Flow Chart
Include all flow charts for state machines or software programs, identifying where the subroutines are called.

Appendix: Detailed Schematics
Include all schematics for the project.

Appendix: Parts List
Include a complete parts list required for construction of the project. The final parts list should include part numbers, descriptions, vendor, and cost. A total cost of the project should be displayed.

Appendix: Benchmark Tests
All fundamental testing performed should be documented that can be used to verify operations of the project. Include bench line values and possible tolerances for reference to ascertain if the system is working properly. Where applicable it should include sample input values and the resulting outputs at test points and the final output.

Appendix: Technician Troubleshooting Flow Chart / Guidelines
Include guidelines for trouble shooting and replacing of key subsystems and parts.

Appendix: Software Hardcopy
Include a hard copy of all software code or an electronic media copy of the files.

Appendix: Significant Parts Data Sheets
Include only significant parts data sheets.

Appendix: Gantt Chart
Include the time line.

Appendix: Copy of Contract
Include a copy of the signed contract for easy reference by the faculty.

Appendix: Resume
Each student must prepare a resume to be submitted as part of the manual. A professionally completed resume is an important part of finding an engineering position.

7.0 PRESENTATION SKILLS

The knowledge that Engineers have is only as good as what they can convey to others, either through oral or written communication. In fact, throughout the design processes, in industry, it is common to have several presentations on the status of the project. Typically there are Conceptual Design Reviews (CDR), Preliminary Design Reviews (PDR), Critical Design Reviews (CDR), and Final Design Reviews (FDR). Each review is targeted at different aspects of the project. Due to time constants there will only be two presentations associated with senior projects, the PDR for CEET 4010 and the FDR for CEET 4020.

Preliminary Design Review:

The main point of a Preliminary Design Reviews (PDR) is to provide critical feedback from a knowledgeable audience early enough that corrections can still be made. Very rarely is the PDR a "make or break" type presentation, unless significant faults are identified.

A PDR will cover a complete description of the problem. An outline of the system level specifications is presented along with a high level discussion of subsystems and significant parts of the project. The PDR may include a detailed discussion of completed aspects of the project.

The PDR should provide enough information that a knowledgeable audience member could identify potential problems that the team may have overlooked or to provide an opportunity to solve a plaguing problem.

Final Design Review:

The Final Design Review (FDR) is held at the conclusion of the capstone experience. All design issues have been addressed and the final product is ready for presentation. An FDR includes an overview of the problem that was solved, an outline of the system, a detailed specification of each subsystem which may include block diagrams, flow charts, or simplified schematics with only applicable parts included, lessons learned, including significant problems and solutions used, and future directions for the project.

General Presentations Guidelines:

Time	Activities
0:00 to 0:05	Introduction of team members and of the project.
0:05 to 0:30	Formal project presentation
	Project Description
	Project Outline
	Timeline and Budget
	Body of the presentation:
	Every team member presents his or her contributions to the project. Each team member should clearly demonstrate technical knowledge on their aspect of the project.
	Conclusion

0:30 to 0:40	The team members professionally demonstrate the project with a Q&A Session.
0:40 to 0:45	The guests and students leave the room so the faculty and advisors can privately discussion additional issues with the team members.
0:45 to 0:50	The team leaves the room so the faculty can evaluate the presentation and project.
0:50 to 0:60	The team is invited back into the room and results are reviewed.

Remember that the focus of the presentation is to show a master of: (1) the problem to be solved, (2) the theory or method used to solve the problem, and (3) the components or circuits used to solve the problem.

The presentation is a formal business meeting. It is unacceptable for children to attend the presentation. Anyone attending the presentation must remain seated quietly for the entire duration of the formal presentation.

Attire:
Attire for all presentations should be business formal.

Visual Aids:
Slides should be easy to read and not crowded with words and text. Avoid using dark lettering on dark backgrounds and clearly label all pictures. Avoid excessive animation on the slides.

Technical Knowledge:
This project is a culmination of all of the classes taken for your Bachelor degree. As such, it is expected that each team member will demonstrate a master of all technical issues related to the project.

Demonstration:
It is expected that as part of the Final Design Review a working proto type of the system will be demonstrated.

Additional Comments:

A minimum of three faculty members must be in attendance to hold an official senior project evaluation. Invite the faculty, advisors, and guests well in advance of your scheduled presentation. Remind them one week before your presentation and again the day before.

