ENME 406: Roller Coaster Engineering  
Spring 2017  
Course Information

Catalog Description  

Course Information  
Through this course, we intend to introduce you to the design of roller coasters. You will learn the design methodology through lectures and team assignments. We will begin the class reviewing the motion and force concepts necessary for roller coasters, and follow them up with general mechanical design concepts. Kinematics and dynamics of the ride elements and riders, braking concepts, power-transmission design, frame design, and car design will be covered next. Biomechanical aspects, design of safety elements, and design of common machine elements used in roller coasters. Team projects in this course will involve coming up with your own roller-coaster design and a working prototype that will satisfy the user requirements provided, safety aspects, and health aspects, while incorporating thrill elements of your choice.

No. of Credits: 3

Prerequisites: ENME 272 (Introduction to Computer Aided Design) and ENME361 (Vibrations)

Meeting Times  
Lecture: Two times a week for 1 hour and 15 min.

Instructor  
Chandrasekhar Thamire, Ph.D., P.E.  
EGR 3133; Email: cthamire@umd.edu; Phone: 301-405-7329  
Office Hours: MTuWTh 2-3 PM

Text (Primary)  
None.

Texts (Supplemental)  

List of topics to be covered
1. Roller-coaster kinematics and dynamics
2. Track-layout design
3. Design of transmission and braking systems
4. Design of key mechanical components
5. Frame design
6. Car design
7. Biomechanical and safety aspects of the rides
8. Manufacturing aspects and cost analysis
Assessment
1. Homework & participation assignments (10%)
2. Exam 1 (15%)
3. Exam 2 (15%)
4. Final Exam (25%)
5. Course project (25%; Final Presentations with demonstrations on the last day of class meetings; Final Reports due during the presentations)

Homework
Homework assignments will cover conceptual questions. Homework will be assigned on Mondays and collected at the beginning of the class on Wednesdays of the following week. During the first part of the semester, you can expect basic motion and design problems for reinforcement of fundamentals. During the latter part of the semester, fewer problems will be given as project tasks will likely involve more steps and iterations and can be expected to be more time consuming.

Homework assignments require concise problem statements (i.e., given and find information in terms of symbolic variables and constants), necessary diagrams such as free-body, kinematic, and kinetic diagrams, a thorough step-by-step solution, and numerical answer with units. Homework may involve CAD or matlab components. Appropriate solid models/drawings/codes may be required to be submitted via elms in such cases.

Late homework will not be accepted. The lowest homework grade will be dropped.

Participation Grade
Attending lectures is strongly recommended. In view of the absence of text-book material on roller coasters, it will be beneficial for you to be present in class and take good notes. To encourage participation, small participation assignments will be given occasionally. When computing grades, the lowest participation-quiz grade will be dropped.

Exams
Exams will be cumulative and will test the material covered in class, and will be closed-book and closed-notes exams. Necessary design formulae (that are not considered fundamental) and property/parameter information will be provided during the exams. If you have to be absent on days when exams are scheduled because of university-excused reasons, please notify in advance with supporting documentation. For illness related reasons, please inform in a reasonable amount of time and upon returning, bring supporting documentation, signed by a health-care professional.

Your responses to exam problems must have a concise problem statement (i.e., given and find information in terms of symbolic variables and their values, when applicable), necessary diagrams such as free-body diagrams, a thorough step-by-step solution, and numerical answer with units.

Project
A team project will be assigned early in the semester. Based on the design specification provided, you will be designing a roller coaster, using the design, thrill, biomechanical, and safety aspects you will be learning in the course using hand calculations and computer software. You will also be demonstrating your design through a working prototype.

Teams can be made of at most five members. A professional report not exceeding 20 pages in length, not including bibliography and appendices, should be prepared and submitted by each team. Appendices should contain all hand calculations, and results from computer analysis. You will also be presenting your projects during the last week of classes.
Individual grades for the projects will be determined from the team project grades and your participation in the project determined by your peers and the instruction team. You will be asked to score the performance of your team members on a scale of 100 for each member and submit individually (periodically). The scores you assign to your team members will be kept confidential and will be used in conjunction with their quality of work (on items that will be specified in the sign-off sheet) to determine each member's participation score. Score your team will receive will be multiplied by your individual participation score when it is less than 90%, and assigned as your individual project score. If you have more than 90% peer evaluation scores, you will receive the same score as the team score.

Course Policies
General course policies, including academic integrity, student conduct, excused absence, and missed assignments, are outlined at http://www.ugst.umd.edu/courserelatedpolicies.html. Additionally, for medically necessitated excuses for exams and project-related assignments, supporting documentation signed by a doctor or health-care professional is required for this course, in addition to timely notice.

Learning Outcomes:
The course primarily contributes to the following student outcomes at low (L) or midrange (M) or high (H) levels:
(a) an ability to apply knowledge of mathematics, science, and engineering (H)
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability (H)
(d) an ability to work in multidisciplinary teams (L)
(e) an ability to identify, formulate, and solve engineering problems (H)
(i) a recognition of the need for, and an ability to engage in life-long learning (L)
(k) an ability to use techniques, skills, and modern engineering tools necessary for engineering practice (M)
(l) an ability to work professionally in both thermal and mechanical systems areas (M)