UNIVERSITY OF NOTRE DAME
DEPARTMENT OF AEROSPACE AND MECHANICAL ENGINEERING
AME40463: Senior Design Project

Fall 2006: Course Handout Package

The following information is provided for your review and personal files. It should provide a valuable resource throughout this course as it describes in detail the project and your responsibilities.

It includes:

Project management:

Project Coordinators:
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Technical Consultants:
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Mr. Richard Strebinger - Richard.B.Strebinger.1@nd.edu
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SECTION I
COURSE POLICY

This course represents the "capstone project" in your undergraduate mechanical engineering education. Your are asked to think of it as a professional experience and conduct yourself as if you had accepted a position in a company that is pursuing a new product development project. Your success and your group's success are closely linked in this course as is the case in the "real world". We hope that you benefit in many ways from this experience and we wish you the best in your new "job". You must also keep in mind that this is a “course” and thus will contain elements like homework and grades. You will find that since the project is “open-ended” you will have the opportunity to decide how much effort you wish to expend and have significant flexibility as to how you invest your time and energy. Keep in mind that, as in most cases, the benefits you gain from this course will most likely be in proportion to the effort you expend.

One other feature of this course, unlike most others that you have taken, is that not everyone will experience and learn the same things. Depending upon those parts of the project that you focus on, your learning experience will be different from others in your group. You will be asked to share your experiences with others in the class, so each can benefit from your efforts, but hopefully you will be given the chance to focus on issues and topics of interest to you.

What you accomplish in this course will be directly related to where you focus your attention and how much effort you expend. As you make those decisions, it may be useful to consider the desired learning outcomes as these are related to how you will be evaluated in the course. In much the same way that the instructor will set objectives for the course, you, as a student should set your own objectives for what you wish to accomplish. As each will have different experiences, it is useful to note the difference between the “outcomes” anticipated for individual students and design groups.

<u>Learning Outcomes for each student:</u>

1. Contribute to a group effort resulting in the design and fabrication of a technically sound and economically viable product.
2. Assume a major role in the design of some key technical feature, component or aspect of the product and be able to effectively communicate your contributions in oral, graphical and written form.
3. Demonstrate the effective use of appropriate analytic, numerical or experimental engineering methods in satisfying Outcome 2.

<u>Desired Outcomes for each group:</u>

1. Develop a concept for a product that has demonstrated market/societal value and in doing so interact directly with potential customers.
2. Develop a virtual model and prototype that effectively demonstrate key technical features of your product concept.
3. Develop a product that contains some form of embedded intelligence typically including sensors, actuators and controllers characteristic of modern mechanical systems.
4. Effectively describe the product concept in various media including technical reports, web-based media and oral presentations.

During the course considerable emphasis will be placed on innovative concepts and prototyping, but it is expected that key technical decisions related to the design of the product concept will be supported by sound engineering analysis. Balancing innovation and enthusiasm with the practical constraints imposed by limited time, skill, resources, facilities and technical support is critical in this course. The projects may also require “interactions” with many outside of the normal classroom environment and this is a key difference between this and many of your other engineering courses. Finally, this semester's project will require consideration of a number of factors and issues not considered in the past thus reference to recent reports or other documents should be done with care.

JOB DESCRIPTION (i.e. course requirements) - The new employees will be assigned to design/build groups each containing 4-6 engineers. Each design group will be responsible for the development of a product concept, preparation of appropriate documentation and fabrication of a prototype that should demonstrate the feasibility of the product's design. Each group member will contribute to the group effort as well as develop areas of individual specialization. In most cases, the prototype will be used to demonstrate the function, and other features you deem to be important, associated with your product - it is NOT the final version of the product that one would introduce into the marketplace but it should be used to **demonstrate the feasibility of key attributes of the proposed product**. Some of the subsystems for the prototype will be purchased from subcontractors (out-sourced) or provided by management and some will be fabricated by the design group.

This project provides you with the opportunity to apply the knowledge gained and skills developed throughout your academic career. It is a challenging project and in order to accomplish the project in the limited time available and the inflexible end-dates for the semester, there is a rigid schedule and various fixed milestones. There are a number of deliverable items due from individuals and from the design groups. Each "employee" should make every effort to satisfy all of these requirements in a timely manner as this is the best way to insure success in both the course and the project. This "job" will require at least 12 hrs. a week total commitment (5 hrs. in class and 7 hrs. outside of class) on your part so please try to plan your semester's activities accordingly. [**Please don't forget this is a 4-credit hour course**.] Consistent commitment of this time each week usually proves more effective than less effort for a few weeks and then excessive, burdensome and frustrating last minute efforts. There is no "right answer" in this project but considerable recognition is provided for "**doing things well**" and you will be "compensated" if your results "**work**." Each group will apply its own skills and energy to the problem at hand. Individually, and as a group, your results will depend upon your **abilities** as mechanical engineers and the **effort** you expend.

Much of the communication between engineers and "management" will take place via email. All students are strongly encouraged to check their email on a very regular basis.

DESIGN GROUPS: The organization of the group is the responsibility of the members of the group. One of the first tasks that the group has is to establish roles and responsibilities for each of its members. One potential organizational structure would require the group to select a Group Leader who will assume the responsibility for overall coordination, resource management and scheduling of the group's efforts. They could also appoint a Chief Engineer, responsible for the technical coordination of all the systems which make-up the design, a Prototype Supervisor who will coordinate the fabrication of the prototype and a CAD Coordinator who will be responsible for the development of the virtual model. Obviously each of these individuals will also have other engineering "discipline" responsibilities. There is no single best organizational structure and each project will be different. It is the responsibility of the entire group to insure an equitable distribution of work – and responsibility - within the group. Each major technical area/subsystem may have a single "lead" engineer but groups should be organized so that individuals are in multiple discipline-subsystem groups and can provide a check on technical data and decisions as well as a "backup" in case of any unforeseen absences during the semester. In the past some of the more frustrating situations have occurred when one person was given sole responsibility for an aspect of the project and for one reason or another failed to follow through on their responsibilities. Having a backup is important. **Please note: establishing a good group "dynamic" should be one of your most important goals in this course.**

COLLABORATIONS OUTSIDE AME40463: One feature of the course will be collaboration with individuals outside of the formal course. You will rely on graduate students and technical support staff for assistance with certain issues and you may also contact former instructors to assist as you become "experts" on a certain aspect of your design. You may also be required to deal with individuals outside of the University and all those dealing should be conducted in a professional manner as you will then be representing Notre Dame as well as yourself and your design group.

SALARY (i.e. grading): Your salary will be determined based on your performance and that of your group. The performance will be evaluated on both your individual achievements and those of your group.

a. Individual deliverables:
   Engineering study, engineering notebook, presentations, etc. 40%
b. Group deliverables:
   Product concept, prototype and presentation of results 60%

An individual's credit for group deliverables is determined using information from the peer reviews. Deadlines have been established for each of the deliverable items and must be strictly complied with. Failure to submit any of the required items may result in dismissal from your new job (i.e. an F in the course.) Additional details on how each of the required elements of the project will influence your "salary" are provided below.

Individual Deliverables: (40% of total)

Individual concept memo	5 %
Engineering analysis or trade study (proposal and report)	20 %
PDR/CDR presentations	5 %
Engineering notebook	10 %

Group Deliverables: (60% of total)

Design Concept Website (project formal documentation)	25 %
Virtual Model of Product	10 %
Prototype (performance and presentation)	20 %
CDR	5 %

Grading guidelines will be provided for major deliverable items and grades posted during the semester on WebCT.

