**INTERNATIONAL EFFICIENCY CHALLENGE**

**ELECTRIC VEHICLE**

**Technical Design Report**

|  |  |  |
| --- | --- | --- |
| **TEAM ID:** |  | |
| **TEAM NAME:** |  | |
| **TEAM CAPTAIN:** |  | |
| **TEAM CAPTAIN’S UNIVERSITY:** |  | |
| **VEHICLE NAME:** |  | |
| **CATEGORY:** | **ELECTROMOBILE** | **HYDROMOBILE** |

# Vehicle Specifications Table

|  |  |  |
| --- | --- | --- |
| Feature | Unit | Value |
| Length | mm |  |
| Width | mm |  |
| Height | mm |  |
| Chassis | material |  |
| Shell | material |  |
| The brake system | hydraulic disc, front, rear, hand brake |  |
| Motor | type |  |
| Motor driver | self-designed, ready-made product |  |
| Motor power | kW |  |
| Motor efficiency | % |  |
| Engine weight | kg |  |
| Battery cell chemistry | type |  |
| Battery pack nominal voltage | V |  |
| Battery pack capacity | Ah |  |
| Battery pack Maximum voltage | V |  |
| Battery pack energy | Wh |  |
| Fuel cell power | kW |  |
| Number of hydrogen cylinders | # |  |
| Hydrogen cylinder pressure | bar |  |
| Super capacitor | yes/no |  |
| You must fill in the fields related to your category. |  |  |

# Vehicle Dynamic Testing

# Braking Test Video

# Pre-Technical Control Videos

1. **Motor Video**
2. **Motor Driver Video**
3. **Battery Management System Video**
4. **Energy Management System Video**
5. **Embedded Recharging Unit Video**
6. **Battery Packaging Video**
7. **Electronic Differential Application Video**
8. **Vehicle Control Unit Video**
9. **Insulation Monitoring Device Video**
10. **Steering System Video**
11. **Door Mechanism Video**
12. **Brake System Video**
13. **Hydrogen System (Fuel Cell, Fuel Cell Control System, Hydrogen Line and Metal Hydride Cylinders) Video (For Hydromobile Only)**
14. **Telemetry Video**

# Domestic Sub-Components

|  |  |  |
| --- | --- | --- |
| 1. **Motor** | **Mandatory for Electromobile/Hydromobile** |  |
| 1. **Motor driver** | **Mandatory for Electromobile/Hydromobile** |  |
| 1. **Battery management system (BMS)** | **Mandatory for Electromobile/Hydromobile** |  |
| 1. **Embedded recharging unit** | **Mandatory for Electromobile** |  |
| 1. **Energy management system (EMS)\*** | **Mandatory for Hydromobile** |  |
| 1. **Battery packaging** | **Optional** |  |
| 1. **Electronic differential application** | **Optional** |  |
| 1. **Vehicle control unit (VCU)** | **Optional** |  |
| 1. **Fuel cell\*** | **Optional** |  |
| 1. **Fuel cell control system (circuit)\*** | **Optional** |  |
| 1. **Insulation monitoring device** | **Optional** |  |
| 1. **Steering system** | **Optional** |  |
| 1. **Door mechanism** | **Optional** |  |
| 1. **Braking System** | **Optional** |  |

*\* Hydromobile category only*

# Motor

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Previous Design** | **Current Design** |
| **Motor Type** | **:** |  |  |
| **Motor Phase Voltage** | **:** |  |  |
| **Motor Power** | **:** |  |  |
| **Motor Speed** | **:** |  |  |
| **Motor Dimensions** | **:** |  |  |
| **Motor Weight** | **:** |  |  |
| **Motor Efficiency** | **:** |  |  |
| **Motor Main Dimension** | **:** |  |  |
| **Stator Dimension** | **:** |  |  |
| **Rotor Dimension** | **:** |  |  |
| **Winding Scheme** | **:** |  |  |
| **Motor Optimization** | **:** |  |  |
| **Magnetic Design and Analysis Model** | **:** |  |  |
| **Thermal Design and Analysis Model** | **:** |  |  |
| **Mechanical Design and Analysis Model** | **:** |  |  |
| **Motor Test Methods and Results** | **:** |  |  |

# 

# Motor Driver

1. *Comparison Table*

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Previous Design** | **Current Design** |
| **Switch** | **:** |  |  |
| **Driver IC** | **:** |  |  |
| **Controller IC** | **:** |  |  |
| **Control Algorithm** | **:** |  |  |
| **Protection Circuit** | **:** |  |  |
| **Electric Circuit Design** | **:** |  |  |
| **Printed Circuit Board Design** | **:** |  |  |
| **Printed Circuit Board Production** | **:** |  |  |
| **Simulation Studies** | **:** |  |  |
| **Dimension (PCB / boxed hardware)** | **:** |  |  |
| **Power / Current / Voltage** | **:** |  |  |
| **Efficiency** | **:** |  |  |

