

Course Outline

1. COURSE INFORMATION

Session Offered	Fall 2023	
Course Name	Vehicle Dynamics	
Course Code	AUTO TECH 4DV3 , SEP 6DV3	
Date(s) and Time(s) of lectures	Monday (10:30-11:20 AM), Friday(11:30-1:20AM)	
Program Name	Automotive and Vehicle Technology	
Calendar Description	Acceleration performance; braking performance; aerodynamics and rolling resistance; ride; tires; steady-state cornering; suspensions; steering systems; rollover.	
Instructor(s)	Moein Mehrtash	E-Mail: Mehrtam@mcmaster.ca Office Hours & Location: Virtual office hours

2. COURSE SPECIFICS

Course Description	<p>A ground motor vehicle is generally intended as a vehicle with mechanical propulsion which can move on the surface of the earth. A modern motor vehicle is supported on wheels with pneumatic tires has energy source that provides the propulsion. Motor vehicle mechanics, intended as the branch of applied mechanics studying the behavior of motor vehicles and their performance. The motor vehicle performance study is started with forces acting on the motor vehicle including the behavior of pneumatic tires and aerodynamics of the vehicles. The dynamic of vehicle can then be used to predict the performance of road vehicle, such as acceleration, braking, rollover, and cornering performance. The dynamic response of vehicle to various excitation sources is another aspect of road vehicle dynamics for ride comfort considerations.</p> <p>The goal of the course is intended to provide information on road vehicle dynamics that will be useful to students in automotive engineering program. Its primary objective is to provide a description of performance, handling, and ride of ground motor vehicle. A combination of six hands-on experiences with lecture material provides outstanding learning outcomes and solid background for the students as future automotive engineers. This course's secondary objective is to serve as obtaining experience in working with automotive standards and test procedures</p>		
Instruction Type	Code	Type	Hours per term
	C	Classroom instruction	
	L	Laboratory, workshop or fieldwork	

	T	Tutorial	
	DE	Distance education	
	Total Hours		
Resources	ISBN	Textbook Title & Edition	Author & Publisher
	ISBN: 1560911999	Fundamentals of Vehicle Dynamics	Thomas D. Gillespie, Society of Automotive Engineers 1992
	Other Supplies	Source Theory of Ground Vehicles, J.Y. Wong, John Wiley & Sons, 2008 Road Vehicle Dynamics: Fundamentals and Modeling, Georg Rill, Crc Press Llc, 2011	
Prerequisite(s)	AUTOTECH 3VD3, 4AE3		
Corequisite(s)			
Antirequisite(s)			
Course Specific Policies	Assignments: <ul style="list-style-type: none">The assignment submission is mandatory (zero for late submission). Assignments must be uploaded to the specified Dropbox on the Avenue to Learn (Hard-copy is not acceptable as a submission). Students are responsible to upload the assignment to the specified folder, failure to do that will not be considered as a submission. Labs: (Due Date: Lab report must be submitted in two-weeks from the lab session, Group submission) <ul style="list-style-type: none">Lab attendance is mandatory. Labs missed due to illness may be excused by the professor if appropriate documentation is provided and the student completes the lab missed on his/her own time, to the professor's satisfaction.Students must complete and submit the lab assignments before the due date posted on Avenue. Lab reports submitted after the posted dead-line or without attending the lab will not be accepted. Lab reports must be uploaded to the specified Dropbox on the Avenue to Learn (Hard-copy is not acceptable as a submission). Students are responsible to upload the Lab reports to the specified folder, failure to do that will not be considered as a submission.		
Departmental Policies	Students must maintain a GPA of 3.5/12 to continue in the program. In order to achieve the required learning objectives, on average, B.Tech. students can expect to do at least 3 hours of "out-of-class" work for every scheduled hour in class. "Out-of-class" work includes reading, research, assignments and preparation for tests and examinations. Where group work is indicated in the course outline, such collaborative work is mandatory.		