AME40493 INC, DESIGN STUDIO MEETINGS (i.e. Class): The "normal" working day for AME40463, Inc. engineers is from 9:30 am – 12:15 pm each Tuesday and Thursday. During this time period presentations, special equipment training, consulting and other forms of interaction between team members, consultants, and middle and upper-level management will take place. All are strongly encouraged to be present from 9:30 am – 12:15 pm each regularly scheduled "work" day. Each Tuesday morning, at 9:30a.m. all engineers will attend a 15 minute coordination meeting in Rm. 129 DeBartolo. At the conclusion of that meeting selected individuals/groups will make PDR presentations to the entire AME40463 Inc, staff. The PDR's for the remaining groups will be scheduled between Tuesday and Thursday mornings and you will be provided with a schedule of presenters and times. During each week every design group will also be scheduled for an informal, 15-minute discussion session with one of the Project Coordinators. The schedule for those sessions will also be provided. It is each engineer's responsibility to know the time and location of all required meetings. The remaining studio time is to be used at your discretion. Time management may be one of the key skills you will need to develop and effective use of design studio times is key to success in this project.

VACATION POLICY (i.e. attendance) The engineers in AME40463 Inc. are allowed to work on a system of “flextime” and this organization is particularly generous in that it provides a very liberal vacation policy for new employees. There are three required "meetings" each week and during the duration of the project, each engineer is allowed to miss, without official University excuse, a total of 5 required meetings before they are separated from the organization (receive a grade of F in the course). The required meetings are: 1) all-class meeting at 9:30 a.m. each Tuesday, 2) your group’s weekly PDR presentation, 3) your group’s weekly informal discussion with a Project Coordinator. It is therefore important that you schedule any interviews, plant trips, weddings, parties or extended vacations with this policy in mind. One is also reminded that all the design project groups will assemble promptly at 9:30 a.m. each Tuesday in 129 DeBartolo and tardiness is **not** an acceptable professional practice. It is each engineer’s responsibility to make sure that your “attendance” at all the required meeting is recorded.

EMPLOYEE COMMUNICATIONS AND COMPUTER POLICY: You are encouraged to use the wide range of campus computer facilities available to you. You are responsible for developing and maintaining all of your own software and archiving your own information and data. Please respect software copyrights. There will also be a course folder on AFS and the course WWW site. Each group will have a “private” folder on this AFS site. Email will be used to provide notices to all class members or to answer questions. Engineers should regularly check their email. Limited PC’s will be available in B-19 (basic web access) and the ISALL for microprocessor programming and their use should be coordinated with other groups. No information should be stored permanently on these PCs. You are encouraged to use the Fitzpatrick clusters during the design studio period if necessary

DESIGN STUDIO POLICY: The AME UNDERGRADUATE DESIGN STUDIO, B-19, Fitzpatrick Hall will be available for your use whenever Fitzpatrick Hall is open. Each group will be allocated a “group workspace” which includes storage equipment, meeting area and fabrication space. The Studio also contains all of the fabrication equipment to be used in this project. This facility has been developed at considerable cost and it is the responsibility of every member of this class to make sure that the equipment in this facility are used for this course only and used in a safe and responsible fashion. You will have access to the Design Studio whenever the lower level of Fitzpatrick Hall is open. The room is equipped with a combination lock, please don’t provide the combination for this lock to students who are not in this course and do not “prop” the door open. Additional guidelines for the use of the Studio and schedules for availability of the prototype fabrication equipment will be provided during the course.

SPENDING, COST ACCOUNTING and EQUIPMENT ACCOUNTABILITY: Each group will be allocated up to $400 for development of their prototype. These funds can be used for raw materials and out-sourced components. A detailed list of expenditures and receipts must be maintained by the groups. Original itemized receipts (not credit card receipts) must be submitted for any purchases at the end of the project. The group can establish their own “petty cash fund” for use in copying, photograph and miscellaneous materials but this is limited to no more than $20 per person. Each group will have available for their use a number of pieces of equipment and tools. All of the issued equipment must be repackaged in the same manner as it was provided and returned in the same condition as issued for the group to receive their reimbursement. Any lost or damaged items will be deducted from your reimbursement.

PROTOTYPE CONSTRUCTION AND SAFETY: Selected machine tools in B-19 are available for your use at any time. The large lathe, band saw, vertical mill and grinder will be available for your use at limited times and may only be used under the direct supervision of appropriate personnel and only after you have been "certified" as a user for that particular piece of equipment. The 2-D CAD/CAM workcells will be available but permission to use this equipment must be granted by management and individual group members must also be "certified" in its operation. Management realizes that the fabrication facilities are limited but an important aspect of the project is **working with the constraints** placed upon an engineering group due to limited resources or facilities and proper planning and scheduling for fabrication. The prototype will contain parts from three sources: 1) provided by management, 2) purchased by group (out-sourced), 3) fabricated by the group. The total cost of all out-sourced parts and raw materials for all fabricated parts must be within the $400. budget limit. Approval for use of any other materials, or equipment must be requested from management. Meeting cost requirements is a very important feature of the prototype development phase of the project. Note that the prototype, as well as all other equipment or supplies purchased from the resources provided by management, remain the property of the University of Notre Dame. Safety glasses **MUST** be worn whenever operating any of the equipment in B19. You must also wear hard-soled, closed shoes (i.e. no sandals, etc.) and appropriate clothing. You must clean up the work area after using any of this equipment. **Unauthorized use of any of the equipment or facilities or violation of these safety regulations is the surest route to dismissal from this new job**. Your safety is the primary consideration.

INTELLIGENT SYSTEMS AND AUTOMATION LEARNING LAB POLICY: ISALL is located in room 358C of Fitzpatrick Hall, and is open Monday-Friday from 8:00 to 4:30. You may work in ISALL any time during these hours, but be advised that technical support staff is available only during regularly scheduled class hours on Tuesday and Thursday and at certain other specific times, which will be posted on the lab door. Keep in mind that there may be other scheduled activities taking place there so you will need to work around those activities with minimal disruption. ISALL is managed by Mr. Brownell, who provides electronic technical support and consultation. Several scheduled workshops have been planned for group members involved in the electronic design and fabrication, the times to be announced. Design groups are encouraged to attend these workshops for their own benefit. Desktop computers in ISALL are provided for programming purposes only, and do not have CAD, MS Office or other software applications installed, but are networked for portability of your work. When working on electronic development in ISALL, please bring the electronic tool set that is issued to your group. Some materials may be stored securely in lockers in ISALL if you do not require access to them after normal working hours. Test and measurement equipment is provided for any electronic need, but you do need permission and you may need instruction in its operation prior to using it. In addition, certain wiring supplies are available for your use, such as connectors, terminals, wire and splicing materials, as well as some "generic" components like resistors and capacitors. Other surplus components such as motors and controllers, rechargeable batteries and chargers, power supplies, sensors, etc. are also available for purchase at a reduced price, or in some cases may be checked out and returned if in good condition. A partial list of these surplus components can be found on the web at www.nd.edu/~isall/. No food or drink is permitted in ISALL, due to the presence of sensitive electronic equipment the use of some hazardous substances, such as lead-based solder. Please observe proper laboratory protocol when working in ISALL.

AME MACHINE SHOP POLICY: The AME machine shop will be available to provide limited support to your group – but the key word is "limited". Mr. Hluchota, the AME Tool and Die maker, will be available for approximately ½ hour for consultation during the weekly design studio sessions. Mr. Hluchota will post his available times. Students are not allowed to use equipment in the AME Cushing shop at any time though Mr. Hluchota may assist you by performing special tasks if time and resources are available. Mr. Hluchota will also support the manual machining equipment in the design studio thus if you encounter any problems with the equipment, please inform Mr. Hluchota.

RAPID PROTOTYING EQUIPMENT POLICY: Limited rapid prototyping capabilities are available to support the development of design prototypes. The suitability, availability and cost associated with the use of any of the AME rapid prototyping equipment must be approved, in writing, by Mr. Richard Strebinger. If your group would like to consider the use of any of the rapid prototyping capabilities (note this does not include the CAM workcells in the Design Studio that are student operated) you will need to make an appointment to discuss the suitability of your plans with Mr. Strebinger. Do not assume this equipment will be available and please do not wait until the "last minute" if you wish to consider this option. Costs associated with using this equipment are part of your overall prototype development costs.

