UNIVERSITY OF PORTLAND
Donald P. Shiley School of Engineering
ME 328 Machine Design, 2020

"Find the gift God gave you. ***Sharpen, hone, and train it****. And, then go use it. Go!"*
-Donald P. Shiley '51

Course Description: Theoretical and practical aspects of the design of various machine components and simple systems. The design criteria are based on stress analysis, manufacturing issues, materials, and fatigue considerations. A modest sized machine design project is required.

Number of Credits: 4

Class Schedule: Section A: M 8:10-9:15 and MWF 12:30-1:25
Section B: M 9:15-10:10 and MWF 1:35-2:30

Course Instructor: Kenneth E. Lulay, Ph.D., P.E.
Shiley Hall 236. Ph: 943-7432. e-mail: lulay@up.edu

Office Hours: Available any time if I'm in my office. I'll try to be in my office:

Monday	11:25-12:00
Tuesday	11:00-12:00, 1:00-1:30
Wednesday	2:40-3:30
Thursday	none scheduled
Friday	9:30-10:10

Prerequisites: EGR221, ME304

Textbook: Budynas, R. G. and J. K. Nisbett, *Shigley's Mechanical Engineering Design*, or others (see course web).

Additional texts: Basic *materials science* and *strength of materials* and other texts may be necessary for projects and homework. Library has such books. Web sources may suffice on occasion.

Learning expectations: It has been said that in college "you learn how to learn." That's very important in engineering – **real engineering problems are not found in textbooks**. In order to get the most out of this class, you will need to practice learning on your own. **Not all problems will be discussed in lectures nor found in your textbook**. Ask questions. It is your responsibility to ask questions when you are confused, need further explanations, etc. **I believe my responsibility is NOT to answer the question for you, but rather to help guide you to answer it for yourself**. So please do not get frustrated when I do not answer your question as directly as you may have hoped – I'm not being obstinate, I'm trying to help you develop skills required for engineering.

Engineering Design (ABET Definition)

Engineering design is a process of devising a system, component, or process to meet desired needs and specifications within constraints. It is an iterative, creative, decision-making process in which the basic sciences, mathematics, and engineering sciences are applied to convert resources into solutions. Engineering design involves identifying

opportunities, developing requirements, performing analysis and synthesis, generating multiple solutions, evaluating solutions against requirements, considering risks, and making trade- offs, for the purpose of obtaining a high-quality solution under the given circumstances. For illustrative purposes only, examples of possible constraints include accessibility, aesthetics, codes, constructability, cost, ergonomics, extensibility, functionality, interoperability, legal considerations, maintainability, manufacturability, marketability, policy, regulations, schedule, standards, sustainability, or usability.

Engineering Design (Lulay's Definition): making sense out of a messy world. (Therefore, students will be exposed to, and have to deal with, "messiness" in this class).

Student Outcomes

Engineering Design:

Students shall demonstrate an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. Students demonstrate the ability to:

a) define an engineering problem by establishing appropriate design project criteria.
b) effectively apply the design process to produce a solution to an open-ended problem subject to multiple criteria
c) explain how public health, safety, and welfare factors affected their design process
d) explain how global, cultural, and social factors affected their design process.
e) explain how environmental factors affected their design process.
f) explain how economic factors affected their design process.

Assessment methods: A moderate sized semester-long design project is assigned requiring design of power transmission. Although design project is a team effort, assignments are given to students as individuals prior to forming teams and throughout the project.

Prior to forming teams, each student is asked to collect background information and to create project criteria. Students are asked to:

a) identify project criteria prior to team formation.

Each student is asked to design a single component as part of the larger project and to explain in writing how various factors affected their design. Students are asked to:

b) design a single component as part of the larger project
c) explain how public health, safety, and welfare factors affected their design process
d) explain how global, cultural, and social factors affected their design process
e) explain how environmental factors affected their design process
f) explain how economic factors affected their design process

Professional Responsibility and Ethics:

Students shall demonstrate an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts. Students demonstrate the ability to:

a) *identify ethical and professional responsibilities associated with the global, economic, environmental, and societal context of an engineering problem.*
b) recognize the possible global, economic, environmental, and societal impacts of an engineering solution.

Assessment methods: A moderate sized semester-long design project is assigned requiring design of power transmission. Although design project is a team effort, assignments are given to students as individuals throughout the project.

Each student is asked to design a single component as part of the larger project and to:
a) describing in writing their ethical and professional responsibility as an engineer associated with the global, economic, environmental, and societal context of their design.
b) describe in writing the global, economic, environmental, and societal impact of their design.

