MET 494, Senior Design and Analysis

Dr. Barry Dupen

Spring 2019

Mechanical Engineering Technology program

PURDUE UNIVERSITY FORT WAYNE

School of Polytechnic
COLLEGE OF ENGINEERING, TECHNOLOGY AND COMPUTER SCIENCE

Course Description

This course will focus on mechanical design, finite element analysis, environmental concerns, and/or ethical challenges. Technical reports will be written, and one will involve an oral presentation.

Prerequisite: Senior standing (see note below).

Course Learning Outcomes

By the end of this course, the student will have demonstrated knowledge and understanding of:

1. Critical thinking, analysis, and synthesis (f).
2. Creative thinking and brainstorming (b).
3. Engineering materials, mechanics, fluid power, fluid mechanics, thermodynamics, and/or automatic control, as appropriate to the project (a1).
4. Manufacturing processes, mechanical design, CAD, and/or industrial operations, as appropriate to the project (a2).
5. Experiment design, practice, and interpretation, as appropriate to the project (c).
6. Teamwork, including cooperation and leadership skills (e).
7. Technical problem-solving skills (f).
8. Written and oral technical reports (g).
9. Timeliness, quality, and continuous improvement (k).

Learning Outcomes of this course contribute to MET Program Outcomes given in parentheses.

Textbook

None.

References

Textbooks and references used in Statics, Strength of Materials, Machine Design, Heat Transfer, Fluids, and other relevant courses.

Course Approach

There are no class meetings. I am available to assist with your team's project. During the last two weeks, groups meet to rehearse in preparation for Oral Presentations on the last day of the semester, using PowerPoint or equivalent.

There are no exams in this course.

Assignments

Assignments	
Proposal	50 points
Written Reports (3)	100 points ea.
Oral Report	100 points
Poster	50 points extra credit

Tentative grading scale					
A	93-100	B–	80-82	D+	67-69
A–	90-92	C+	77-79	D	63-66
B+	87-89	C	73-76	D–	60-62
B	83-86	C–	70-72	F	0-59

Prerequisites

The only prerequisite is Senior Standing. However, if you have not completed all of the technical courses listed in the first six semesters of the MET Bingo Sheet, you are probably not ready for this course, and should consider enrolling at a later date.

Notices from the SSD Office (Services for Students with Disabilities) and SAP (Student Assistance Program)

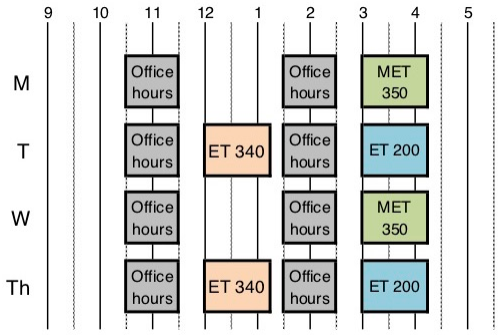
Students with disabilities are encouraged to discuss course requirements with their instructors to develop strategies for success. For more information, contact the SSD office in Walb 113, (260) 481-6657 Voice/TTD, or www.ipfw.edu/ssd.

Students with personal problems should contact SAP in Walb 113 for free counseling, at 260-266-8060 or 1-800-721-8809.

MET 494 – Senior Design & Analysis

This class is unlike any other in the MET program. There are no lectures. All reports are group projects. You may work on reports together, or choose the best writer to write the report…each team member receives the same grade. You may choose a single presenter for the Oral Presentation, but most groups in the past have used multiple speakers.

I typically stay through 5 pm or to the end of the last class, whichever is later. My office door is always open when I am in. Contact information: (260) 481-6383, met.dupen@gmail.com



Schedule

Date	Assignment	Descriptions & Guidelines
1/7-1/10	**Group meetings**: Stop by my office with your group to discuss your project **Contact Information**	Form groups of two to four students and select a design project. Three is the ideal group size. Ask for preliminary verbal approval from instructor for your project. Send the e-mail address you commonly check to met.dupen@gmail.com to receive course announcements.
1/16	**Formal Proposal, 50 points** Projects may be entirely student-funded, or funded by an industrial sponsor. The professor will evaluate the proposal quickly and either approve it as-is, recommend improvements, or reject it. Once the final proposal is approved, the group is responsible for its successful completion.	Include: • Project title. • Names and e-mail addresses of team members. • Purpose, function, & description. • Drawings or sketches. • Performance specifications (numerical) and optional specifications (materials, aesthetics, etc.) • Size. • Cost. • Ownership. (Who owns it when you are done?) • Personnel assigned to major areas of activity (design, analysis, drawings, ordering, fabrication, assembly, testing, testing analysis, report-writing).
2/18	**Progress Report #1, 100 points** Changes in system performance specifications may be proposed in this report with written justification, and the professor may approve or disapprove them.	At a minimum, the report must include: • Complete sketches of the system. • Some finished drawings. • Any components that have been ordered or fabricated • Free-body and/or system diagrams and associated equations. • Solutions to all major equations. These solutions may be handwritten. • Gantt chart showing the current status of various items. • Bibliography, listing all sources of information (catalogs, books, web sites).
3/18	**Progress Report #2, 100 points**	At a minimum, the report must include: • All design calculations (many typed in final form). • Design analysis should be done or nearly complete. • Plan for the testing procedure that will soon start. • Prints & drawings. • Photographs of components. • Updated references. • Updated Gantt chart, showing original targets & actual completion dates. See below for an example.

