Subject Guide – Automotive Systems Engineering

Shortened Name	ASE	**Semester**	1-2022
Class Time (weekly)	Thur, 13-16	**Lecture hours**	3h x 15w
Subject Code	090125118	**Assignment and self-study**	5h x 15w
ECTS credits	6	**Preparation for exam**	30
KMUTNB Credits	3(3-0-6)	**Total working hours/semester**	150

1 Revision date of this document, reasons for revision

- 30.06.2023

2 Course description

Power and energy requirements; Functional description of driveline components such as clutch, gearbox, differential and brake units; Power units of vehicle; Driving performance of motor vehicle; Suspension system; Steering system.

3 Lecturer

- Asst. Prof. Dr Saharat Chanthanumataporn

4 Expected learning outcomes (in accordance with the MAE program ELOs)

Primary LOs (primary content of class, knowledge is explicitely evaluated (for example, by exams), larger share of overall grade)

- Ability to apply the fundamental knowledge, to analyze and identify automotive engineering problems as well as to develop the mathematical models for advanced analyzing (GELO 1)
- Knowledge and understanding of principles, techniques and methodology of automotive engineering and design (SELO 1)
- Knowledge and understanding of scientific fundamentals relevant for automotive engineering and design (SELO 2)
- Knowledge of the State-of-the-Art *of selected examples* of technical systems and technologies in the field (SELO 3)

Secondary LOs (not primary content of class, but implicetly taught by application, for example by project work or assignments. Is evaluated, lower share of overall grade)

- Ability to write a professional-quality report on a research or problem-solving project (GELO 3)
- Ability to present a project in front of a professional audience (GELO 6)
- Knowledge and understanding of scientific fundamentals relevant for automotive engineering and design (SELO 2)
- Knowledge of the State-of-the-Art *of selected examples* of technical systems and technologies in the field (SELO 3)

Note: These ELOs correspond to the Program ELOs (referenced in parantheses) but are specifically worded for this course by omissions and additions (in *italics*).

5 Assessment

Each student will be individually assessed based on the performance on assignments, a project and written exams, with the overall grade resulting from the shares as below:

Evaluated items	**shares**
Midterm exam, 180 minutes, on content of “unit # 1-6” of the class	35%
Final exam, 180 minutes, on content of “unit # 7-12” of the class	35%
Seminar: 60-minute presentation of current research interest	30%
Total	**100%**

- Both exams are closed book and paper-based
- Each student has to propose one journal paper (to be presented in seminar) for approval by week 9.

6 Teaching materials

- Power-Point presentations for lectures, handed over as reference and learning material
- Exercise-assignments for each week’s topic
- Solutions for exercise-assignments, handed over one week after exercise

7 Books and references

- Automotive engineering fundamentals by Richard Stone and Jeffrey K. Ball
- Fundamentals of Vehicle Dynamics by Thomas D Gillespie
- Theory of Ground Vehicles by JY Wong
- Vehicle Dynamics: Theory and Application by Reza N. Jazar
- Automatic Transmissions and Power Trains by William R. Crouse

The book is not required to take part in the course but recommended background reading.

8 Course schedule

Week	Date	Activity, Class Title (unit number)	Evalu-ation %	Class Hours
1	10/08	Introduction & Overview of automotive engineering		3
2	17/08	Vehicle power demand I		3
3	24/08	Vehicle power demand II		3
4	31/08	Power unit (ICE)		3
5	07/09	Transmission I		3
6	14/09	Transmission II		3
7	21/09	Hybrid/electric vehicles		3
8	28/09	**Midterm Exam**	35%	
9	12/10	Braking System		3
10	19/10	Suspension System I		3
11	26/10	Suspension System II		3
12	02/11	Steering system		3
13	09/11	Driving Performance		3
14	16/11	**Final Exam**	35%	
15	23/11	**** Seminar ****	30%	3
16	30/11	**** Seminar ****		3
17	07/12	**** Seminar ****		3
		(Sums)	100%	45

9 Content details

Unit #	Title	Lesson (L) Contents
1	Introduction & Overview of automotive engineering	• Definitions: automobile, automotive engineering • History of automobile • Overview of automotive systems and components
2	Vehicle power demand I	• Definitions: propulsion power and load • Air drag mechanism on automobile • Effect of vehicle body such as forebody, rear-end inclination, underbody, cooling system on air drag force • Drag force, side force, lift force calcution
3	Vehicle power demand II	• Rolling resistance and factors affecting rolling resistance such as Tire temperature, Tire inflation pressure/load, Velocity, Tire material and Design, Tire slip, Typical coefficients • Rolling resistance and gradient Resistance calculation • Total road load and fuel economy effects
4	Power unit (ICE)	• History of automobile power units • Fundamental of internal combustion engine • Internal combustion engine thermodynamics
5	Transmission I	• Overview, definition, function of transmission system • Working principle of manual transmission system • Manual transmission system gear ratio calculaiton
6	Transmission II	• Working principle of automatic transmission systems • Planetary gear calculation • Diffierential gear calculation
7	Hybrid/electric vehicles	• Definitions and types of hybrid electric vehicles • Working principle of various hybrid systems • Characteristic of additional components such as electric motor and battery
8	Braking System	• Energy of motion and work of braking • Determination of brake stopping distance and brake efficiency • Vehicle dynamics during braking • Working principle of braking systems and related components
9	Suspension System I	• Overview, definition, function of suspension systems such as hotchkiss, trailing arms, semi-dependent, MacPherson strut and double wishbones • Overview, definition, function of suspension components such as various types of spring, shock absorber and stabilizer bar
10	Suspension System II	• Suspension terminology • Camber, caster and toe angle effect on vehicle dynamics • Anti-squat/anti-dive geometries
11	Steering system	• Function and history of steering system • Kinematic and calculaiton of ackermann and trapezoidal steering geometry • Steering Mechanisms
12	Driving Performance	• Acceleration Performance • Traction-limited acceleration • Engine power-limited acceleration

10 Details on the evaluation of Expected Learning Outcomes

		MT-Exam	Final Exam	Project			
				Quality of paper	Quality of slides	Presen-tation	
		35%	**35%**	**10%**	**10%**	**10%**	
GELO1	Ability to apply the fundamental knowledge, to analyze and identify automotive engineering problems as well as to develop the mathematical models for advanced analyzing	10%	10%				**20%**
SELO1	Knowledge and understanding of principles, techniques and methodology of automotive engineering and design	10%	10%				**20%**
SELO2	Knowledge and understanding of scientific fundamentals relevant for automotive engineering and design	10%	10%	2.5%	2.5%		**25%**
SELO3	Knowledge of the State-of-the-Art of selected examples of technical systems and technologies in the field	5%	5%	2.5%	2.5%		**15%**
GELO3	Ability to write a professional-quality report on a research or problem-solving project			5%	5%		**10%**
GELO6	Ability to present a project in front of a professional audience					10%	**10%**