ME 5243: Advanced Mechanism Design
Syllabus – 2017 Fall Semester

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Office Hours: Tuesday 11:00 am – 12:00 pm or by appointment

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Office Hours: Thursday 1:00 pm – 2:00 pm

Meeting Times & Places:
Class: Tues and Thurs 9:05 am - 11:00 am Mechanical Engineering 221

Prerequisites:
Undergraduate course in kinematics (ME 3222 or equivalent), upper division College of Science and Engineering undergraduate or graduate student.

Course Objectives:
- To develop student understanding of the theoretical background for basic and advanced kinematics and synthesis of mechanisms to achieve desired motion.
- To introduce students to basic and advanced computer-based tools for analysis and synthesis of mechanisms.
- To provide an opportunity for students to use theory and application tools through a major mechanism design project.
- To improve student ability to communicate understanding of the subject through professional technical reports and oral presentations.

Course Description:
In this course, we will study advanced topics in kinematics with a focus of mechanism synthesis techniques. The course will primarily focus on planar mechanisms, but will also treat spherical and spatial mechanisms. Course content will come from a variety of sources including class notes, texts, and journal articles. Course topics will be applied through a semester long design project. Topics of study include: review of kinematics fundamentals, classification of mechanisms, type synthesis, graphical synthesis techniques, and analytical synthesis techniques including dyad form, ground pivot specification, M&K circles, Burmester curves, Chebychev spacing, velocity synthesis, four and five prescribed positions, and multi-loop synthesis. Cam design, spherical mechanisms, spatial mechanisms, spatial transformations, and spatial dyad synthesis will also be discussed. This course will involve large amounts of team interaction through active learning activities in class and a major design project, which will implement the key topics presented in class through practical applications.

Required Course Materials:
- (2) small 45º triangles (4” or 6”)
- (1) ruler
- (1) compass
- (1) protractor
- (1) goniometer (recommended, not required)
Course Outline (Major Topics):

1. Fundamentals of Mechanisms 1.5 weeks
2. Type Synthesis of Mechanisms 0.5 weeks
3. Graphical Synthesis of Planar Mechanism 1.5 weeks
4. Analytical Synthesis of Planar Mechanism 6 weeks
5. Solution Rectification 0.5 week
6. Mechanism Optimization 0.5 weeks
7. Cam Design 1.5 weeks
8. Spatial Mechanisms 1 week

See the course web site for a more detailed schedule.

Course Web Site: http://www.me.umn.edu/courses/me5243/

Class Structure:
The class sessions will be front-loaded or “flipped,” meaning that you will watch videos and complete readings before coming to class and then engage in activities in class that extend your understanding of the material. You must come to class having watched/read the required background. Your understanding of the background material will be assessed with short quizzes. Class will involve a variety of settings including group work, small and large group discussions, demonstrations, reflective activities, and mini-lectures. You are expected to come to every class prepared for an in-depth discussion of the topics listed on the schedule. You must have completed the assigned readings and videos before coming to class! Pre-class assignments will be posted on the course web page. Plan on bringing your drawing tools to class every day for in-class activities.

Tests:
Five tests, approximately 25 minutes in length, will be given throughout the semester. The lowest test score will be discarded. A missed test will count as the discarded grade. All tests will be weighted equally and the homework counts as part of the test grade.

Homework:
Homework assignments are designed to prepare you for the next test. Homework will be collected at the time of the test. 10 points of each test score will be based on the attached homework. Homework will be checked only for completeness. You will receive scores of 10, 7, 4, or 0 based on the apparent completeness. If you do not turn in your homework, the highest possible score for the test is 90/100. Late homework will not be accepted.

Quizzes:
At the start of most class sessions, there will be a short quiz. The purpose of the quiz is to ensure that you watch the assigned videos and complete the assigned readings. To account for “bad days” and absences, the scores from 20% of your quizzes will be dropped. For example, if 10 quizzes are given throughout the semester, the scores from the lowest two quizzes will be dropped.

Project:
The class material will be applied through a semester long design project of a topic of your choosing. Projects will be completed in teams and will be evaluated through progress reports, an oral presentation, and a formal design report. Late project reports will result in a grade reduction of 10% per 24 hours late (or portion thereof). More information about the projects is contained in a separate handout.

Groups:
Please form yourselves into project teams of 3 or 4 students. Please e-mail the TA a list of team members and a team name by class #3 (9/12/2017). Anyone not in a group by that date will be arbitrarily grouped by class #4.
Final Exam:
The final exam will be held Tuesday, December 19, 8:00am – 10:00am. If you are unable to take the final exam at the scheduled time due to a valid reason, please see the instructor to make arrangements for an alternative time. Except for emergency situations, any arrangement must be made 2 weeks prior to the exam.

Re-grades:
Any grade disputes must be made within 1 week of returning the assignment. The material to be re-graded must be submitted to the instructor with an attached written explanation of the grading inaccuracies (a sentence or two will suffice). The item will usually be re-graded in its entirety, and your score may go up or down. Nevertheless, if a mistake was made in grading (which certainly happens), I encourage you to re-submit your work for correction.

Grade Computation:
Grade point ranges will be determined at the end of the term. In general, 90-100 is some form of an “A”, 80-90 is some form of a “B”, and 70-80 is some form of a “C.” The weighting of evaluation criterion is as follows:

- Project: 40%
- Tests/Homework: 35%
- Final Exam: 15%
- Quizzes: 10%

Course Policies:
1. Accommodations for Students with Disabilities: Students with special needs must talk to the instructor as soon as possible; all conversations will be kept confidential. As per University policy, reasonable accommodations will be made on an individual student basis.
2. Student Conduct: The classroom environment is very important to promoting learning. Disruptive behavior that might interfere with the learning process of other students will not be tolerated.
3. Sexual Harassment: Sexual harassment is prohibited as defined by the University policy which can be found at: https://policy.umn.edu/hr/sexualharassment
4. Academic Dishonesty: All submitted work must be your own. Any form of academic dishonesty will be treated very seriously. If you have any concerns about the authenticity of your work, or when group work is appropriate, please contact the professor. For further information about the University policy on academic dishonesty, refer to http://www.umn.edu/regents/policies/academic/StudentConduct.pdf

I look forward to working and learning with all of you throughout the semester. Please stop by my office at any time during office hours throughout the semester. Also, feel free to contact me by e-mail with any questions. I look forward to doing my best to make this class a pleasant and successful learning experience.