	<p>The use of cell phones, iPods, laptops and other personal electronic devices are prohibited from the classroom during the class time, unless the instructor makes an explicit exception.</p> <p>Announcements made in class or placed on Avenue are considered to have been communicated to all students including those individuals that are not in class.</p> <p>Instructor has the right to submit work to software to identify plagiarism.</p>	
3. SUB TOPIC(S)		
Week 1	Tire Mechanics: Structure and Rolling Resistance	Ch. 4 and Ch. 10
Week 2	Tire Mechanics: longitudinal and lateral force generation	Ch. 4 and Ch. 10
Week 3	Vehicle Aerodynamics	Ch. 4
Week 4	Vehicle Aerodynamics and Dynamic Axle Loads	Ch. 1
Week 5	Dynamic Axle Loads and Acceleration Performance	Ch. 2
Week 6	Test 1 and Review	Ch. 2
Week 7	Braking Performance	Ch. 3
Week 8	Vehicle Handling: steady cornering performance	Ch. 6 & 8
Week 9	Tractor-semi Trailer Handling	Notes
Week 10	Rollover and experimental measurement	Ch. 9
Week 11	Test 2 & Review	
Week 12	Ride and Comfort	Ch. 5 & 7
Week 13	Final Exam Review	
<p>Classes end: Wednesday, December 6</p> <p>Final Examination Date: Friday, December 8 to Thursday, December 21</p> <p>Mid-term recess: Monday, October 9 to Sunday, October 15</p>		
List of experiments		
Lab 1	Aerodynamic Drag Calculation of a Vehicle	
Lab 2	Road Test Handling: Constant Velocity Cornering Aerodynamic Drag Calculation	
Lab 3	CarSim: Coast-Down Testing	
Lab 4	CarSim: Brake System and Proportioning	
Lab 5	CarSim: Rollover	
Lab 6	CarSim & Simulink: Cruise Control System Modeling	
<p>Note that this structure represents a plan and is subject to adjustment term by term.</p> <p>The instructor and the University reserve the right to modify elements of the course during the term. The University may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes.</p>		
4. ASSESSMENT OF LEARNING *including dates*		Weight

Term Test I	15
Term Test II	20
Lab Activities	15
Assignments	15
Active Learnings	5
Final Exam (Extra project in addition to final exam for SEP 6DV3)	30
TOTAL	100%

Percentage grades will be converted to letter grades and grade points per the University calendar.

5. LEARNING OUTCOMES

1. **Identify** the road loads (aerodynamic, tractive, and rolling resistance) experienced by a road vehicle
2. **Interpret** the design considerations of a road vehicle performance in acceleration, braking, cornering, and rollover
3. **Explain** the fundamental of ride excitation sources and how to tune vehicle response for the comfort ride
4. **Understand** the vehicle rollover and accident experience
5. **Apply** the knowledge in vehicle road test and lab experimentation situation:
 1. **Determine** the road drag (rolling resistance and aerodynamic drag) of a vehicle
 2. **Demonstrate** the barking performance of a road vehicle (stopping distance and ergonomic design) based on automotive standards
 3. **Calculate** the understeer coefficient in the constant-radius test
6. **Analyze** and critically evaluate the road vehicle performance
 1. **Analyze and predict** vehicle performance in handling, ride, and roll stability.
 2. **Design and develop** standard road tests to evaluate the vehicle performance
 3. **Simulate** the performance a road vehicle dynamic using CarSim

6. COURSE OUTLINE – APPROVED ADVISORY STATEMENTS

ANTI-DISCRIMINATION

The Faculty of Engineering is concerned with ensuring an environment that is free of all discrimination. If there is a problem, individuals are reminded that they should contact the Department Chair, the Sexual Harassment Officer or the Human Rights Consultant, as soon as possible.

http://www.mcmaster.ca/policy/General/HR/Discrimination_Harassment_Sexual_Harassment-Prevention&Response.pdf

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. It is your responsibility to understand what constitutes academic dishonesty.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at <https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/>

The following illustrates only three forms of academic dishonesty: The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com, please go to www.mcmaster.ca/academicintegrity.

COURSES WITH AN ON-LINE ELEMENT

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

ONLINE PROCTORING

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

COMMUNICATIONS

It is the student's responsibility to:

- Maintain current contact information with the University, including address, phone numbers, and emergency contact information.
- Use the University provided e-mail address or maintain a valid forwarding e-mail address.
- Regularly check the official University communications channels. Official University communications are considered received if sent by postal mail, by fax, or by e-mail to the student's designated primary e-mail account via their @mcmaster.ca alias.
- Accept that forwarded e-mails may be lost and that e-mail is considered received if sent via the student's @mcmaster.ca alias.
- Check the McMaster/Avenue email and course websites on a regular basis during the term.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the Code of Student Rights & Responsibilities (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, whether in person or online.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's Academic Accommodation of Students with Disabilities policy.

REQUESTS FOR RELIEF FOR MISSED ACADEMIC TERM WORK

McMaster Student Absence Form (MSAF): In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office normally within 10 working days of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests. <http://www.mcmaster.ca/policy/Students-AcademicStudies/Studentcode.pdf>

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, including lectures by University instructors. The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.