UCLouvain

lmeca2215

2022

Vehicle System Dynamics

5.00 credits	30.0 h + 30.0 h	Q1

Teacher(s)	Fisette Paul ;
Language :	English
Place of the course	Louvain-la-Neuve
Main themes	Fundamental theoretical notions in view of studying vehicle dynamics For the two families of vehicles (road and railway): - Historical survey of the technology ("dynamics-oriented") - Description and analysis of the typical dynamical phenomena - "Macro" modelling of vehicles: sprung and unsprung masses approach - Specific models related to the wheel/road, wheel/rail contact - Model-based illustration of typical dynamical behaviours and parameter sensitivity analysis "Specific vehicle" dynamics (road vehicles : bicycle, motorcycle, truck and trailer ; railway vehicles: metro with combined wheel/rail and tire, Maglev) and/or particular situations (vehicles on uneven terrain or loose ground, tracked vehicles, ') Multiphysics modelling of vehicles: application to different cases, such as - Pneumatic suspensions in railway vehicles, - Hydraulic suspensions in cars, - Semi-active suspensions in cars. Vehicle dynamics : the "industrial" point of view (railway and road vehicles)
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 In consideration of the reference table AA of the program "Masters degree in Mechanical Engineering", this course contributes to the development, to the acquisition and to the evaluation of the following experiences of learning: • AA1.1, AA1.2, AA1.3 • AA2.1, AA2.2, AA2.3 • AA3.1, AA3.3 • AA4.1, AA4.2, AA4.3, AA4.4 • AA5.2, AA5.3, AA5.6 • AA6.3, AA6.4 By the end of this course, students should be able to understand the kinematic and dynamical phenomena responsible for road and railway vehicle behaviour, in terms of stability, handling and comfort. They will also be able to model them mathematically and build a simulation program: using it, they will point out various vehicular behaviours and emphasize the role of mechanical devices which are at the root of vehicle dynamical performance.
Evaluation methods	The evaluation is an open book oral exam: • The theoretical course counts for 60% of the points • The project counts for 40% of the points
Teaching methods	• 13 or 14 theoretical lectures/industrial seminars • 1 project in vehicle dynamics: bibliographic or modeling
Content	1. Introduction : Fundamental concepts of kinematics, multibody dynamics, vibration and numerical methods in view of analysis of vehicle stability, handling and comfort 2. Railway vehicles - Technology : carbodies, bogies, primary and secondary suspensions, track, track irregularities, vehicle morphology (tramway, metro, high-speed trains, etc.), main concepts: load, Y/Q ratio, critical speeds 3. Railway vehicles - "Macro" models: carbodies/bogies/wheelset/wheel/rail contact simplified model, simplified wheelset model (stability) and vertical model (comfort) 4. Railway vehicles - specific models: wheelset-track 3D model, independent wheel-rail model, wheel-flange second contact, curved track model, primary and secondary suspensions models, etc. 5. Railway vehicles - specific models: (cont.) 6. Railway vehicles - use and interpretation of models : model versus experiment, parameter sensitivity analyses, model-based understanding of the fundamental dynamical phenomena 7. Road vehicles - Technology: suspensions (classification), role of the tire, anti-roll bar system, etc., main concepts: struts, car roll centre, torsion bars, suspension typical motions 8. Road vehicles - "Macro" models : sprung and unsprung masses, geometrical roll centre computation, Ackermann steering geometry 9. Road vehicles - specific models : 3D kinematics of suspensions : McPherson strut, multi-link suspensions, etc., torsion and anti-roll systems, tire/ground modelling : description of the various models (lateral, longitudinal, vertical, combined) and model-based comparison ; flexible modelling of carbodies 10. Road vehicles - specific models: (cont.)

	11. Road vehicles - use and interpretation of models : model versus experiment, parameter sensitivity analyses, model-based understanding of fundamental dynamical phenomena (understeering/oversteering, entry curving, steady state curving, comfort criteria with different road profile characteristics 12. Specific vehicles - Technology and Modelling : bicycles and motorcycles (stability, gyroscopic effects, wheel/ground contact models, '), and/or trucks and trailers (lateral stability, jacknifing), and/or tracked vehicles on loose and uneven terrains (geometrical models, constitutive models, ') 13. Industrial Seminar on Railway systems (Vehicles, Infrastructure) 14. Industrial Seminar on Road vehicles (Design, Dynamics)
Inline resources	https://moodle.uclouvain.be/course/view.php?id=1447
Other infos	Industrial seminars given by experts in the field are organized every year.
Faculty or entity in charge	MECA

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Mechanical Engineering	MECA2M	5		🔍
Master [120] in Electro-mechanical Engineering	ELME2M	5		🔍