Date	Assignment	Descriptions & Guidelines
4/15-4/18, 4/22-4/24	**Oral Presentation Rehearsals** Rehearsal slots are available on a first-com, first-served basis. Rehearsals are required.	See Oral Presentation guidelines, below.
4/22	**Final Report, 100 points** Write the report using guidelines from ENG W421. The Department will keep this paper copy. For the Final Report only, please submit a *single* pdf file containing the report and all drawings. This report will be archived at the Helmke Library.	At a minimum, the report must include: • Purpose & function. • Initial performance specifications. • All relevant design calculations (typed). • Diagrams and formal engineering drawings. • Photographs of components and completed machine. • Fabrication procedure. • Test results, including a comparison with initial performance spec.s. • Overall cost. • Conclusions. • Bibliography listing references, catalogs, & websites. • Updated Gantt chart, showing original targets & actual completion dates. Above all, the Final Report should tell a story.
4/24	**Poster, extra credit 50 points** Every group is strongly encouraged to produce a poster for extra credit. The object is to sell someone on your idea, so make it look as professional as possible. Posters will be judged by MCET faculty and members of the MET and IET Industrial Advisory Committees at the Oral Presentation. Posters become property of the Department, and are used to promote the MET program to prospective students. Need ideas? See examples from previous years outside the MCET office.	The project title must be legible from a distance of 10 feet; the text from a distance of 2 feet. Text should be typed; drawings must be done with CAD or other software. Use 20" × 30" foamcore…also called foam board (about ¼" thick…do not use ¾" thick board). The poster should include: • Project name and student names • Sponsoring company or individual • Introduction: What was the purpose or objective? What did you hope to accomplish? What is special about your solution? • Discussion: What did you do, and how did you overcome design problems? • Conclusions: How well did you accomplish your objectives? • Photographs, drawings, or graphs that help to tell the story of your project • Along the bottom, type: PFW Mechanical Engineering Technology Senior Design class, Spring 2019
4/26	**Oral Presentation, 100 points** Use PowerPoint or equivalent. Presentations should be about 12 minutes, plus 5 minutes for questions. **All class members must attend all of the presentations.** Members of the MET Industrial Advisory Committee are invited to the presentations. This is a good opportunity to display your abilities to prospective employers.	At a minimum, the report must include: • Introduction to the topic. • List of group members. • Purpose. • Initial performance specifications. • The most significant design calculations with appropriate diagrams. • FEA or stress analysis (if you did one). • Test procedure and results. • Comparison between initial performance specifications and final test results. • Cost analysis based on a realistic production quantity for the product.
5/3	**ETCS Poster Day, 50 points** 1-3 pm, Helmke Library	Show and discuss your poster with representatives of local industry.

Gantt Charts

Henry Laurence Gantt (1861-1919) is described variously as a mechanical engineer, an industrial engineer, a social scientist, and a consultant.

He was one of the first people to recognize and understand the importance of *motivation* in the workplace. Instead of the traditional punishment system to discourage poor work, Gantt believed in using reward systems to encourage good work. He instituted minimum wage systems and bonus pay incentives.

He thought a lot about how work should be organized, and at the ripe old age of 56, in 1917, he invented the Gantt chart, which is a horizontal bar chart that tracks *time* rather than production quantities.

He died two years later, but his Chart was adopted quickly around the world. Usually, bright ideas take decades to spread. For example, Young's Modulus was not accepted in the Engineering community for 50 years. In contrast, Gantt charts became widespread in less than ten years.

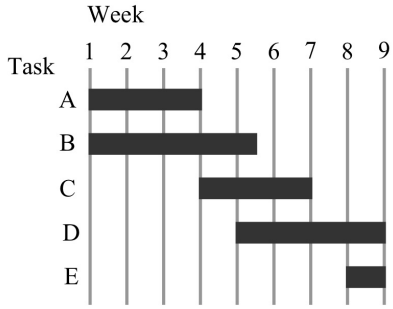
In 1929, ASME established the Henry Gantt medal, which is awarded for distinguished achievement in management and service to the community.

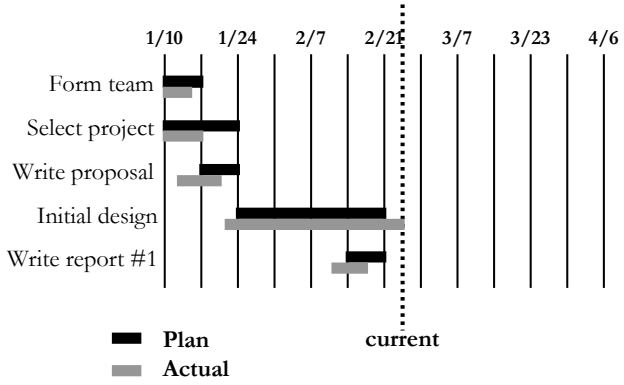
There are numerous ways to design a Gantt chart…sometimes the budget is shown in an extra column to the left of the task list. You can use Microsoft Project to build your Gantt chart, if you have it at home or work.

If you don't have access to MS Project, you can use MS Excel by shading the bars cells in the spreadsheet. The Gantt chart in your reports should include:

- Task list on the left
- Time along the top
- Marker to show where you are in time
- Comparison between the Original Plan and the Actual Accomplishments.

Some tasks will take less time than expected; some will take more; and some will begin later than planned. The "Actual" bars will help you keep track of these changes.





Suggested References

Your favorite Statics / Dynamics / Strength of Materials / Machine Design / Heat Transfer / Fluids textbooks

Mark's Handbook for Mechanical Engineers

Machinery's Handbook

Roark's Formulas for Stress and Strain

Ingenious Mechanisms for Designers and Inventors, *Five Hundred and Seven Mechanical Movements*, or equivalent

Manufacturers' websites: cost & availability of components, materials properties, MSDS, etc.

The Elements of Style (E.B. White) or equivalent writing style book

The Visual Display of Quantitative Information (Edward Tufte) or any of his subsequent books on graphical excellence

[*] Image from ganttchart.com