

Study program / course: Mechanical Engineering			
Type and level of study: Master academic studies			
Course: Vehicles with increased permability			
Lecturers: Miroslav D. Demic, Ph.D., full professor			
Status of course: Obligatory for module M₈, I semester			
Number of ECTS: 6			
Precondition: none			
The objective of course			
Education of students in the areas of theory of motor vehicle's motion not included in programs of the subjects from basic studies (Track laying vehicles, Wheeled tractors, Motorcycles with increased permability, Multiple axle vehicles and Vehicles on air springs).			
The outcome of course			
The ability of students to: mathematically describe the tracked drive and its interaction with road, describe the resistances during straight line drive of the tracked vehicle, calculate performances of a tracked vehicle, explain steerability, stability and braking parameters of a tracked vehicle, describe resistances during straight line drive of wheeled tractors, calculate performances of wheeled tractors, explain stability of wheeled tractors, describe resistances during straight line drive of motorcycles in conditions of increased motion resistance, calculate performances of motorcycles with increased permability, identify the models for analysis of vibration behavior of motorcycles with increased permability on the road, explain power separation and drive moments for multiple axle vehicles, explain basic demands for steering and models for analysis of vibration comfort of multiple axle vehicles and explain the operating principle and vehicle resistance for vehicles on air springs.			
Syllabus			
Theoretical study			
Basics of tracked vehicles motion: Kinematics of tracked drive. Motion path of caterpillar thread points. Absolute speed and acceleration of a caterpillar thread point. Influence of caterpillar thread joints length on its kinematics. Caterpillar thread load: static load, centrifugal forces; caterpillar thread vibration; total caterpillar thread load, Caterpillar thread efficiency. Caterpillar thread – road interaction. Limit tractive force. Resistance forces during straight line drive of tracked vehicles. Gradient resistance. Air resistance. Inertial resistance. Caterpillar threads drive resistance. Operation resistance. Traction-speed characteristics of tracked vehicles. Specific features of tracked vehicles. Performances of tracked vehicles with hydraulic torque converter. Braking of tracked vehicles. Braking parameters of a tracked vehicle in the case of use of braking system. Engine brake. Braking with road resistance. Turning of tracked vehicles. Kinematic relations. Resistances and necessary force for turning the tracked vehicle. Systems for turning the tracked vehicles. Stability of tracked vehicles. Longitudinal and lateral stability in specific driving conditions. Longitudinal ground clearance of tracked vehicles, Longitudinal ground clearance of tracked vehicles during motion on mud, snow, ice and hard obstacles. Selected chapters from the theory of wheeled tractors: Forces and resistances to motion, Selection of engine power, Performances, Characteristic cases of tractor stability loss. Selected chapters from the theory of motorcycle with increased permability motion, Forces and resistances to motorcycle motion, motorcycle performances, Performances of motorcycles with classical and continually varying transmission, Characteristic cases of motorcycle stability losses, Road behavior of motorcycles. Motorcycle steerability. Design measures for improvement of road behavior of motorcycles, Basic concepts of motorcycle vibration comfort. Selected chapters from the area of multiple axle vehicles, Classification, Steerability demands, Drive moments' distribution at multiple axle vehicles, Vehicles on air springs, Basic principles, Principles of motion, performances.			
Practical Studies:			
Verbal exercises: individual work on seminar paper and its defending; getting to know Mechanical desktop software. Student will be trained for basic research in the area of the subject in the framework of study research.			
Recommended reading			
1. Demic, M.: "Theory basics of tracked vehicles", (in Serbian), Technical faculty, Cacak, 1992			
2. Demic, M.: "Motorcycle mechatronics", (in Serbian), Faculty of mechanical engineering from Kragujevac, "DSP" Kragujevac, 1996			
3. Demic, M.: "Theory of motion of motor vehicles", (in Serbian), Technical faculty, Cacak, 1999			
The number of hours of active teaching:			Other classes:
Theory: 3	Practical classes: 1.4	Other forms of teaching: 0.6	Research study: 0
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Methods of teaching			
Teaching will be conducted with the use of multimedia tools, which will create conditions for more active participation of students. Problems from the area of the subject will be solved; introduction to Mechanical desktop software conducted and working on seminar paper and its defending will be done during verbal exercises. Testing of knowledge is done through one individually done seminar paper and two colloquiums (one corrective colloquium is anticipated). Verbal final exam is anticipated.			
Evaluation of knowledge			
Pre-final exam obligations	points	Final exam	points
Activities during the classes:	/	verbal exam	30
Practical classes:	/		
Colloquiums(s) :	40 (2x20)		
Seminar(s) :	30		