1. *Ready-made Product Specifications Table*

|  |  |  |  |
| --- | --- | --- | --- |
| **Characteristic** |  | **Description/Values** | |
| **Manufacturer Part No** | **:** |  | |
| **Rated current (A)** | **:** |  | |
| **Rated voltage (V)** | **:** |  | |
| **Frequency of operation (kHz)** | **:** |  | |
| **Current limit (A)** | **:** |  | |
| **Driving/Control method** | **:** |  | |
| **Weight (kg)** | **:** |  | |
| **Dimension (Length x Width x Height)** | **:** |  | |
| **Efficiency (%)** | **:** |  | |
| **Operating temperature range** | **:** |  | |
| **Programmable** | **:** | **Yes** | **No** |
| **Regenerative braking mode** | **:** | **Yes** | **No** |
| **Over-voltage protection** | **:** | **Yes** | **No** |
| **Under-voltage protection** | **:** | **Yes** | **No** |
| **Over-current protection** | **:** | **Yes** | **No** |
| **Over-heat protection** | **:** | **Yes** | **No** |
| **HALL protection** | **:** | **Yes** | **No** |
| **Phase winding disconnect protection** | **:** | **Yes** | **No** |

# Battery Management System (BMS)

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Previous Design** | **Current Design** |
| **Battery Packing Design** | **:** |  |  |
| **Output Voltage** | **:** |  |  |
| **Output Current** | **:** |  |  |
| **Balancing Method (active or passive)** | **:** |  |  |
| **Circuit Design Type** | **:** |  |  |
| **SOC Estimation Algorithm** | **:** |  |  |
| **Control Algorithm** | **:** |  |  |
| **Domestic or Not** | **:** |  |  |

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# Embedded Recharging Unit

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Previous Design** | **Current Design** |
| **Circuit Topology** | **:** |  |  |
| **Power** | **:** |  |  |
| **Output Voltage Range** | **:** |  |  |
| **Output Current Ripple** | **:** |  |  |
| **Input Power Factor** | **:** |  |  |
| **Power Conversion Efficiency** | **:** |  |  |
| **PWM Controller IC** | **:** |  |  |
| **Protection Circuits / Components** | **:** |  |  |
| **PCB Size** | **:** |  |  |

# Energy Management System (EMS) (Hydromobile category only)

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Previous Design** | **Current Design** |
| **Circuit Topology** | **:** |  |  |
| **Power** | **:** |  |  |
| **Input Voltage Range** | **:** |  |  |
| **Output Voltage Range** | **:** |  |  |
| **Power Conversion Efficiency** | **:** |  |  |
| **PWM Controller IC** | **:** |  |  |
| **Semiconductor Power Switches** | **:** |  |  |
| **Protection Circuits / Components** | **:** |  |  |
| **PCB Size** | **:** |  |  |

# Battery Packaging

# Electronic Differential Application

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Previous Design** | **Current Design** |
| **System Topology (Used Sensors, Control Units, Actuators etc.)** | **:** |  |  |
| **Vehicle Model (Kinematic Model, Simple Dynamic Model, Full Vehicle Model etc.)** | **:** |  |  |
| **Control Algorithm** | **:** |  |  |
| **Considered Exceptional Cases and Proposed Design Solutions (Low Adhesion, Split Friction (Mu), Weight Transfer, Acceleration /Deceleration on Curves etc.)** | **:** |  |  |
| **Applied Simulation Scenarios** | **:** |  |  |
| **Performance Results for Simulation Scenarios** | **:** |  |  |
| **Applied Test Scenarios** | **:** |  |  |
| **Performance Results for Test Scenarios** | **:** |  |  |

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# Telemetry System

# Vehicle Control Unit (VCU)

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Previous Design** | **Current Design** |
| **VCU Functions** | **:** |  |  |
| **Controller IC** | **:** |  |  |
| **Number of VCU I/O** | **:** |  |  |
| **Electronic Circuit Design** | **:** |  |  |
| **Printed Circuit Design** | **:** |  |  |
| **Printed Circuit Manufacturing** | **:** |  |  |
| **Software Algorithm** | **:** |  |  |
| **Experimental Study** | **:** |  |  |
| **Size (PCB / Box)** | **:** |  |  |

# Insulation Monitoring Device

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Previous Design** | **Current Design** |
| **Micro Controller IC** | **:** |  |  |
| **Measuring Accuracy at 50kΩ** | **:** |  |  |
| **Measuring Accuracy at 200kΩ** | **:** |  |  |
| **Measuring Accuracy at 1MΩ** | **:** |  |  |
| **Does the system give warning under 10kΩ resistance?(Y/N)** |  |  |  |

# Steering System

# Door Mechanism

# Braking System

# Mechanical Details

# Hydrogen System (Fuel Cell, Fuel Cell Control System, Hydrogen Line and Metal Hydride Cylinders) (Hydromobile category only)

1. ***Fuel Cell***
2. ***Fuel Cell Control System***
3. ***Hydrogen Line and Metal Hydride Cylinders***

# Vehicle Electric Scheme

# Unique Design by Team