Students who are doing a project for a local company are encouraged to invite their direct supervisors to the presentations. Parking arrangements can be made for visiting employers.

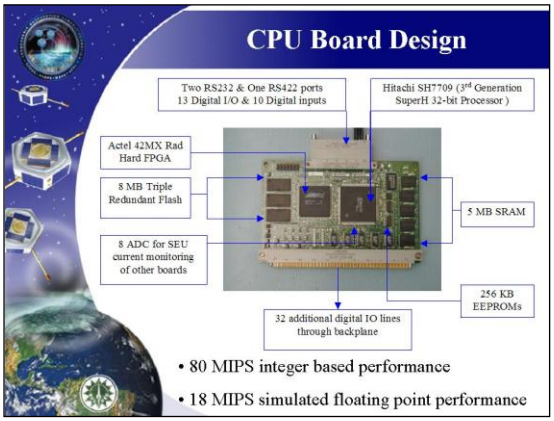
Rehearse, rehearse, rehearse your presentation before you attempt to give it officially to the faculty. It is always very obvious who has practiced and who has not. If you are planning to use the multimedia equipment, it is important that you practice using it. Students may be asked to make a preliminary presentation to the senior project coordinator during one of the weekly 30-minute meetings.

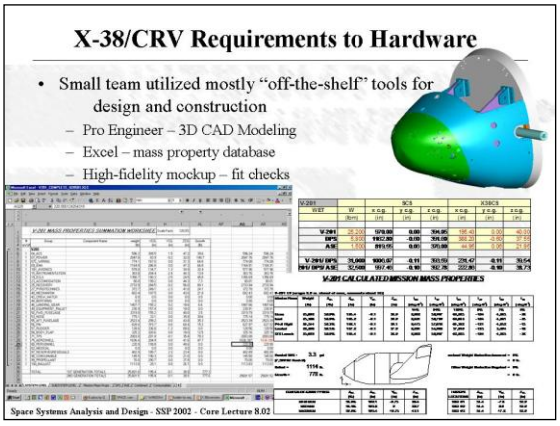
Prepare the room before the presentation. It is recommended that you reserve the room one hour before the start time of your presentation to allow enough time to set up and test your project. Obtain and try out the multimedia equipment to make sure that it is working correctly.

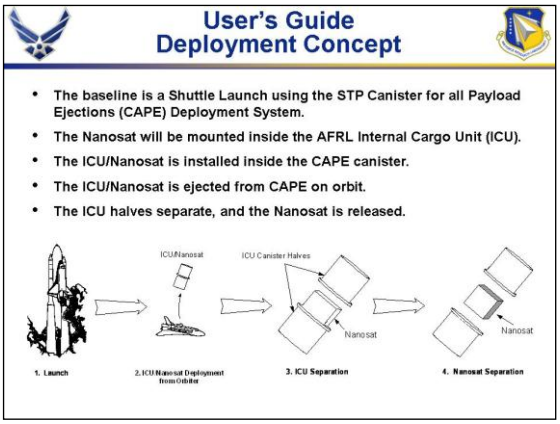
Recommend that all questions are held to the end. Do not encourage questions until you are into the question and answer period. Early questions or distractions may make it difficult to cover all of the required topics.

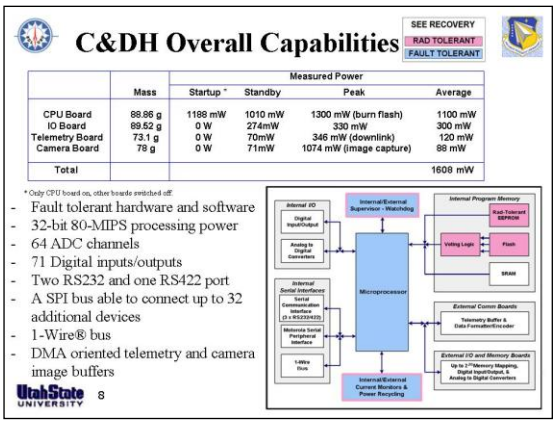
Visual aids are very important. A considerable amount of time should be taken in preparing quality visual aids. Microsoft PowerPoint software is available on all departmental computers. Remember a good slide is one with few words and a picture to describe what the team did.

Sample Slides:









8.0 GRADING PROCEDURE

For the purpose of this course, students will receive their individual final grade as determined from the criteria listed in the course syllabus.