CODE OF HONOR POLICY: All work submitted in this course must be the work of the student or students submitting the work. Students should be careful to properly cite the sources of ideas and other information that they submit if they are not their own. Because of the "creative" nature of the projects, it is imperative that proper credit be given to the sources of the intellectual property. Obviously collaboration and group effort are key to success in the course, but there are various items (e.g. engineering notebook, individual feasibility study, etc.) that must be the work of the individual engineer and submitted information must be the student's own or carry citations to the source. If you have any questions about the appropriateness of a collaboration or citation for an information source, ask prior to submitting the work.

SECTION II:
REQUEST FOR DESIGN CONCEPTS

PROJECT OPPORTUNITIES:

Students will be assigned to project groups and each group will be assigned one of the following projects.

1. ASME design contest:

This project is based upon the guidelines provided by the ASME for their 2007 design competition.
http://www.asme.org/Communities/Students/2007_Design_Problem.cfm
Additional product deliverables from those defined by the ASME, comparable to the other AME40463 projects, will be required to complete the course requirements for AME40463. Groups who participate in this project agree to develop designs that will qualify them for participation in the ASME contest in the Spring 2007 - if their design warrants participation. (There will be only 4 students in each of these groups in compliance with ASME guidelines.)

2. Basic Ambulatory Assistance System (BAAS):

This project involves the development of a product that will assist movement from place to place (replacing normal walking) for a nominally healthy person who has sustained a leg, knee, ankle, or foot injury. The target customers might be a college student who has sustained an athletic injury that will incapacitate them for a relatively short period of time. The product will assist the person's walking or movement within the dorm, on campus and in classroom buildings. It ideally includes some level of automation that interacts with the "user." Low cost, flexibility, all-weather usage should be important considerations. Ideally this product is more sophisticated than crutches; more adaptable than a wheel chair; and more compact and significantly less expensive than a golf cart and can allow independent use by the injured person.

3. Circuit board assembly, solder and test system: (CBAST)

This product falls in the broad category of automated fabrication and robotic-enhanced devices. The team will be provided with: 1) a sample "complete" circuit board, 2) a sample circuit board that represents the "before" state of the completed circuit board, 3) a specific component (a resistor) and "cartridge" used to position this specific component within the device. This component must be automatically taken from the cartridge and positioned on the circuit board and soldered in place. The design team will develop a device into which a user can manually place the incomplete circuit board and manually attach the test leads. The device will then automatically retrieve the necessary component from the cartridge and properly position it on the board. The device will then automatically solder the component in-place using conventional electric-resistance-heated soldering equipment and then test the integrity of the final "assembled" circuit board and display the state of the assembled circuit board to the user.

4. Innovative musical instrument (IMI)

This project will allow the teams to be very creative and can possibly result in a concept that has market value. The groups will be tasked with developing a new and unique musical instrument that incorporates multiple traditional tone/note sources (i.e. percussion, string, woodwind, or brasswind) into a single instrument. The instrument should be able to be played BOTH manually or in an automated fashion (e.g. player piano).

Each project group is required to meet the following project requirements.

PROJECT REQUIREMENTS: Each design group must:

1. Develop the conceptual design for product and develop effective documentation to communicate the purpose, form, function and feasibility of the product. The design must be based upon sound engineering modeling, analysis, simulation and prototyping. The documentation should include engineering justification for the product and address issues related to market viability, performance, manufacturing and assembly and all documentation must be able to be distributed in a digital format.
2. Present the results of this concept development project in a formal Concept Design Review at the conclusion of the project.
3. Fabricate a "proof-of-feasibility" prototype for the proposed concept. The prototype should be capable of demonstrating key capabilities of the product. The prototype may also be used to demonstrate selected features of the assembly, operation, or packaging of the proposed product but it need not be a fully-functioning replica of the final product. Each group will be required to develop a detail set of prototype performance requirements and the success of the prototype will be measured against these requirements.
4. Develop a complete virtual model (ProE complete assembly, subassemblies and components) of the proposed product.
5. Include in the product in a significant and effective manner some element of embedded intelligence. Though it is not a sufficient requirement, this feature is necessary for your group to receive an "A" level grade for your design for the concept.
6. Follow established procedures for collecting and reporting time spent on the project, maintain and return all issued equipment, follow safety guidelines and submit cost accounting records for the entire project.

SPECIAL CONSIDERATIONS FOR THE PROOF-OF-CONCEPT PROTOTYPE

The proof-of-concept demonstration should satisfy the following:

1. Total design project costs cannot exceed the total of the $400 provided by ME40463, Inc. and up to $20 per engineer that can be collected from the members of the design group. The total cost includes all out-sourced parts, raw materials, tools, administrative costs (copying, etc.) and supplies (glue, wire, etc.). All administrative cost must be covered by the group's individual contributions.

2. Component parts can be either fabricated in-house or purchased from outside vendors (out-sourced). All out-sourced parts must be accounted for in the overall cost at their full retail value. Groups cannot "out-source" component fabrication processes without expressed written approval of management.

3. All "in-house" parts must be fabricated by the design group using the facilities provided in B19, Fitzpatrick Hall or by special arrangement groups may use other University facilities such as the rapid prototyping CAM equipment.

4. The completed prototype and all "scrap" materials are the property of the AME department.

5. The prototype should be suitable for display and presentations to the public or other interested parties.

6. Issues related to product safety and environmental impact must be considered and demonstrated in the design and documentation.

SECTION III.
PROJECT SCHEDULE AND PRIMARY MILESTONES

Project Schedule - Primary Milestones

22 Aug	Initial meeting, project overview
24 Aug	Individual concept memo and sketches due, Project groups assigned
29 Aug	Initial group Task Tracking Summary (TTS) due
5 Sept	Preliminary Design Reviews (PDRs) begin
19 Sept	Group preliminary concept completed , Preliminary www site posted Individual engineering feasibility/trade study proposal due
12 Oct	Individual engineering feasibility/trade study due
31 Oct	Prototype performance requirements due
16 Nov	Concept design documentation draft (CD submission) Virtual model completed
21 Nov	"In-house" prototype demonstration
28 Nov	Concept Design Review presentation - In-house review and grading
30 Nov	Concept Design Review presentation to external review panel Engineering notebook submission
5 Dec	Final design documentation (CD) submission, peer reviews, studio check-out

Details on Deliverable Items:

Individual Deliverable Items: (**All Items must be submitted in order to receive a course grade**)

1. Due 24 Aug: Individual Product Concept Memo - A document that provides each engineer's individual "idea" for a proposed product. The first page (typed) should include an explicit statement of the target market and other pertinent product design requirements, and a brief written description of the concept including a description of the "intelligent" capabilities it should posses. There should be at least one additional page (**must be hand-drawn and hand-labeled**) should include multiple sketches of the product, or elements of the product to assist in understanding its basic operation and "form." Each engineer should prepare multiple copies of the complete document (one for management and one for each of the other members of their design group.) Make sure you make a copy for yourself. (Hardcopy, non-electronic submission.)

2. Due 5 Sept: Preliminary Design Reviews - One member of each group will make a formal oral presentation providing an "update" on the development of the product concept. This is a graded event and a

grading rubric for the presentation will be provided. Each group member will make this presentation at least twice during the semester. Dates will be assigned by Management but "date-trades" with Management's prior approval will be possible. Beginning on 5 Sept. a member of a number of groups will make this presentation to the entire class during the all-class meeting on Tuesday. Presentation schedules will be posted on-line.

3. Due 19 Sept: Individual Engineering Feasibility Study Proposal - Details provided later in this handout. (Hardcopy, non-electronic submission.)

