TE4241   FUNDAMENTALS OF VEHICLE DYNAMICS

1. GENERAL INFORMATION

Course name:	Fundamentals of Vehicle Dynamics
Course code:	TE4241
Volume:	2(2-1-0-4)

- Theory: 30 hours
- Exercise/ Project: 15 hours
- Experiment: 0 hour

Prerequisite courses:	- None
Courses learned first:	- TE3200: Structure of automobiles
	- TE3210: Theory of automobiles
Paralel courses:	- None

2. COURSE DESCRIPTION

This course belongs to a group of compulsory major and advanced specialized knowledge, taught for students in the 4th year in the academic programme of engineers and students in the first year of the master programme. The course provides learners with advanced knowledge about automotive dynamics, as well as methods and skills to build equations that describe the dynamics model of automobiles in longitudinal, horizontal and vertical directions. Upon completion of this course, learners will be able to learn and evaluate the dynamical properties of cars as well as learn the courses of automobile powertrain systems, mechatronic systems on automobiles.

In addition, the course also provides learners with the skills and attitudes needed in research and development to work in intensive automotive research environments.

3. OBJECTIVES AND EXPECTED LEARNING OUTCOMES

Upon completion of this course, student will be able to:

Objectives /Expected learning outcomes	Description Objectives /Expected learning outcomes of the course	Output standard allocated for the course/ level (I/T/U)
[1]	[2]	[3]
M1	**Explain dynamics and its effects on safety and comfort in the process of moving vehicles on the road**	1.2.2; 1.2.11; 1.3a.3, 2.1.1; 2.2.2; 2.3.1; 2.4.6; 2.5.4; 4.1.2; 4.1.5
M1.1	Explain the concepts of interactive force transfer between mass components on cars, between wheels and road surfaces and dynamical relationships	[1.2.2, 1.2.11, 1.3a.3, 2.1.1; 2.2.2; 2.3.1] (IT)
M1.2	Explain the impact of dynamic parameters on safety and automobile control	1.2.2; 1.2.11; 1.3a.3, 2.1.1; 2.2.2; 2.4.6,

Objectives /Expected learning outcomes	Description Objectives /Expected learning outcomes of the course	Output standard allocated for the course/ level (I/T/U)
		2.5.4; 4.1.2; 4.1.5 (IT)
M2	**Establishing basic models of automobile dynamics research**	1.2.2; 1.2.11; 1.3a.3, 1.3a.9; 2.1.1; 2.1.2; 2.1.3, 2.2.2; 2.3.1; 2.4.2; 2.4.6; 2.5.4; 4.1.2; 4.1.5
M2.1	Analysis of structural components in automobile dynamics models	1.2.2 (ITU); 1.2.11 (TU); 1.3a.3 (T), 1.3a.9 (T); 2.1.1 (T); 2.1.3 (T), 2.2.2 (T); 2.3.1 (I); 2.4.6 (I); 2.5.4 (I); 4.1.2 (IT); 4.1.5 (IT)
M2.2	Identify and understand the internal and external forces in the vehicle dynamics model	1.2.2 (IT); 1.2.11 (ITU); 1.3a.3 (ITU), 1.3a.9 (T); 2.1.1 (T); 2.1.2 (TU); 2.1.3 (T), 2.2.2 (T); 2.3.1 (I); 2.4.6 (I); 2.5.4 (I); 4.1.2 (IT); 4.1.5 (IT)
M2.3	Develop a system of differential equations describing the vehicle dynamics	1.2.2 (TU); 1.2.11 (U); 1.3a.3 (U), 1.3a.9 (U); 2.1.1 (TU); 2.1.2 (U); [2.1.3, 2.2.2; 2.3.1; 2.4.2; 2.4.6; 2.5.4; 4.1.2; 4.1.5] (T)
M3	**Identify assessment methods and technical solutions to improve the quality of automobile dynamics**	1.2.11; 2.1.1; 2.1.2; 2.1.3, 2.2.2; 2.3.1; 2.3.2; 2.4.2; 2.4.6; 2.5.4; 4.1.2; 4.1.5
M3.1	Actively learn and identify computer software applications to solve dynamic models	2.1.1 (T); 2.1.2 (TU); [2.1.3; 2.2.2; 2.3.1;

Objectives /Expected learning outcomes	Description Objectives /Expected learning outcomes of the course	Output standard allocated for the course/ level (I/T/U)
		2.3.2; 2.4.2; 2.4.6; 2.5.4; 4.1.2; 4.1.5] (T)
M3.2	Identify criteria and methods for evaluating vehicle dynamics	[2.1.1; 2.1.2; 2.1.3, 2.2.2; 2.3.1; 2.3.2; 2.4.2; 2.4.6; 2.5.4; 4.1.2; 4.1.5] (T)
M3.3	Identify research and development to improve the vehicle dynamics	[2.1.1; 2.1.2; 2.1.3, 2.2.2; 2.3.1; 2.3.2; 2.4.2; 2.4.6; 2.5.4; 4.1.2; 4.1.5] (T)

