

YOUSOUF - BOUKRA - 1700055

ALTERNATIVE - POWERTRAIN - M6X02209

LEVEL: 06

BSc. AUTOMOTIVE ENGINEERING

LOCATION: HOME

TIME: 2 HOURS

DATE: 11 / 05 / 2020

FIRST NAME : YOUSOUF

LEVEL : 6

LAST NAME : BOUKRA

- STUDENT NUMBER: 1700055

MODULE CODE : MCX02209

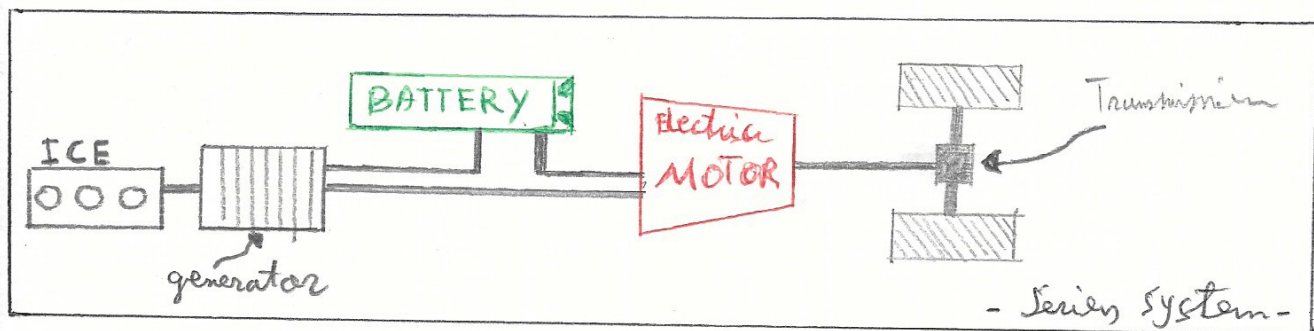
PAGE NUMBER: 1

Question 03 :

a1. Vehicle architecture : 01: Hybrid :

- There are variety of methods to achieve an electric-internal combustion Hybrid system. These multiple ways can be differentiated through the linkage of the electric and the combustion portions of the Vehicles' powertrains. The two major and commonly used ways are through: Series ~~Hybrid~~ Hybrid, and Parallel Hybrid.

Series Hybrid :



In Series hybrid technology, the combustion engine does not directly power the drive train, rather it drives the electric ~~motor~~ generator which is linked to the electric motor that powers the drive trains.

advantages :

- flexibility due to the lack of mechanical connections between the wheels and ICE
- better efficiency compared to parallel system.
- efficient during drive cycles that encompass of many stops and starts.

FIRST NAME : YOUSOUF

LEVEL : 6

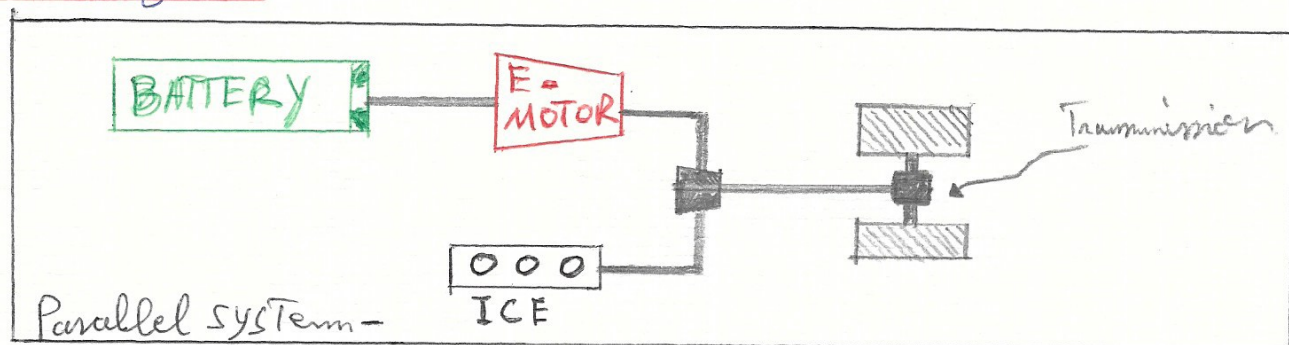
LAST NAME : BOUKRA

- STUDENT NUMBER : 1700055

MODULE CODE : M6X02209

PAGE NUMBER : 2

Parallel hybrid:



- Parallel system connect both the electric motor, and ICE to the Mechanical transmission. They assist the mechanical drive train on acceleration, and accept regenerative energy by braking, and their contribution can be designed to a defined level.
- With the split power drive train, the Torque of ICE and E-Motor are combined by a planetary gear, which permits to select the power distribution between the ~~two~~ branches of the powertrain.

02: electric motor:

- Electric Motors are the future of Vehicle Technology, specifically Brushless DC Machines are implemented widely in the Automotive industry. The motor contains advanced technology compared to Brushed DC, as it replaces the brushes with electronic commutator, making the motor very reliable and efficient. They are also known as "Synchronous" type because the magnetic field generated by the stator and the rotor revolve at the same frequency.

FIRST NAME: YOUSOUF

LEVEL: 6

LAST NAME: BOUKRA

- STUDENT NUMBER: 1700055

MODULE CODE: MGX02209

Page Number: 3

- Other Benefits of electric motor are: Very high speed, high efficiency, High Torque Density, Very low maintenance, and low noise while being environmentally friendly.

- disadvantages: expensive, ~~Require high energy~~ Require High energy Storage system which make vehicle very heavy. ~~Driver concerned of~~

31- fuel cell:

Using hydrogen as a fuel cell is a preferred approach in a long term, fuel cell uses a process that is essentially the reverse of electrolysis to combine hydrogen and oxygen in the presence of a catalyst to generate electricity. The product used here is water, fuel cells are much more efficient than if hydrogen been burned in ICE. after 70%. However, they are expensive due to the architecture of their technology.

FIRST NAME: YOUSOF

LEVEL: 6

LAST NAME: BOUKRA

- STUDENT NUMBER: 1700055

MODULE: M6X02209

Page Number: 4

- b1 investigate and contrast alternative technologies for:

II- Drive / electrical Machines:

- in conventional EV machine, the electric motor is installed in the position of the ICE ~~and~~ ~~the~~ ~~motor~~, and it transfers power to the wheels via a drive shaft. This method allows EVs to make use of the automotive technology already existing in cars with engines.
- However, with in-wheel electric machines, motors are installed close to ~~the~~ each of the drive wheels, and are moving the wheels through very small drive shaft. This gave it many advantages which are:
 - ~~that~~ - No time lag, due to the short drive shaft.
 - Motors power is ~~transmitted~~ transmitted to the wheels.
instantaneously
 - Very Precise wheel control.

FIRST NAME: YOUSOUF

Level: 6

LAST NAME: BOUKRA

Student Number: 1700055

MODULE CODE: MGX02209

Page Number: 5

21-energy storage:

- the ~~emulative~~ technologies will be discussed here: Battery Power and Supercapacitor/ultra-capacitors storage systems:

a) ~~1.1.1~~ Battery: Lithium ion Batteries are nowadays

Representing the most used technology in electric vehicle energy storage systems. Meanwhile, other technologies have also been pursuing their development in the auto industry such as Ni-MH batteries, Ni-Cd, and Lead-Acid Batteries.