4. Due 12 Oct: Individual Engineering Feasibility/Trade Study - This is an important source for the quantitative justification for the decisions made during the design process and demonstrates the individual engineer's ability to develop and use analytic or numerical models and to provide quantitative justification for design decisions. The results must be based upon appropriate engineering modeling and analysis. Details provided later in this handout. (Hardcopy, non-electronic submission.)

5. Due 30 Nov: Individual Engineering Design Notebook - Each group member will submit their handwritten engineering notebook for final review and evaluation. Details on the notebook are provided later in this handout. These notebooks will be briefly reviewed and ratings provided periodically during design studio sessions. Each engineer must bring their notebook to every studio session and it should be available for evaluation at anytime during those sessions. (Hardcopy, non-electronic submission.)

6. Due 5 Dec: Individual Peer - Management will provide a form that each group member will complete. A sample of this form is included in this package. Careful review of this form at the beginning of the semester may assist you in understanding the important issues that will be used by your peers to evaluate your performance during the project. You will be expected to provide quantitative and qualitative assessments of the contributions of each of the members of your group. In order to receive your grade in this course, you must submit this document by the required due date. (Hardcopy, non-electronic submission – form provided.)

Design Group Deliverable Items:

1. Weekly Due Dates: Group WWW site - Each group will develop and regularly update a group web site. The site, as minimum, will include:

- Group name
- Group members and contact information
- Project design goals and project concept
- Weekly Preliminary Design Reviews
- Weekly Task Tracking Summaries and Project Budget information
- Other information deemed appropriate by the group to document their design and its evolution

This site should provide the basis for the formal, web-based documentation of this product development project. The web site should be suitable for public viewing on 19 Sept. Great care should be exercised to make sure the site and any links are professional in content and presentation. (Electronic submission)

2. Due 29 Aug: Weekly Group Task Tracking Summary (TTS) which details individual task-based time resource allocation for work conducted up to and including the beginning of the all-groups meeting each Tuesday. This information will then be due every Tuesday for the remainder of the semester. Each group will develop their own collection procedure and this information will be included, and updated weekly, on the group's web site. (Electronic submission)

3. Due 19 Sept: Group Concept Selection Memo and Presentation - Each design group will develop a brief report (no more than 2 pages of typed "body" with appropriate attachments) in the form of an internal memo that describes the product concept they will pursue for the remainder of the project. The report should detail key technical issues that they intend to address during the feasibility studies as well as a schedule of key deliverable items or milestones for the remainder of the project. The attachments should also include a description of any "collaboration" they have developed with consultants, customers, etc. and the manner in which those collaborations will be used during the design process. This memo must be posted in a prominent manner on the group's web site. Each group will then make a 5-minute "presentation" to highlight their proposed design concept and to list the key technical challenges they anticipate in its development. This will be the PDR for this week. This series of presentations will take place during the Tuesday, all-class meeting and all engineers are required to attend all the group presentations. This will serve as this week's PDR. (Electronic submission)

4. Due 31 Oct: Prototype Performance Requirements - Each group is responsible for developing the performance requirements and "grading rubric" that will be used to evaluate the success of their prototype. (Electronic submission – posted on www site.)

5. Due 16 Nov: Design Concept Documentation (draft) – See Section IV of this handout for details. This will be developed and submitted in digital format. The major component of the group "grade" on this project documentation is associated with the version submitted on this date. The group may be required to make certain changes in the final submission but the "Draft" should be their best effort and it is the most important deliverable item in the course. Ideally no changes to the Draft would be needed prior to submission of the Final version of this documentation. This submission should include the completed "virtual model" of the design concept. (Electronic submission on a CD)

6. Due 21 Nov: In-house Prototype Demonstration - Each group will demonstrate the operation of their completed prototype. The prototype and its performance will be evaluated against the performance criteria provided by the design group.

7. Due 28 Nov: CDR In-house presentation– Each group should be prepared to make their CDR presentation to an in-house reviewer. This should be the complete and final version of the presentation (i.e. all visual aids must be completed at this time) and this will be a graded event and represent 75% of the CDR evaluation. The presentation must include quantitative engineering justification for the proposed concept. This is an "engineering" presentations, not a marketing pitch. It is emphasized that the CDR must demonstrate the quantitative engineering modeling and analysis used to support the critical design decisions. A demonstration (real or virtual) of the prototype should take place during this presentation. All group members are expected to participate in the CDR.

8. Due 30 Nov: Concept Design Review (CDR) and Prototype Demonstration - This 20 minute, formal oral presentation to an industrial review panel will be scheduled on this date. The time and location for these presentation is TBD and depends upon the availability of the guests.

9. Due 5 Dec.: Final Design Documentation - It should contain all changes, as identified by management, from the draft submission. It should also contain the group's Concept Design Review presentation visual materials. (Electronic submission on a CD)

Group Formal Presentation Schedule:

Weekly Preliminary Design Reviews: (see below)

19 Sept Project Concept Overview: A 5-minute presentation to the entire organization. The group is limited to 2 viewgraphs for this presentation. (Due to time limitations, these visual aids should be "printed" for presentation on a standard overhead projector – not computer projection.)

30 Nov Concept Design Review: A 20-minute formal, presentation to invited, external reviewers followed by a period for questions and discussion.

Weekly Preliminary Design Review (PDR):

Each week one member of the group will prepare a seven-minute formal, oral presentation that will highlight the status of the "product" being developed. Each week the presentation will be "graded" and must contain the following elements:

1. Current graphic to illustrate the design and a brief update on the status of the design.
2. The results of the action taken in response to the previous week's action items (obviously this information will not be required the first week!)
3. List of 3 topics that represent key engineering challenges and the action that will be taken to address them during the next week.
4. This presentation must be suitable for posting on the group's www site.

ENGINEERING FEASIBILITY STUDY REPORTING REQUIREMENTS

This engineering feasibility study will be the major individual deliverable. The actual study will be preceded by the submission of a brief proposal that is intended to assist the engineer in planning this key element of the project. Note this study must produce **quantitative** information that should be used in assessing the feasibility or important characteristics of the proposed concept. Think "trade study!"

Proposal (due 19 Sept)

The proposal is a one-page-maximum typed, document that should include:

1. Statement of the purpose/goals of the study.
2. Description of the engineering analysis or simulation tools to be used in the study.
3. Information that you will develop as a result of the study
4. Decisions that the study is expect to influence.
5. Task schedule for the study (key milestones)

Report (due 12 Oct):

The study report itself will contain the following readily identifiable items.

1. Statement of the purpose/goals of the study.
2. Detailed description of the information gathered, tests conducted, engineering analysis performed or simulation tools used with particular emphasis on the assumptions associated with them and their limitations.
3. Presentation of the results of the study - graphical results are preferred but tables or charts are acceptable if they adequately represent the results.
4. Discussion of the interpretation of the results of the study.
5. Brief discussion of the impact of the study on the design.

The basic format for the presentation of the trade study is up to each engineer. A technical memo format might be ideal. The entire report should not exceed 7 pages(12 pt font, double space). If a trade study involves hardware development or testing, the engineer should discuss with management an appropriate format for presenting their results.

ACTIVITIES AND DELIVERABLES ON THE LAST CLASS DAY – 5 Dec:

This project has many facets that require planning and coordination and differ from a traditional course. Every effort is made to make sure that all course requirements are completed by the last day of class to assist the engineering in scheduling activities associated with other courses.

1. Each design group should submit a document that includes a list of all expenses associated with the development of their prototype. The list should detail all the items purchased and the associated cost. You will also need to provide original receipts for each purchase (not credit card charge receipts but store itemized receipts) if you wish to be reimbursed for the purchase. You also must indicate the NAME and local address for the one member of the group who will receive the reimbursement. That person will then be responsible for distributing the funds to the individual members of the group. The reimbursement will be deposited into the University account of the responsible individual. The maximum amount that will be reimbursed will be $400. less any deductions due to damaged or lost equipment. If you do not submit this information on this date, your group will not receive a reimbursement and thus bear this cost yourself.