4. LEARNING MATERIALS **TÀI LIỆU HỌC TẬP**

Textbook

Not available

Reference books

1. Vehicle dynamics / Martin Meywerk. (KHXG: TL243 .M207m 2015)
2. Vehicle dynamics and control / Rajesh Rajamani. (KHXG: TL243 .R103R 2006)
3. Fundamentals of vehicle dynamics / Thomas D. Gillespie. (KHXG: TL243 .G302T 1992)
4. Vo Van Huong, Nguyen Tien Dung, Duong Ngoc Khanh, Dam Hoang Phuc: "Vehicle dynamics". Vietnam Education Publishing House, 2014. (Library of the Automotive Department)

5. ASSESSMENT

Component points	Assessment method	Description	Objectives /Expected learning outcomes are assessed	Proportion
[1]	[2]	[3]	[4]	[5]
A1. Points for the learning process (*)	**A1.2. Mid-term test**	**Writing test**	**M2.1÷M2.3**	**40%**

A2. Points for final assessment	A2.1. Final test	Writing test	M1.1÷M1.2 M2.1÷M2.3 M3.1÷M3.3	60%

* Points for the learning process will be adjusted by adding attendance points. Attendance points are from –2 to +1, according to Hanoi University of Technology's Official Training Regulations.

6. TEACHING PLAN

Week	Content	Expected learning outcomes	Teaching and learning activities	Assessment form
[1]	[2]	[3]	[4]	[5]
1	**Chapter 1: Overview of automobile dynamics** 1.1. Concept of automobile dynamics 1.2. Automobile structure related to vehicle dynamics 1.3. Research methods of automobile dynamics	M1.1; M3.2	Teaching;	A1.1
2	**Chapter 2: Wheel dynamics on automobiles** 2.1. General introduction 2.2. Structure and physical properties of wheels	M1.1; M1.2	Read the references first; Teaching;	A1.1
3	2.3. Dynamics of automobile wheels 2.4. Wheel slip 2.5. Wheel traction ability	M2.1÷M2.3	Read the references first; Teaching; Exercises	A1.1
4	2.6. The dynamics of the wheel when it is impacted by horizontal force 2.7. Wheel dynamics models	M2.1÷M2.3	Read the references first; Teaching;	A1.1
5	**Chapter 3: Automotive vertical dynamics** 3.1. Overview of the study of vertical and vibration dynamics of automobiles 3.2. Motion smoothness and dynamic safety 3.3. Factors causing automobile vibrations	M1.1; M1.2; M3.2; M3.3	Read the references first; Teaching; Discussion	A1.1; A2.1
6	3.4. Models to study vertical	M2.1÷M2.3	Read the references	A1.1; A2.1

Week	Content	Expected learning outcomes	Teaching and learning activities	Assessment form
[1]	[2]	[3]	[4]	[5]
	dynamics		first; Teaching; Exercises	
7	3.5. Models to study vertical dynamics (continued)	M2.1÷M2.3; M3.1	Read the references first; Exercises; Discussion	A1.1; A2.1
8	**Chapter 4: Automotive longitudinal dynamics** 4.1. Overview of the study of longitudinal automobile dynamics 4.2. Model of longitudinal automobile dynamics 4.3. The forces that prevent the movement of automobile	M1.1; M1.2; M2.1÷M2.3; M3.2; M3.3	Read the references first; Teaching; Exercises	A1.1
9	4.4. Motor characteristics and gear ratio distribution in automobile gearboxes 4.5. The limited motion states of automobile 4.6. Optimal distribution of traction and braking force 4.7. Torsional vibrations in the powertrain	M3.2; M3.3	Read the references first; Teaching; Discussion	A1.1, A2.1
10	**Chapter 5: Automotive horizontal dynamics** 5.1. Overview of the study of horizontal automobile dynamics 5.2. Automobile dynamics when turning	M1.1; M1.2; M3.2; M3.3	Read the references first; Teaching;	A2.1
11	5.3. The movement state of the automobile when turning 5.4. Basic model of automobile dynamics when turning	M2.1÷M2.3; M3.2; M3.3	Read the references first; Teaching; Exercises	A2.1
12	5.5. General model of horizontal automobile dynamics	M2.1÷M2.3; M3.1÷M3.3	Read the references first; Teaching; Exercises; Discussion	A2.1

Week	Content	Expected learning outcomes	Teaching and learning activities	Assessment form
[1]	[2]	[3]	[4]	[5]
13	**Chapter 6: Controlling automobile dynamics** 6.1. Objectives to control automobile dynamics 6.2. Overview of active safety systems in automobiles 6.3. Vertical dynamics control	M1.1÷M1.2; M3.1÷M3.3	Read the references first; Teaching; Discussion	A2.1
14	6.4. Control the parameters of the suspension system 6.5. Control steering system and wheel deflection angle	M1.1÷M1.2; M3.1÷M3.3	Read the references first; Teaching; Discussion	A2.1
15	*Summary and review*		Discussion	

7. REGULATIONS OF COURSE

(Regulations of the course if any)

8. APPROVAL: …………………..

Chairman of the Scientific Council

The team developed the syllabus
Dr. Trinh Minh Hoang

9. UPDATED PROCESS

Update times	Adjusted content	Date approved	Applied from semester / year	Remark
1	……………			
2	…………………			