Team Work:

Students shall demonstrate an ability to function effectively on a team whose members provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives. Students demonstrate:

a) team can establish goals and effectively plan tasks.
b) team members are mutually reliable and meet deadlines and objectives
c) team members practice inclusive and collaborative decision making/communication
d) team members establish leadership by holding themselves and each other accountable for project tasks and objectives

Assessment methods: A moderate sized semester-long machine design project is assigned to teams of 3 or 4 students.

a) Students demonstrate attainment by defining project criteria and creating a project plan as a team (flow chart). Prior to forming teams, students create project criteria as they each deem appropriate. Once teams are formed, it becomes a team effort to review and revise the individual criteria to create criteria the team agrees upon.
b-d) Students demonstrate attainment by providing evaluation to team members and reflecting upon their own abilities including their peer's evaluation of themselves. Students use CATME for evaluation of themselves and their team members:
b) CATME question 3/K: Keeping the team on track
c) CATME question 2/I: Interacting with teammates
d) CATME question 1/C: Contributing to the team's work

Experimentation:

Students shall demonstrate an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
a) *can develop and conduct appropriate experimentation*

b) can analyze and interpret data
c) can use engineering judgment to draw conclusions

Assessment methods:
A moderate sized semester-long design project is assigned requiring design of power transmission. During the project, students:

a) conduct various tests including creating motor performance curve and design requirements.
b) analyze and interpret the data (creating performance curves, etc.), and
c) use judgment to apply the data to design a gear-based power transmission system.

Machine Design Specific:

Students shall demonstrate an ability to formulate and solve machine design problems by analyzing machine components with consideration to various service conditions (static, fatigue, impact, corrosion, etc.).

Students shall demonstrate an ability to understand basic design considerations for components such as bearings, gears, and brakes.

E-mail: Students are required to check their UP email accounts daily.

Policy on Late Assignments: All assignments are due at the beginning of class. Special circumstances may allow for exemptions. Discuss with instructor. Each student may have 1 late assignment (48hour extension) without penalty if instructor is notified before midnight of the due date. Clearly write "LATE EXCEPTION" on the top of the first page.

Policy on Exams: No makeup exams will be given. If you cannot attend an exam for a legitimate reason, please contact the instructor to arrange to take the exam in advance. Upon receiving your graded exam, you have the right to question the grading of your exam. You must provide a typed page addressing the specific issue in question and present this page along with your original exam to the instructor. You have one week from the day your exam is returned to question any grading decisions.

Topics Covered:

Subject:	Chapters	Week	Subject:	Chapters	Week
General design issues	1	1	Column Buckling	4	3
Project mgmt			Impact & contact	4	4
Design process			Vibration	N/A	5
Miscellaneous			Fatigue analysis	6	6-8
Static failure, stress concentrations	3, 5	2	Fasteners	8	8-11
			Component Design	7-17	12-14
Motors/power trains	N/A	3			

Grading:		
	Midterm exams	10% each (4 exams), or 5% for worst*
	Final Examination	25% (or 20%)*
	Design Project	15%
	In Class Activities	5%

Quizzes	5%
Homework	15%
Total:	100%

Better than 90%	A: Demonstrate deep understanding (could teach others)
Better than 80%	B: Demonstrate good understanding of most concepts (could explain it well to others).
Better than 70%	C: Demonstrates understanding of most concepts
Better than 60%	D: Not demonstrate understanding of many concepts
0%-60%	F: Not demonstrate understanding of most concepts

*Exams and Final Exam: the worst exam score will be worth 5% less than indicated. If a midterm exam is your worst exam score, that exam will be 5% of the total grade. If the final exam is the worst exam score, it will be worth 20%. Students with an average midterm exam score of 93% or higher do not need to take the final exam, they will automatically receive 100% for the final.

Quizzes: there will be regular quizzes (10 minutes per quiz) to help you know what you don't know – and hence, help you to know what to ask. The worst quiz will be dropped. No make-up quizzes will be given – but if you know in advance you will be absent on the day of a quiz, arrangements can be made if you talk to me.

In-Class Activities (ICA's): we will have ICA's (once or twice per week). At times, these may be related to assignments, but many of the ICA's will be qualitative not quantitative. They are meant to help you understand machine design better, but not necessarily improve your analysis skills (analysis is a small part of design). To receive credit for ICA's you will need to actively participate in them and submit a completed handout (with your name on it).

Team Project: there will be a substantial project in this course meant to help you learn about the design process. Details will be provided later.

Homework: Homework will often be challenging – this is good, this is how people learn. Great engineers know how to struggle with problems – the path to finding the "right answer" to real engineering problems always involves struggling. The homework assigned in this course is meant to be the ***minimum*** sufficient to help you judge your depth of knowledge. Many topics will require you working additional problems before you can honestly be convinced you do understand the material deeply. "Traditional" problems will be graded on completeness only (completeness includes complete and proper problem-solving format). Solutions will be posted and I expect you to check your own work, not just copy the answers – you learn by doing. There will be two variants of homework: "design" and "traditional"; both will be part of the weekly assignments ("design" problems will be identified as such on the homework). The "design" homework problems are more extensive, perhaps requiring the creation of software code, laboratory testing, etc..

University Policies and Resources

School of Engineering's Lab/Shop Access and Safety Policy: No one is allowed to work in the shops or labs without appropriate training from the shop technician and without instructor permission.