2. Each group should submit the final version of their design documentation on a single CD.

3. Each individual should submit, in a sealed envelop, the peer review form distributed during the last week of class.

4. All personal equipment, supplies, books, tools, etc. must be removed from the design studio by the end of the studio session. Each of the groups must return all equipment that was issued to them, their prototype and any surplus materials purchased by University funds. Any personal items left in the design studio after this date will be disposed of.

5. Each member of the group will assist in the “clean up” of BOTH group and common work areas. The room must be in the same condition, when you leave on this last class day, as it was when you entered on the first day of the project.

SECTION IV: DESIGN CONCEPT DOCUMENTATION REQUIREMENTS

The overall format of the design documentation is left to the discretion of the design group - designing an effective framework to present your product is an important part of the project. The internet has become an important engineering "tool" as it allows organizations to work across continents and time zones as well as it provides a means of communication with almost unlimited potential. To provide you with some experience in using the internet as the media for documentation of this project, each group will develop a web site that meets the requirements defined by the ASME Design Engineering Division (DED) Design Education Committee's Young Design Engineer's Project Competition.

http://divisions.asme.org/ded/educomm/YEDPC.html

Each group will be required to develop all 6 elements described by the ASME. The scope and detail provided by the "optional" items, 3 – 6, will obviously influence the effectiveness of the documentation and the evaluation of the group's efforts. Particular care must be taken to comply with all appropriate ethical and copyright issues in the preparation of this site. Both a draft (due Nov. 16) and a final version (due Dec. 5) must also be submitted on a single CD. It is the CD version that will be graded by management, but the web version that will be evaluated by the other engineers. Every effort should be made to make sure the framework/software/etc. you use to develop your website is compatible to both formats (CD and web) and you test this very early in the development of your documentation.

The overall content of the design documentation is left to the discretion of the design group but you will be provided a copy of the grading rubric that will be used to evaluate the sites and it should provide an indication of expected contact and the relative importance of each element. For this particular project its purpose is to document the current status of the product, provide quantitative engineering justification for the decisions made to date and highlight potential strengths and weaknesses. It should be technically correct, concise, comprehensive and consistent. Effort will be required in the review and editing of text and other content by all members of the group in order to produce acceptable documentation.

It is anticipated that this digital documentation will be submitted to the ASME if they reinstitute their competition.

SECTION V:
ENGINEERING NOTEBOOK

This will be an important individual deliverable item. It represents a continuous "diary" of your activities on this project. This should be a hardbound notebook (permanent or spiral bound but NOT snap-ring binders). The purpose of an engineering notebook is to document the development of this product from your perspective and to help you record your activities, contributions and rationale for the decisions that you have made.

You should include on each page of the notebook the date/time of all entries. The book should document any thoughts or ideas you or your group-mates develop. This is the type of information that may prove vital in a patent application development. The notebook may include items such written text, sketches, flowcharts, timetables, vendors, part numbers, or any other useful information that you think should be included. These notebooks are frequently used to date when inventions were conceived. You may tape information onto pages within the book, but the contents of the book must not fall out. You may fill more than one book and they should be numbered sequentially. You do not need to "tape" into the notebook information that has been recorded or "published" in other forms such as the individual concept study or engineering feasibility study. This book should represent the "notes" used to develop those studies. **These notebooks will be graded, and will provide an important measure of your individual contribution to this group project.**

The following information has been adapted from a handout provided by Dr. G. Bernstein, Dept. of Electrical Engineering. The use of engineering notebooks is somewhat "universal" across engineering disciplines and a good habit to develop early in your career.

Why a notebook?

Provide a useful record for yourself and your co-workers and protection and documentation in the patent process

What goes in a notebook?

Anything you think will be of value. Ideas and thoughts related to the product or the project, preliminary calculations, notes from group meetings, notes from phone conversations (vendors, etc.) along with name and numbers, notes from your review of article and books, "taped in" emails, letters, "napkins with scribbles", etc.

Some formatting suggestions:

Sign (bottom of page) and date (top of page) each page as you complete it
Adequate size to allow you to staple or tape in other information
All entries in pen only
No blank pages and any large blank areas crossed-out
Written legibly - if it can't be read, it's useless (also will result in a poor grade!)

" I just wanted to drop you a line and let you know … that I can now appreciate what you guys were trying to get us to accomplish over the course of the semester. I ended up getting a job at Rolls-Royce as a design engineer. The very first day on the job, I was actually handed an engineering notebook pretty similar to the one I used in senior design, and I use it everyday." - from an email from a recent AME grad.

SECTION VI:
COMMENTS FROM PREVIOUS STUDENTS

At the end of each semester students are asked to provide comments for future projects as part of their peer review and course evaluation. The following are some of their comments that may prove helpful as you participate in this project. They are not listed in any special order but address many aspects of this course and project.

- Do Pro-E drawings as soon as possible, so you can figure out integration of parts.
- The best course of action is to plan everything out with great detail. Detail on the Pro E drawings will greatly improve assembly time, as well as reduce the number of mistakes.
- Build a strong group dynamic from the start, this way communication will improve and ideas will come across and be received better.
- Start and finish one thing, document it well in a design notebook - random numbers mean little without written support. Simplify the problem as much as possible.
- Make your group deadlines fairly and stick to them. Barely anything that you throw together last minute is going to work. Make every decision with simplicity in mind.
- Talk to your peers and professors. You can learn much more from a simple conversation than you can from reading a 400 page textbook.
- Make everyone on your group feel important. Everyone has something important to contribute, no matter how minor it may seem.
- Be a Group Player. Remember that this is a GROUP project and that you are a member of a group. Sometimes you have to sacrifice your own goals for the success of the group's goals.
- I'd recommend constantly checking the work others are doing. KEEP IT SIMPLE.
- Get a plan and stick with it. Order parts ASAP. Some take months to get.
- Really think about every decision. Ask yourself 1,000 times why you are choosing A over B.
- Don't assume black always goes to black and red to red!!
- Work as a group and develop good group dynamics early in the semester. It will make the project so much smoother.
- Time management is key. Do not procrastinate. If you think of something that needs to be done, do it immediately. In this way you should not have to pull any all-nighters at all. It is not an impossible project. Just plan ahead and learn to cross the hurdles as they come up.
- Remain open to new ideas and listen to what other people are trying to say.
- When choosing the Group Leader, choose someone who you know can do it - not someone who wants to see if they can.
- Have fun. This class is a lot of work, but it doesn't have to be stressful. Having fun makes all the work easier.
- 1) Have fun. 2) Learn from the experience. 3) Take advantage of the opportunity. 4) Be daring in the design. 5) Make your life easy by keeping it simple (yet fun).
- Find as much info about “out-sourced” components, materials, kits, etc. that are available as soon as possible so that you can decide what ideas are feasible.
- Don't make up numbers just to meet deadlines - they will come back to haunt you.

SECTION VII:
FAQ's

This course experience is unlike most that you have encountered in the past. As you work through this project you may wonder why the course is structured as it is. To help you better prepare for this project and understand the rationale associated with many of the activities in the course, you should review the following. If you have other questions about the project, or want more details on the answers provided below, please ask. Please note, certain elements of the course change each semester so direct comparison with past semesters is cautioned.

How does this course fit into the overall ME curriculum?

It is an opportunity to tie together much of the knowledge and experiences gained in many other courses and to apply that knowledge to the design of an engineering system. There is no new technical information formally presented in this course, though each of you will learn many different things depending upon what aspects of the project you are involved with. *Everyone in the course has a different experience* and learns different things, depending upon your level of involvement, interests and background. There are many ways that you can tailor this course to your own interests and goals.

Why the different kinds of project?

