1MG11: SYSTÈMES DE PROPULSION HYBRIDES ET ELECTRIQUES

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Course target

- Understanding, analyzing, and designing clean propulsion systems for vehicles
  - = understanding the environment and energy challenges of transport systems
  - = understanding the problems and constraints of energy conversion systems in vehicle applications (impact upon vehicle architecture and performances)
  - = understanding the different kinds of propulsion systems (thermal engines, electric motors, electrochemical converters, etc.)
  - = understanding the different energy storage systems (fuels, batteries, supercaps, fly wheels, etc.)
  - = understanding how to combine them to take the best of each of them in an integrated system

Course target

- Assess the performance of the propulsion system and of the vehicle
- Choose a motor with its fuel / energy
- Combine several solutions (hybrid propulsion systems)
- Optimal energy / power management
- Case studies

Agenda

	Date	Cours	Lieu
01	21/09	Introduction et Organisation	TEAMS
		Défis pour l'automobile	
		Sélection d'une motorisation (partie 1)	
02	28/09	Sélection d'une motorisation (partie 2)	TEAMS
03	05/10	Architecture des Systèmes de Propulsion	TBC
		ICE + embrayage + boite de vitesses	
		EV & HEV	
04	12/10	Caractéristiques et performances des moteurs à Combustion Internes	TBC
		Caractéristiques et performances des machines Electriques	

Agenda

TBC	Date	Cours	Lieu
05	19/10	Introduction au calcul des performances des véhicules (partie 1)	TBC
		Forces aux roues/ Résistance à l'avancement	
06	26/10	Introduction au calcul des performances des véhicules (partie 2)	TBC
		Vitesse max, pente max, accélération, consommation	
		Projet partie 1: Performance of véhicule à moteur à combustion interne	
XX	02/11	CONGE D'AUTOMNE	

Agenda

	Date	Cours	Lieu
07	09/11	Performance des véhicules électriques	TBC
08	16/11	Batteries et systèmes de stockage de l'énergie et de la puissance	TBC
09	23/11	Véhicules Hybrides. Principes de fonctionnement Architecture et Composants	TBC
		Projet partie 2: Performance of VE	
10	30/11	Piles à combustible - Véhicules à Pile à Combustible	TBC
	07/12	Laboratoire: Banc à rouleaux	
XX	18/12	Projet: Remise des projets	
**	**/01	Examen en janvier	

Course. Table of Content

- Introduction: context and challenge of clean propulsion
- Selection of a propulsion system
  - Selection and comparison
  - Internal combustion engines
  - Electric vehicles
  - Hybrid powertrains
  - Fuel cell vehicles
- Internal Combustion Engines
  - Engine principles and architecture
  - Engine performances and characteristic curves
  - State-of-the-art and Future trends

Course. Table of Content

- Electric motors
  - Electric motor type
  - DC / AC /SRM
  - Power electronics
  - Modelling

- Fundamental of vehicle propulsion and braking
  - Powertrain technologies
  - Propulsion forces and road resistances
  - Performance evaluation
    - Max speed, gradeability
    - Acceleration
  - Energy consumption and emissions
    - Driving cycles, estimation procedures, chassis dynamometer

Course. Table of Content

- Electric vehicles:
  - Electric powertrain & Architecture
  - Performances
  - Design principles
  - Selection battery, electric motor, dear box

- Energy and power storage systems
  - Batteries
  - Characteristics
  - Technologies

Course. Table of Content

- Hybrid vehicles architecture
  - Concept of hybrid powertrain
  - Key Components
  - Energy Management Strategies
  - Case studies
    - Passenger cars: Prius, Insight
    - Hybrid buses: electric vs hydraulic

- Fuel Cell and Fuel Powered Vehicles
  - Principles
  - Modeling
  - Sizing

Agenda

- Lectures & Exercises
  - Mardi: 08:30-11:30
  - TEAMS
- Labs
  - Thermodynamic Labs (B49)

Projects

- Part 1: Performance assessment of ICE and EV vehicles:
  - Max speed, Max slope,
  - Acceleration, Elasticity
- Part 2: Modeling of consumption of ICE and EV against NEDC driving cycles
  - Simulation of energy consumption
  - City driving speed limits 30 km/h vs 50 km/h
  - Comparison and discussion
- Assessment:
  - Evaluation of the reports
  - Defense = second part of the exam.

Labs

- Lab:
  - Chassis dynamometer
  - Group of 4 students
- When:
  - December
- Assessment:
  - Report for the group
- Where:
  - Laboratory of Thermodynamics 49, Sart Tilman.

Exam and evaluation

- Projects → continuous evaluation
  - Evaluation: Reports
  - Oral presentation: final discussion and feedback.
- Oral exam
  - Theory (Summary of 4 pages available)
- Period → January

Lecture notes & Contact

- Copies of slides are available on web site:
  - http://www.ingveh.ulg.ac.be/index.php?page=GED-Gramme
  - Cours >> 1MG11

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References

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  - Available on academia.edu

- Les véhicules hybrides. Des composants au système. Sou la direction d François Badin. Editions Technip, Paris, 2013
- C.C. Chan and K.T. Chau. « Modern Electric Vehicle Technology » Oxford Science Technology. 2001.
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