- Ni-MH advantages over other Battery technologies can be ~~high~~ highlighted below:

- high ~~energy~~ energy density and power.
- allowing an autonomy of over 300 km (70 Wh/kg energy)
- increased life cycle (until 80% Depth of Discharge DOD)
- Recyclable material.
- excellent thermal properties (operating temperature range -30°C to $+70^{\circ}\text{C}$)
- Capability of using energy from Recovery of Regenerative Systems. (KERS)

FIRST NAME: YOUSOUF

LEVEL: 6

LAST NAME: BOUKRA

- STUDENT NUMBER: 1700055

MODULE: MEX02209

PAGE NUMBER: 6

b) ultra Capacitors

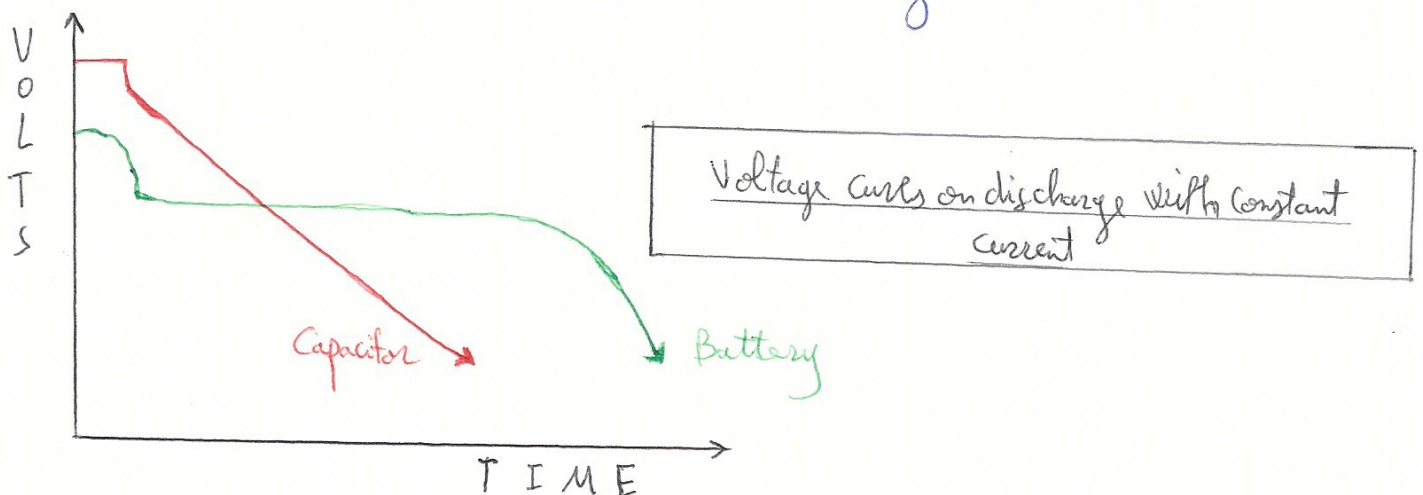
- Supercapacitors have several benefits over batteries, but currently they also have few drawbacks. It is interesting however that, they are used in the New "Lamborghini Sian".

- While batteries store energy in a form of chemicals, super or ultra capacitors store electricity in a static state, making them better and faster in terms of charging and discharging energy. They are also very effective for collecting energy generated under braking, ~~that then~~ then rapidly releasing it upon acceleration.

- two main ~~disadvantages~~ drawbacks are:

- energy density as they are not able to store as much energy as a battery system.

- Supercapacitors cannot hold a charge as long as Lithium ion battery for example; supercapacitors-powered car would run out of energy if it left stand for a week without running.



FIRST NAME: YOUSOUF

Level: 6

LAST NAME: BOUKRA

- Student Number: 1700055

MODULE: MEX02209

Page Number: 7

31 Re-fuelling: in this section I will discuss Refuelling Technologies for Hydrogen:

- first let's discuss filling station technology: Hydrogen Refuelling Stations (HRS) can be part of a station for fossil fuel ~~Refueling~~ Refueling or Built independently.
- a HRS is composed of a Basic unit, or of Basic unit plus a production unit if Hydrogen is produced on site.
- Certain technical components are necessary ~~to~~ for the construction of Hydrogen Refueling Station. for all Refueling station this include adequately sized storage facilities for Hydrogen, compressors which bring the Hydrogen to the desired ~~gas~~ pressure level, a pre-cooling system, and dispensers for delivering the fuel.
- However, if vehicle with Hydrogen technology where to use the fuel in a form of Hydrocarbons or liquid Hydrogen. there will be no need for a new infrastructure and expensive Hydrogen stations and also the vehicle will not need ~~the~~ a heavy and costly Hydrogen tanks or pressurised vessels. that because Hydrocarbon works as followed:
 - By performing methanol and ethanol in the presence of steam at high temperature, the Hydrogen can be liberated, resulting in fuel steam containing Hydrogen (70-75%). this method means that Hydrogen will be created on board of the car. making it a potential technology for the future.