The time you devote, the support resources and your engineering experience limit the scope of the project that can be accomplished in a single semester. The projects and the schedule have been selected to be consistent with the 14 week semester and a 4-credit hour course. Every effort has been made to present these projects in a fashion consistent with industry practice. Once the general framework is established, it is ideal if each student can identify a product or part of a project that stimulates their interests and can best prepare them for the kinds of things they may encounter in the future.

Why are there so many different kinds of "deliverables"?

The project involves the kinds of activities you will encounter in an actual product development effort. Each deliverable is intended to provide you with an intermediate goal and useful information as you proceed through the project. Every activity should build upon information or decisions associated with previous activities. The key deliverables are the engineering feasibility studies, the concept web-based documentation, the prototype and the concept design review presentation.

What is the most important thing I should gain from this course?

You should improve your ability to make, communicate and justify "engineering" decisions. Following very closely behind that - you should improve your ability to work as part of a project group in developing a product with severe time constraints and limited resources.

Why don't you tell us exactly what kind of product to design?

This course often requires the students to select the basic objectives for the project they select. It is hoped that you have given some thought to the project and you selected a project that does engage your interests. By dealing with "collaborators" outside of the course, you will get some experience in working with potential customers. Engineers do not work in a vacuum and developing some experience with the early stages of the product design process is important.

Why do we each have to propose a concept if we are only going to design a few?

If each individual brings an independently developed idea to the table as the group begins its development of a concept, then there is a greater potential of a group identifying good ideas that are synthesized from the individual concepts. If a group sits down and discusses "ideas" before the individuals can develop some ideas on their own, you may limit the scope and diversity of your potential concept. No initial ideas are "bad", some under further review may prove impractical but often it is the combination of features from different ideas that prove most successful.

Why is the schedule so rigid?

To accomplish all the things necessary to complete the major deliverables within one semester, we need to set certain milestones along the way. The milestones (along with the academic calendar) define the project schedule. By reviewing the project schedule you will see that you don't have much time to complete many of the tasks in the project. No one expects that each of the tasks will be completed "perfectly" and in all cases it is understood that if you had more time, you could have done more. **Keep reminding yourself that you are trying to develop and validate a "concept" for this product not a detailed, final engineering solution that would be ready to go into production.** Another realistic aspect of the simulation is that just like in the real world, you will never have enough time to be absolutely satisfied with the product you produce.

Why is the course scheduled as it is?

There are a certain number of hours each week when the group must be together to communicate, share ideas, solve problems and review progress, thus the design studio periods each week have been set aside to assist you in finding a time when all the group can be together and your "consultants" are available. Much of your detailed engineering will also be done in subgroups so you can have a system of checks and balances and with your very different schedules, finding convenient group meeting times is almost impossible. The five-plus hours you have scheduled each week, <u>if used effectively</u>, should reduce the need for additional group meetings outside of class. Some of the concerns related to this project taking too much time are often directly related to an inefficient use of the studio time. The "flextime" policy gives you some discretion as to how best to use your time.

Why can't we pick our own design groups?

You may be able to select the company you will work for but until you are the boss you will rarely be able to select all of your colleagues. Learning to communicate and work with people who you don't know is an important attribute that you will want to develop. Every attempt will be made to assign the groups so that individuals can pursue topics of interest to them.

What happens if I don't like some of the members of my group?

See the answer to the question above. You will need to separate you personal opinions from your professional behavior. Understand that all students have different goals and personalities and that you may learn more about yourself as you deal with others. Developing good people skills as well as tolerance and understanding will be worth the effort.

What happens if we really have a problem with someone on the group?

See management before a small issue creates problems that will be hard to overcome. Keep in mind that everyone is under considerable stress and subjected to very demanding workloads. Try to deal with internal differences as professional a manner as you can but if you feel that you are unable to, see your instructor and all discussions will be kept in the strictest confidence.

Why all the emphasis on the engineering feasibility/trade studies?

This element of the project (though it takes on different names) is fundamental to the process that engineers use to assist in making and justifying engineering decisions. Often you will have to “estimate” or even “guess” in order to make some of the decisions required during this project. Some decisions will be based upon your experiences or the experiences of others but some must come from, and be substantiated by, engineering modeling, analysis and simulation. That is part of what makes engineers different from “hobbyists” who work in their garages. Your group will only have time to study a very small number of areas so part of the challenge is to identify those areas where your efforts will have the highest payoff or reduce critical risk factors associated with your concept. After you leave here you will find people will require you to justify your decisions and this will help you figure out how that’s done.

Why do we need to write a proposal for the engineering feasibility study?

This will help you and management determine if you have selected a reasonable topic for your study. Since this study is a key element in your grade, and for one of the few times in your academic career you get to “ask the question” that you will eventually need to answer, you want to be very careful not to attempt an ill-posed study or one that is too difficult to accomplish in the time allotted or one that will not effectively influence the design of your product. The proposal is part of the overall project planning process and will help the group determine how its “people” resources are being used. Remember bad proposals usually create problems for you and your group and inadequate forethought usually leads to bad proposals.

Why do we have to keep a formal engineering notebook?

The process of documenting your engineering activities in the form of a notebook or journal is used (required) in many organizations. The notebook will help you keep track of who’s doing what, when to meet again, what you are responsible for, why you made a particular decision weeks earlier, etc. Developing some experience and good work habits in this area will prove useful for years to come.

Why is this course only one semester long?

We could extend the projects for two semesters, or more, but there are so many other issues related to your academic schedules that this would create many additional problems. This question is often the result of students concerned about how the final prototype functions and their concern is that if they had more time, they could get more done, and they would be sure it would work. Though certain measures of success in the course dependent upon the performance of the prototype, it is not an over-riding issue and actually, you get to define your expectations for the prototype and work to achieve them. Real success depends upon your ability to achieve progress in the major learning objectives of being able to make and justify engineering decisions and being able to work as part of a project group. It doesn’t take two semesters to achieve those goals.

Why does this course take up more time than some of my other courses?

It is a 4-credit hour course and represents the capstone experience in your undergraduate program. Due to the very “open ended” nature of the projects - there is no right answer - and thus a tendency on the part of the students not to know how “to start” or when “to quit.” Also due to the lack of experience in projects of this scope, often students don’t plan their time effectively and leave certain decisions and activities until the last minute. One of the biggest sources of problems in this area comes from an individual or group not devoting adequate time to the early phases of the project. If you make a somewhat arbitrary, and often last minute, decision early in the project you can end up creating problems later on that could have been avoided. The expectation is that you devote consistent and reasonable effort to the project and present the results achieved. Not every group will achieve the same level of success with the same level of effort and this should be recognized. Individually you need to decide how much effort you want to expend and then communicate that to your group. Don't assume responsibilities or make commitments that you cannot satisfy.

Why the emphasis on "smart" products?

Potential projects are judged on a variety of characteristics. In the last few years it has been one of the course goals to provide projects that have embedded "intelligence" and a certain degree of autonomous operation. The importance of embedded controllers and "smart" systems in mechanical engineering is growing and we hope to reflect that in our projects. This year most of the projects also attempt to introduce you to various issues that occur early in the design process and allow you to exercise a higher degree of innovation.

We don't have to manufacture the actual product so should we be concerned with issues related to manufacturing and assembly?

Very definitely. You will not carry this project on into the detailed design and manufacturing stages but you must consider those issues in your design. You will most likely need to include issues related to materials selection, materials processing, and assembly. The feasibility of the overall product can be correlated to the functional behavior of the prototype - if it doesn't demonstrate what you set out do demonstrate, how can one effectively judge the proposed product. The level of detail that you can provide in each of these areas depends upon your concept, experience, knowledge and where you place emphasis in the project.

What is the purpose of the Peer Review?