Completion of Contract

Successful completion of all the terms in the signed contract will constitute a passing grade with the actual letter grade depending upon the grading criteria for the course.

Unsuccessful completion of all the terms in the signed contract may constitute a failing grade with the letter grade depending upon the grading criteria for the course.

Weekly Grades

The project coordinator will determine completion of weekly goals based on the following:

1. Team Building Skills
    a. Fulfilling share of load
    b. Attendance at meetings
2. Project Management Skills
    a. Weekly goals
3. Design and Research Skills
    a. Research
    b. Circuit design
    c. Problem solving
    d. Use of advisor
    e. Construction skills
4. Documentation
    a. Log book
    b. Schematics
    c. Manual

All recorded weekly grades will be made available to the participating faculty during the presentations.

Final Grades

The Final grade for each course will be awarded based upon the criteria established for the course listed in the course syllabus.

Team Building Skills	20%
Project Management Skills	20%
Design and Research Skills	20%
Documentation Skills	20%
Presentation Skills	20%
Fulfillment of the Contract	

Senior Projects Presentation Evaluation

	1	2	3	4	Grading %
Teamwork	Student did not participate as part of the team.	Student team participation was erratic.	Student fully participated in team activates.	Student encouraged teamwork and spearheaded part of the overall project.	20 %† (Team Building)
Organization	Faculty cannot understand presentation because there is no organization or sequence of information.	Student is difficult to follow because of erratic delivery of information.	Student presents information in a logical sequence that is easy to follow.	Student presents information in an interesting way that is easy to follow.	10 %† (Project Management)
Degree of Completion	Student does not have a schedule.	Student is behind schedule.	Student is on schedule.	Student is ahead of schedule.	10 %† (Project Management)
Subject Knowledge	Student is misinformed on the subject. Student answers questions about the subject incorrectly.	Student can answer basic questions about the subject but does not elaborate.	Student demonstrates a firm understanding and answers all questions.	Student demonstrates a mastery of knowledge and expounds on answers to all questions.	10 %† (Design and Research)
Technical Merit	Student did not use any knowledge gained though previous CEET department courses.	Student used the knowledge gained from one previous classes taught from the CEET department.	Student used the knowledge gained from two previous classes taught from the CEET department.	Student used the knowledge gained from three or more previous classes taught from the CEET department.	10 %† (Design and Research)
Grammar / Mechanics	Student has more than five spelling errors and grammatical errors throughout the presentation.	Student has three or four spelling errors or grammatical errors throughout the presentation.	Student has no more than two spelling errors or grammatical errors throughout the presentation.	Student has no spelling or grammatical errors.	5 %† (Documentation)

Graphics	Student did not incorporate figures, tables, schematics, or graphics into presentation and manual.	Student miss used graphics, inappropriately captioned them, or included non related information.	Student uses graphics that relate to the subject and to the text.	Student uses advanced graphics and/or other software package tools to enhance the presentation and manual.	5 %† (Documentation)
Log Book	No entrees	Incomplete	Complete	Detailed	5 %† (Documentation)
Manual	No entrees	Incomplete	Complete	Ready for submission to ERGO	5 %†† (Documentation)
Appearance	Personal appearance is inappropriate for the occasion and audience. (Tee shirt)	Personal appearance is somewhat inappropriate for the occasion and audience. (Business casual)	Personal appearance is appropriate for the occasion and audience. (Business attire)	Personal appearance is completely appropriate for the occasion and audience. (Sunday best)	5 %† (Presentation)
Preparedness	Student is not prepared to present.	Student is somewhat prepared, but not rehearsed.	Student is prepared, but could use more rehearsal.	Student is prepared and well rehearsed.	5 %† (Presentation)
Delivery	Student reads all information from electronic presentation or cue cards making no eye contact with audience.	Student frequently refers to electronic presentation or cue cards but makes some eye contact with audience.	Student refers to bullet items in the electronic presentation or cue card and maintains eye contact with audience.	Student rarely refers to the electronic presentation or cue card and maintains eye contact with audience.	5 %† (Presentation)
Elocution	Student speaks unclearly and incorrectly pronounces words.	Student speaks softly and pronounces most words correctly.	Student speaks clear and pronounces words correctly.	Student speaks clearly, projects, and pronounces words correctly.	5 %† (Presentation)
Demonstration (N/A for 4010)	No Demonstration	Partially functioning demonstration.	Fully functioning demonstration.	Fully functioning demonstration of all aspects of the project.	Pass or Fail *

† Exact percentage value may vary depending upon consensus of EET faculty
†† Completion of the manual is required to obtain a passing grade from CEET 4020
* Exact weight will vary between 0% and 50% to guarantee a passing grade for a completed project.