FIRST NAME: YOUSOF

Level = 6

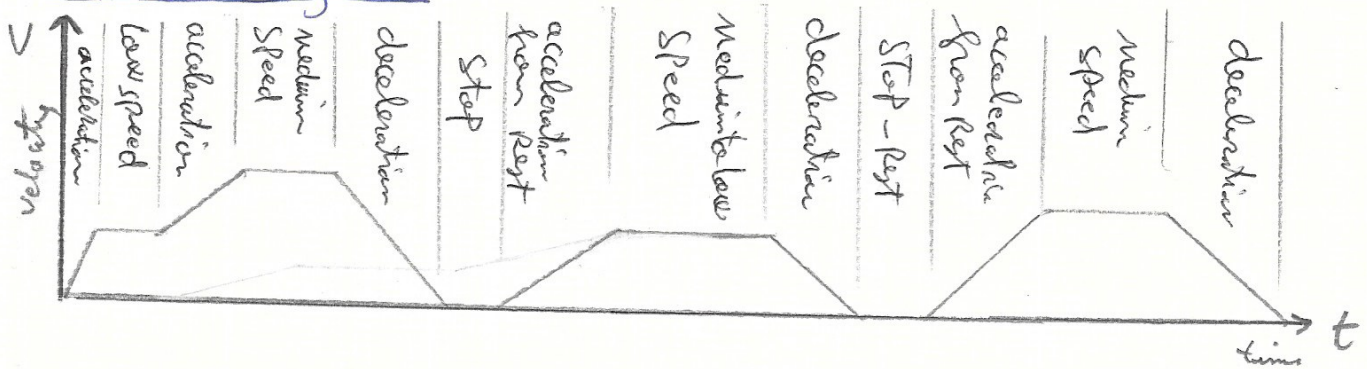
LAST NAME: BOKRA

Student Number: 1700055

MODULE: M6X02209

Page Number: 8

C1- drive cycle:



- We can investigate the drive cycle chart above by saying that the Van will experience a lot of stop for considerable amount of time to discharge the load or charge the load. and the Van will most of the time be in a medium speed (22 m/s MAX) which is equivalent to 50 mil per hour.

- The Vehicle though will need High Torque to serve its function and considerable power.

d) Recommendation of alternative selection: CNG is an environmentally friendly fuel, and it can be fitted along with petrol in a separate fuel tank (compressed between 200 and 300 bar), it is safe as it can be stored at ambient temperatures ~~and become it is~~. The Vehicle/Van will need to have injectors which are compatible and the benefits of it are discussed below:

77% less PM emissions / 11% less CO₂ / 90% less NOx / 35% cheaper than Diesel / 75% cheaper than petrol / quick to fuel up / safe and sustainable.

FIRST NAME: YOUSOUF

LEVEL: 6

LAST NAME: BOUKRA

- STUDENT NUMBER: 1700055

MODULE CODE: M6X02209

Page Number: 9

Question 02:

1) discussing energy storage technology selected:

System selected is flywheel: for endurance Racing Car

- a flywheel is a rotating mechanical device that is used to store rotational energy that can be called up instantaneously, which is suitable for racing.
- a flywheel contains a spring mass in its center that is driven by a motor, and when energy is needed, the spring force drives a device similar to a ~~turbine~~ turbine to produce electricity, slowing the rate of rotation. A flywheel is recharged by using the motor to increase its rotational speed once again.

System selected for Road car: lithium batteries:

- lithium batteries can store considerably high energy compared to flywheels, which make them suitable for long distance ~~travelling~~ travelling.