Throughout your career you will be evaluated on a variety of skills and attributes - many of these assessments will be very qualitative. You will also be required to make objective assessments of peers and subordinates. The peer review - particularly if you think a bit about it as the semester progresses - will also begin to help you understand how others may view your performance as an engineer. Do you listen, how effectively do you meet deadlines and communicate your ideas to others, etc. Just as you will review others, you will be reviewed and that is something to keep in mind. Lastly, upper management uses this information to decide how to fairly distribute credit for the collective accomplishments of the group.

What role will CAD software like ProE play in this semester's project?

The digital (virtual) representation of the group's concept may be one of the most important engineering "tools" available to you to evaluate important aspects of your design. Since you will most likely need to fabricate selected parts of your product and you will definitely need to develop visual representations of the concepts, ProE will be vital. Remember if it won't "fit together" in ProE, you can be pretty sure it won't fit together when you make/buy the parts. Though ProE will not guarantee performance, it will help determine feasibility and help you communicate your ideas.

When can we begin the prototyping process?

This is not a "cut-and-try" engineering project but at this very early stage in the product development process, you may find it useful to begin some type of prototyping very early in the project. These prototypes may be used to help you understand how components or subsystems perform, how to achieve certain features or they may be "virtual" (ProE) in nature. You have a limited budget but it is important to begin to get you hands on hardware very early in the project. This is particularly important when it comes to the interactive features that your product must manifest. Developing experience with sensors, actuators and the embedded controllers is a must and should **begin at the very beginning of the semester**. Keep in mind the prototypes have various purposes. In your case it is to demonstrate basic feasibility of the concept and its operation. It need not "look" just like the final product - but then you may also wish to develop a non-functional, visual prototype to use to assess customer acceptance and response too. Also recall that you will eventually be judged on your ability to use your engineering modeling and analysis skills to justify your design decisions and this will be a key part of your design proposal.

Why is most of the documentation due well before the end of the semester?

The documentation (draft) is due at that point in the semester when the design should be "done" (frozen) and you are primarily involved in validating your decisions via your prototype. By submitting it prior to the formal review, you are allowed some time for reflection and feedback from management. It also gives you a chance to complete this important deliverable before the rush of activities that takes place at the end of the semester. With the proposal completed, preparation for the CDR is easier as you have already developed the figures and data and now it just a matter of explaining what you've done to the reviewers. Though this is called a draft, if you are careful and submit complete and professional documentation at this point, you will not need to spend any effort making corrections in order to prepare the final version for submission at the end of the semester.

Why are the "locked down" tools in B-19 only available for limited times?

All of the equipment in B-19 must be used with some care. We've worked very hard to make sure there are no injuries and students use the equipment properly. The locked down equipment must be used under supervision and there are limited times when that supervision is available. From the beginning of the semester each group should use the regular class meeting sessions to develop the necessary skills for part fabrication, training and certification on the use of this equipment. If you wait until later in the semester to begin to fabricate components or learn how to form certain elements of your design, you will be at a disadvantage. Without knowing how to perform a particular machining function, you will have real difficulty designing a part that can be machined. Your design must be developed in a manner that recognizes the limited resources and those limits include limited access to machines. If your design requires excessive machining, specialized equipment or skills you don't have, there is a flaw in the design.

Why do we have weekly PDR's?

They provide an opportunity to help you develop your presentations skills as well as identify important issues during the project. You can also learn from experiences and problems encountered by other groups. It also gives everyone practice in asking questions as well as answering questions. Many of your questions in a traditional class are related to "how do I do this" where in this class, the question are relate to "why did you do this." These presentations are your opportunities to justify your engineering decisions. Finally they help prepare you for the CDR where you will present your efforts to a panel of engineers from industry and at that time you want to be prepared. It is much easier to practice your presentation skills in front of a class than it is in front of a potential employer.

Why the digital presentation of the documentation and other course content?

The American Society of Mechanical Engineers thinks that digital presentation of this kind of information is important or they would not he conducting a contest based upon it. With the advent of global product design and the key role the www now plays in technical communications, this project provides each group with some experience with these issues.

Why do you keep answering our questions with "questions"?

Recalling the key goal of developing your ability to make decisions, the role of management (middle and upper) is to ask questions to assist the students who are ultimately responsible for making the decisions. Management will do everything possible to help you answer your questions but they will not make decisions for you. We will provide facts when we can, and help you troubleshoot problems, but the eventual responsibility for all the decisions made in the project, depend upon the "engineers" (i.e. the students).

Why do we need this ridiculously large "course handout"?

This project is different from most other academic experiences you have had at ND, you need some place to go to gather information on the how's, where's and why's for this project. The handout should be considered to be an "employee's manual." You need to review it carefully at the beginning of the semester to understand what is expected of you and then hang on to it and refer to it as the project progresses through the semester.

Section VIII:

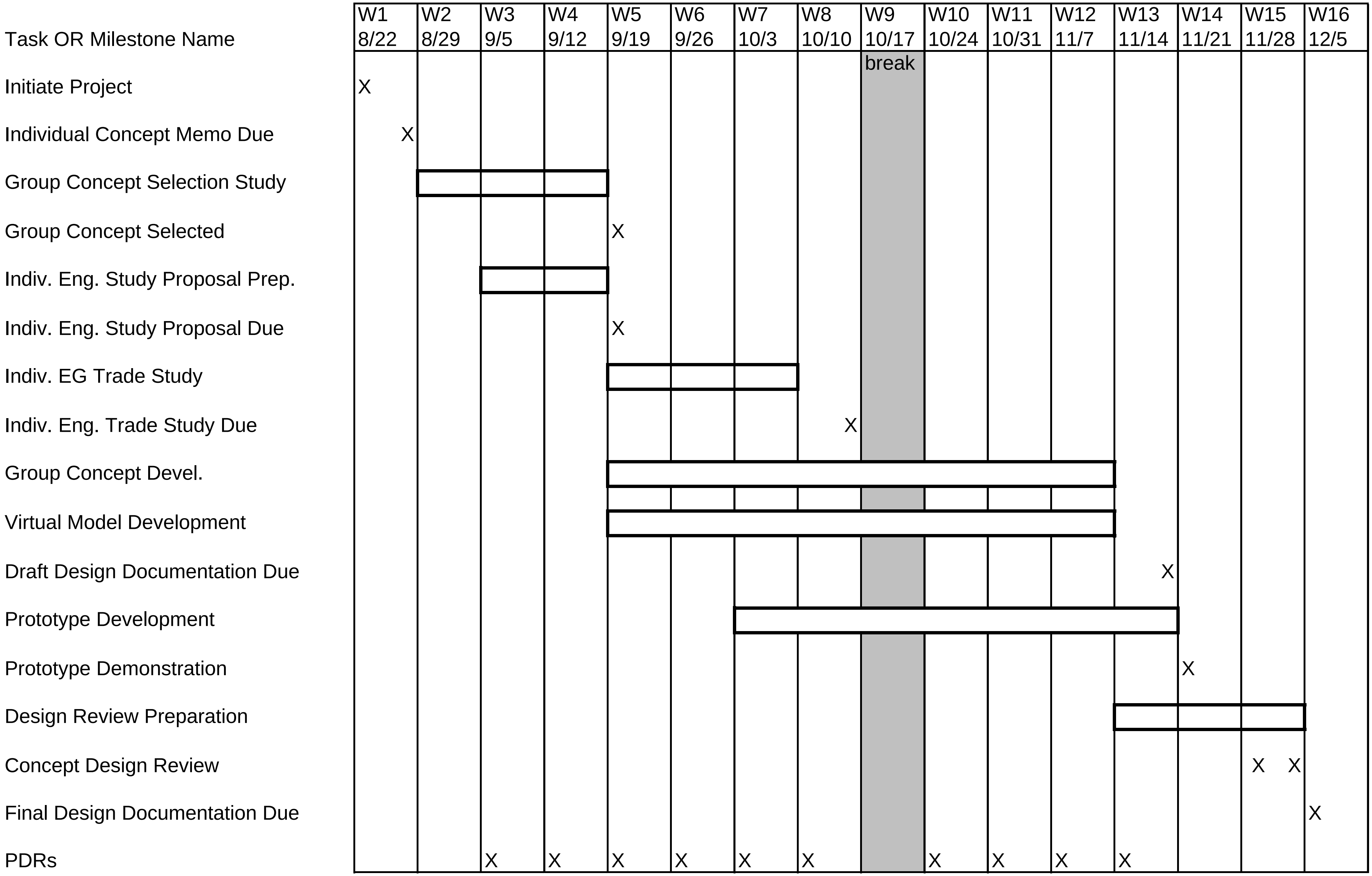
Attachments

1. Semester Calendar (with key dates for AME40463 indicated)
2. Project Gantt Chart (Task Timeline)
3. Group Task Tracking Summary
4. Peer Review Form
5. Grading Guidelines
    a. Individual Concept Memo
    b. Engineering Notebook
    c. NOTE: Grading guidelines for other graded items will be distributed/posted during the semester