University of Portland's Code of Academic Integrity
Academic integrity is openness and honesty in all scholarly endeavors. The University of Portland is a scholarly community dedicated to the discovery, investigation, and dissemination of truth, and to the development of the whole person. Membership in this community is a privilege, requiring each person to practice academic integrity at its highest level, while expecting and promoting the same in others. Breaches of academic integrity will not be tolerated and will be addressed by the community with all due gravity.

Assessment Disclosure Statement
Student work products for this course may be used by the University for educational quality assurance purposes.

Accessibility Statement
The University of Portland endeavors to make its courses and services fully accessible to all students. Students are encouraged to discuss with their instructors what might be most helpful in enabling them to meet the learning goals of the course. Students who experience a disability are also encouraged to use the services of the Office for Accessible Education Services (AES), located in the Shepard Academic Resource Center (503-943-8985). If you have an AES Accommodation Plan, you should make an appointment to meet with your faculty member to discuss how to implement your plan in this class. Requests for alternate location for exams and/or extended exam time should, where possible, be made two weeks in advance of an exam, and must be made at least one week in advance of an exam. Also, you should meet with your faculty member to discuss emergency medical information or how best to ensure your safe evacuation from the building in case of fire or other emergency.

Mental Health Statement
As a college student, you may sometimes experience problems with your mental health that interfere with academic experiences and negatively impact daily life. If you or someone you know experiences mental health challenges at UP, please contact the University of Portland Health and Counseling Center in Orrico Hall (down the hill from Franz Hall and Mehling Hall) at www.up.edu/healthcenter or at 503-943-7134. Their services are free and confidential, and if necessary they can provide same day appointments. In addition, after-hours phone counseling is available if you call 503-943-7134 and press 3 outside of business hours. Also know that the University of Portland Public Safety Department (503-943-4444) has personnel trained to respond sensitively to mental health emergencies at all hours. Remember that getting help is a smart and courageous thing to do – for yourself, for those you care about, and for those who care about you.

Non-Violence Statement
The University of Portland is committed to fostering a community free from all forms of violence in which all members feel safe and respected. Violence of any kind, and in particular acts of power-based personal violence, are inconsistent with our mission. Together, we take a stand against violence. Join us in learning more about campus and community resources, UP's prevention strategy, and reporting options on the Green Dot website, www.up.edu/greendot or the Title IX website, www.up.edu/titleix.

Ethics of Information
The University of Portland is a community dedicated to the investigation and discovery of processes for thinking ethically and encouraging the development of ethical reasoning in the formation of the whole person. Using information ethically, as an element in open and honest scholarly endeavors, involves moral reasoning to determine the right way to access, create, distribute, and employ information including: considerations of intellectual property rights, fair use, information bias, censorship, and privacy. More information can be found in the Clark Library's guide to the Ethical Use of Information at libguides.up.edu/ethicaluse.

The Learning Commons
Trained peer tutors and writing assistants in the Learning Commons, located in Buckley Center 163, work with you to facilitate your active learning and mastery of skills and knowledge. For questions about the Learning Commons, please send all correspondence to Jeffrey White, Administrator, at white@up.edu. The Learning Commons is a program of the Shepard Academic Resource Center (SARC.)

Math Resource Center: Appointment-based tutoring is available through our online scheduler at www.bit.ly/up_mrc. Walk-in tutoring Sundays through Thursdays evenings. For MTH 141, request appointments at math141@up.edu. The course-specific schedule can be found at www.up.edu/learningcommons, or the reception desk in BC 163.

Writing Assistance: Brainstorming ideas for your paper, create an outline, work on citations, or review a draft with a Writing Assistant. Visit www.up.edu/learningcommons to access our Writing Center schedule.

The Language Studio: Contact the language assistance hotlines to schedule a time to meet throughout the semester at chinesetutor@up.edu, frenchtutor@up.edu, germantutor@up.edu, or spanishtutor@up.edu.

Natural Sciences Center: Send your tutoring requests to biotutor@up.edu, chemtutor@up.edu, or physicstutor@up.edu.

Speech & Presentation Lab: Improve your presentations by requesting an appointment at speech@up.edu.

Group Work Lab: Make an appointment for your group project at groupwork@up.edu.

Nursing Tutoring: Tutoring is available for pathophysiology, BIO205, anatomy and physiology, and other nursing courses on a walk-in or appointment basis. Up-to-date schedule information is at www.up.edu/learningcommons/nursing.

Economics and Business Tutoring: For support in economics, OTM, finance, accounting, and business law courses, send requests for appointments to your discipline's tutor email hotline: econtutor@up.edu, otmtutor@up.edu, financetutor@up.edu, accountingtutor@up.edu, or bizlaw@up.edu.

Shiley Sophomore Fellows: Provides tutoring in several sophomore engineering classes. To make an appointment, send a request to stepUP@up.edu.

Learning Assistance Counselor: Learning assistance counseling is also available in BC 163. The counselor teaches learning strategies and skills that enable students to become more successful in their studies and future professions. The counselor provides strategies to assist students with reading and comprehension, note-taking and study, time management, test-taking, and learning and remembering. Appointments can be made in the on-line scheduler available to all students in Moodle or during posted drop-in hours.