Presentation scores will be weighted by the applicable percentage and totaled, with the final course grade being awarded as:

A	3.7 to 4.0
A-	3.3 to 3.7
B+	3.0 to 3.3
B	2.7 to 3.0
B-	2.3 to 2.7
C+	2.0 to 2.3
C	1.7 to 2.0
C-	1.3 to 1.7
D	1.0 to 1.3
E	< 1.0

9.0 SPECIAL INTEREST ITEMS

The following items are of special interest to students:

- Students should not begin working on a senior project until their project has been approved with a completed contract. Project approval must be granted before officially registering for CEET 4010.
- Students earn individual grades for each senior projects class. Each grade, once earned, will not be changed because of changed circumstances or by a project that was not completed. For example, if a student fails to complete CEET 4020, they will not have to repeat CEET 4010.
- Incomplete, "I", will only be given to students because of illness or accidents. Procrastination or unforeseen design problems will not be rewarded by incomplete grades.
- Students who realize that they will not make the end of semester deadlines should withdraw from the course before the end of the seventh week.
- Students that realize that they will not make the end of semester deadlines after the seventh week of the semester will be given the grade that they have earned.
- Changes and improvements have been made because of feedback from students, faculty, and advisors.

10.0 TEMPLATES

Contract Template

<PROJECT TITLE> CONTRACT

TEAM MEMBERS NAME	ADDRESS	PHONE NUMBER
_____	_____	_____
_____	_____	_____
_____	_____	_____

TEAM ADVISOR	COMPANY	PHONE NUMBER
_____	_____	_____

PROJECT DESCRIPTION:

Paragraph 1: Define the problem to be solved and the theory behind the proposed solution for the problem.

Paragraph 2: Explain in detail the work to be performed in the development or prototype phase of the project. Identify exactly what product will be delivered at the conclusion of CEET 4010.

Paragraph 3: Explain in detail the work to be performed in the final phase of the project. Identify exactly what product will be delivered at the conclusion of CEET 4020.

Block Diagram / Flow Chart
Gantt Chart

COORDINATOR APPROVAL: DATE:

_____ _____

FACULTY APPROVAL: DATE:

_____ _____ (Rick Orr, ET Department Chair)
_____ _____ (Professor Julanne McCulley)
_____ _____ (Professor Christian Hearn)
_____ _____(Professor Michael Ballard)

Weekly Goal Template

Project Title: _____

Course: 4010 4020 Week: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Date completed form was submitted: _____

Goals and Accomplishment Criteria for Team Member #1_____:

This Weeks Goals	Last Week Goals Status (To be completed by Coordinator)
1	1
2	2
3	3
Estimated Time:	Total Time Spent:

Goals and Accomplishment Criteria for Team Member #2_____:

This Weeks Goals	Last Week Goals Status (To be completed by Coordinator)
1	1
2	2
3	3
Estimated Time:	Total Time Spent:

Goals and Accomplishment Criteria for Team Member #3_____:

This Weeks Goals	Last Week Goals Status (To be completed by Coordinator)
1	1
2	2
3	3
Estimated Time:	Total Time Spent:

End of Week Grade by the Senior Project Coordinator

Team Member #1 _____ Team Member #2 _____ Team Member #3 _____

Senior Project Presentation Evaluation Template

Student Name			
Teamwork			
Organization			
Degree of Completion			
Subject Knowledge			
Technical Merit			
Grammar/Mechanics			
Graphics			
Log Book			
Manual			
Appearance			
Preparedness			
Delivery			
Elocution			
Demonstration			

Notes:

Comments for Project Coordinator:

Comments for Students:

Electronic Engineering Technology

Student Data Sheet and Survey

(DO NOT include any student ID number or Social Security Number on this form.)

Last Name: _____

First Name: _____

Date: _____

Contact information for the semester:

Street Address: _____

City: _____

Home Phone: _____

Work Phone: _____

Cell Phone: _____

Email: _____

Major (check all that apply)

_____ AAS Electronics Engineering Technology

_____ BS Electronics Engineering Technology

The purpose of this survey is to obtain contact information for use in CEET 4010 and 4020. University databases often have incorrect and outdated information.