Department of Aerospace and Mechanical Engineering
University of Notre Dame
Fall 2006

	Mon	Tues	Wed	Thur	Fri	
AUG		22 First Class Day	23	**24**	25	
	28	29	30	31		
SEPT					1	
	4	**5**	6	7	8	
	11	12	13	14	15	
	20	**19**	20	21	22	
	25	26	27	28	29	
OCT	2	3	4	5	6	
	9	10	11	**12**	13	
	16	**17**	**18**	**19**	**20**	**Break**
	23	24	25	26	27	
	30	31				
NOV			1	2	3	
	6	7	8	9	10	
	13	14	15	**16**	17	
	20	**21**	22	**23**	**24**	**Thanksgiving**
	27	**28**	29	**30**		
DEC					1	
	4	**5**	6 Last Class Day	7 study	8 study	
	11	**12**	**13**	**14**	**15**	**Exams**

Project Task Timeline – Gantt Chart – Fall 2006



Sample Task Tracking Summary

Team Member		Total Time for week		All Project Meeting (All AME40463 engineers present)	Design Group / Subgroup Activity (All or some Group members)	Individual Activity		Planning, Organization, Collaborator Coordination	Engineering Analysis or Modeling	Reporting or Documentation	Prototyping
A											
B											
C											
D											
E											
TOTALS											

AME40463: Fall 2006 Design Group Task Tracking Summary

Group Name: ________________________________ For the Week of : / / to / /

AME40463: Fall 2006 Senior Design Project
Confidential Peer and Project Evaluation

Place the following evaluation forms in a **sealed envelope** and return it to Prof. Batill, by 9:30 a.m., Tuesday, December 5, 2006.

Reviewer: ______________________________________

A. Peer Evaluation: This form should be used to provide a confidential, professional evaluation of each member of your design team - YOU DO NOT EVALUATE YOURSELF. This evaluation is an important experience for you and key element in the instructor's evaluation for your fellow engineers. You will be evaluated on your ability to provide an effective evaluation of your team members. Please consider each item carefully. Rate each member of the team (**not** including yourself), in each area, on a scale from 0-10 with a ten being the highest rating. THE AVERAGE FOR THE ENTIRE GROUP MUST BE "5" FOR EACH CATEGORY (i.e. you have a total of 20 points to distribute to your team members in each category if there are 5 engineers in your group). You will have to select your own relative merit on that scale and it is most important that you are consistent. You are also asked to provide brief handwritten comments about each team member. In order for you to receive a grade in this course, you must submit this evaluation.

CATEGORY	1	2	3	4	5	6	7	8	9	10	TOTAL
ENGINEER'S NAME											
1.											
2.											
3.											
4.											
TOTAL (=20)											

CATEGORIES:

1. TECHNICAL ABILITY
2. WRITTEN COMMUNICATION SKILLS
3. ORAL COMMUNICATION SKILLS: LISTENING AND SPEAKING
4. WILLINGNESS & ABILITY TO WORK WITH OTHERS IN THE GROUP
5. ABILITY TO ADAPT TO NEW IDEAS
6. WILLINGNESS AND ABILITY TO CONTRIBUTE IDEAS
7. LEVEL OF OVERALL EFFORT
8. COMPLIANCE WITH GROUP DEADLINES
9. CONTRIBUTION TO PROPOSAL
10. CONTRIBUTION TO PROTOTYPE

B: SPECIFIC COMMENTS ON EACH INDIVIDUAL:

1. NAME: ______________________

COMMENTS:

2. NAME: ______________________

COMMENTS:

3. NAME: ______________________

COMMENTS:

4. NAME: ______________________

COMMENTS:

D. Recommendation Comments:

IF YOU COULD OFFER **ONE PIECE** OF ADVICE TO SOMEONE WHO WILL TAKE THIS COURSE IN THE FUTURE, PLEASE DO SO BELOW.

ISSUES RELATED TO COURSE CONTENT AND PRESENTATION. THIS IS THE CAPSTONE EXPERIENCE IN THE MECHANICAL ENGINEERING CURRICULUM. WE HAVE ATTEMPTED TO DEVELOP AN ACADEMIC EXPERIENCE THAT WILL PROVIDE THE GREATEST BENEFIT TO YOU AS YOU BEGIN YOUR PROFESSIONAL CAREER. PLEASE PROVIDE ANY COMMENTS RELATED TO THE COURSE, ITS ORGANIZATION, PRESENTATION, FACILITIES, ETC. WHICH YOU THINK WOULD BENEFIT FUTURE STUDENTS IN THIS PROGRAM.

AME 40463 Senior Design Project: Fall 2006

Individual Concept Memo- Grading Criteria

Engineer: ______________________________ Score: ______

Possible Total Rating - 25 pts

1. Format: (5 pts)
    a. Single, typed first page — 2 pts
    b. Hand-drawn sketches — 2 pts
    c. Sketches labeled — 1 pt

2. Explicit statement of target market — 3 pts

3. Explicit and obvious statement of pertinent design requirements — 3 pts

4. Brief written description of concept and its key features — 4 pts

5. Explicit statement of “intelligent features” or capabilities — 3 pts

6. Hand-drawn sketches: (7 pts)
    a. Quality of sketches — 3 pts
    b. Effectiveness in explaining operation — 2 pts
    c. Effectiveness in explaining form — 2 pts

Evaluator’s Comments:

AME40463 Fall 2006: Design Notebook Evaluation

Engineer: ______________________________ Score : ____________________________

Total Possible score - 40 pts.

Overall Use and Presentation: (20 pts)

1. Consistent entries (10 pts)
   a. Multiple entries every week during the project (10)
   b. Entries on Tues/Thurs every week during the project (8)
   c. Multiple entries for most weeks (some weeks missing) (6)
   d. Entries on Tues/Thurs (some weeks missing) (4)
   e. Irregular use with significant gaps in entries (2)

2. Professional presentation (5 pts)
   a. Consistently neat and well organized (5)
   b. Irregular or marginal quality of presentation (2)
   c. Consistently poor presentation (0)

3. All entries dated (3 pts)

4. All entries in pen (2 pts)

Overall Content: (20 pts)

1. Engineering content (5 pts)
   a. Consistently used to record the technical issues (5)
   b. Irregular or marginal use to record technical issues (2)
   c. Not used to record the technical issues (0)

2. Organizational material and meeting or discussion notes content (5 pts)
   a. Consistently used to record the organizational issues (5)
   b. Irregular or marginal use to record organizational l issues (2)
   c. Not used to record the organizational issues (0)

3. Useful and effective sketches and schematics with explanations (10 pts)
   a. Effective, consistent use of drawing/sketches to illustrate ideas (10)
   b. Consistent use of drawing/sketches – many incomplete or confusing (7)
   c. Inconsistent use of sketches (4)
   d. Limited and incomplete use of illustrations (2)
   e. Sketches not used to document design development (0)