

MECH 4006: VEHICLE ENGINEERING I

Course Outline – Fall 2016

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Class Schedule Tuesday 8:35-9:55 Room SA 615
Thursday 8:35-9:55 Room SA 615

This course does not have labs or tutorials.

Overview

The objectives of the course are to provide: introduction to vehicle dynamics nomenclature and conventions; an understanding of the basic approach used for evaluating road vehicle performance, handling, and ride quality; an appreciation of the effects of design and operational factors affecting road vehicle behaviour; and an overview of recent advances in automotive technologies.

Required Text Wong, J. Y., Theory of Ground Vehicles, Fourth Edition, John Wiley, 2008.

Evaluation Midterm Exam 30%
Final Exam 70%

Assignments

Problem sets and course readings will be assigned regularly. Assigned problems will include theoretical, practical, and computational components. Assignments will not be marked but solutions will be discussed in class. Completing assigned problems is *essential* to success in the course.

Exams

Midterm and final exams will be closed book and will cover all material contained in course notes, assigned textbook readings, and assigned homework problems. Formula sheets will be provided with the exams. The midterm exam will be held during the class period on October 18, 2016). The midterm exam will be returned to students; the final exam is for evaluation purposes only will not be returned to students.

Academic Accommodation

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

Pregnancy obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see the Student Guide (<http://www2.carleton.ca/equity/accommodation/academic/students/>).

Religious obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see the Student Guide (<http://www2.carleton.ca/equity/accommodation/academic/students/>).

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (if applicable).

Outline

Week Topics

- 1,2 Performance characteristics of ground vehicles. Motion of a vehicle as a rigid body. Properties of pneumatic tires: rolling resistance, tractive (braking) effort and longitudinal slip (skid), performance on wet surfaces.
- 3 Aerodynamic drag estimation. Dynamic load transfer, maximum transferable tractive force.
- 4 Acceleration limits, gradability, deceleration and braking, maximum deceleration rates, stopping distance. Antilock braking systems.
- 5,6 Power plant performance and selection. Transmission characteristics, selection of gear ratios. Vehicle performance analysis, estimation of acceleration time and distance.
- 7 Handling characteristics of road vehicles. Lateral behaviour of pneumatic tires, lateral force and side slip angle, cornering stiffness.
- 8,9 Steady state cornering. Neutral steer, understeer, and oversteer. Directional stability of road vehicles. Characteristic speed and critical speed. Steady state response characteristics. Active stability control. Four-wheel steering.
- 10 Transient handling characteristics. Testing of handling performance.
- 11 Ride characteristics of ground vehicles. General vehicle ride models, linear model of sprung and unsprung mass. Two-degrees-of-freedom ride model for sprung mass, pitch and bounce, oscillation centres.
- 12 Criteria for good ride, dynamic index, flat riding tuning. Suspension mechanics. Suspension dynamic properties. Active and semi-active suspensions.
- 13 Review