MEEN 3130 – Machine Elements
3 credit hours Spring 2017

Instructor: Dr. Mark Wasikowski (mark.wasikowski@unt.edu)
Sections: TR 10 – 11:20 AM and TR 12:30 – 1:50 PM (F175). Both section are same.
Office and Hours: F101L. TR afternoons. Anytime I am here and door is open. I am here to help you.
Teaching Assistant (Grader): TBD

Catalog Course Description: Applications of the principles of mechanics and mechanics of materials to machine design. The elements of machines are analyzed in terms of their dynamic behavior. Selection and sizing of machine elements. Students use the finite element technique for the analysis of machines and their counterparts.

Pre-requisite:
MEEN 1000 Discover MEE
ENGR 2332 Mechanics of Materials (stress, implies statics too)
Required:
"Mechanical Design of Machine Elements & Machines", 2nd, Collins, Wiley (9780470413036)
Optional:
"Shigley's Mechanical Engineering Design", 10th, Budynas; McGraw Hill (9780073398204)

Course Topics and Structure: overall machine design and sizing of components. Failures and failure prevention. Application to machine design and mechanical elements such as power transmission shafting, bearings, gears, fasteners, and springs. Engineering concepts and practical applications are equally important to problem solving.

ABET Criteria: MEEN 3130 addresses several ABET program outcomes, including applying knowledge of mathematics, engineering and science as well as identifying, formulating and solving engineering problems. Upon successful course completion, students will be able to:

- State the fundamental principles used in the study of elements for machine design
- Apply principals of mechanics, materials, stress analysis, statics, and dynamics to machine sizing
- Determine loads applied and define, evaluate, and select appropriate materials for design
- Determine failure modes and deformation of a design
- Apply static and dynamic failure theories in design analysis
- Select appropriate dimensions and size of machine elements

Communication: Communication is UNT's Blackboard (BB) system and university email. Must have valid UNT email registered through BB. Verify course enrollment and availability. BB used to post syllabus, homework, lecture slides, grades, etc. REEF used for participation, attendance, and some quizzes. Each student must have a REEF account linked to this course.

Disability Policy: Reasonable accommodation made to facilitate special needs. If accommodations required, student meet with Office of Disability Accommodation (ODA), (940) 565-4323. After meeting, contact me to discuss accommodations. For more information, see http://www.unt.edu/oda.

Academic Dishonesty: UNT core values of trust, honesty, and integrity are necessary for learning to occur. Each student expected to complete own work. Cheating will not be tolerated and will result in score of zero. Student will be reported to Provost Office, Office of Academic Integrity, for appropriate disposition. No exceptions.

Grades: Standard grading scale used: 90/80/70/60. No curve.

15% Participation: Learning begins with preparing for, attending, and participating in lecture. Lecture is mix of slides, problem solving, and group discussion. Lesson plans distributed in class each day. Slides, if required, available on BB ahead of time. Download and print slides before class. Review slides / read assigned textbook sections ahead of time following lesson plan. Participate through attendance, group problem solving, helping others, and answering questions. UNT's REEF system tracks participation on-line. Create (or update) REEF account and link required.

10% Homework: Homework allows you to practice course material and receive performance feedback prior to exams. Assigned every class period and due beginning of next class. Come to class with any questions on homework.

10% Quizzes: in class closed book quizzes provided often to evaluate reading comprehension and problem solving ability from recently presented material. Typically one problem approximately 30 minutes similar to homework. Unannounced REEF based quizzes may also be given in class.

20% Mid Term Exam 1: Comprehensive in class closed book assessment of failure prevention, part 1, evaluating both qualitative engineering applications (multiple choice, essay) and problem solving ability.

20% Mid Term Exam 2: Comprehensive in class closed book assessment of machine parts, part 2, evaluating both qualitative engineering applications (multiple choice, essay) and problem solving ability.

25% Term Project: apply course to practical machine of your choice, focusing on practical "real world" experience. Tailored to suite your interests within diverse field of mechanical and energy engineering. Analysis may be performed either using hand / calculations and/or computer software (CAD, FEA, etc.)

Tentative Schedule:

Exam 1: 2/28
Exam 2: during assigned final exam time
Term Project: 5/4 (last day or class)

Regrades: Any re-grade request must be made in class day is returned. No re-grade requests permitted after class dismissed. Entire exam will be re-graded, which may result in lower score than originally assigned. Make-up NOT allowed with only exception being University excused absences with documentation provided in advance.

TERM PROJECT

The purpose of this project is to allow you to apply the course theory to a practical machine of your choice. This focuses the course on the practical and gives you "real world" experience. 25% of the course can be tailored to suite your interests within the diverse field of mechanical and energy engineering. This project is a great learning experience for using engineering software and provides excellent experience for a resume. Analysis may be performed either using hand / calculations and/or computer software (CAD, FEA, etc.) Be careful if you select a computerized approach.

Project results should be organized in the following sequence in a project report (MS Word) that is professionally written (neat, organized, clear, etc.). Calculations performed by hand, along with hand drawn diagrams, can be integrated directly. However, all text is in MS Word format. Projects not clearly organized, that follow a different format, or can't be understood will not be accepted and will receive a grade of 0. Check points will be provided as the course progresses. This provided a due date for each of the 13 requirements.

1. Select a machine that you have a strong interest in. The machine must:
    a. Be a real machine that currently operates on the market or in a laboratory
    b. Have publically available data so you can model it, or be able to estimate any required data
    c. Transfer significant power and torque
    d. made from steels alloys
    e. Have at least 4 elements and 3 joints
    f. Have at least 1 spinning shaft supported by rolling element bearings
    g. Have at least 1 gear set
2. (5) Background. Discuss the history, background, description, operation, pictures, and design of machine
3. (5) Determine representative applied loads based on realistic service operation. This includes power, torque, forces, moments, motions, weights, etc.
4. (5) Draw complete Free Body Diagram of entire machine to solve for all reactive loads at the boundaries
5. (10) Draw Free Body Diagrams of each machine element and solve for all joint and shaft loads
6. (10) Use appropriate stress theory to determine max design stress that size each element
7. (10) Use appropriate static failure theory to determine margin of safety for each element
8. (15) Use appropriate fatigue failure theory to determine life of each element.
9. (5) Determine shaft deflections at gears and misalignment at bearings. Discuss effect on bearings and gears.
10. (5) Determine shaft critical speeds and effect on operation
11. (10) Analyze bearings for loads, life, and reliability.
    a. (5) How would life be affected if reliability increased by 5%.
    b. (5) How would reliability be affected if life goal was doubled
12. (10) Lay out the gear set geometry. Determine gear tooth loads. Determine module, pitch diameter, and all pertinent gear geometry as defined in class.
13. (5) Compare / contrast advantages and disadvantages of the gear type used compared to other gear types.
14. (5) Summary. Discuss overall performance of the design and lessons learned during the project. What would you have done differently, if anything? Does your machine actually meet its warrantee life?