**INTERNATIONAL EFFICIENCY CHALLENGE**

**ELECTRIC VEHICLE**

**TECHNICAL DESIGN REPORT GUIDE**

***Deadline: January 16 – 19, 2023***

|  |  |
| --- | --- |
| **TEAM ID:** |  |
| **TEAM NAME:** |  |
| **TEAM CAPTAIN:** |  |
| **TEAM CAPTAIN’S UNIVERSITY:** |  |
| **VEHICLE NAME:** |  |
| **CATEGORY:** | **☐ ELECTROMOBILE** | **☐ HYDROMOBILE** |
| **VEHICLE STATUS:** | [ ]  **NEW VEHICLE** | [ ]  **EXISTING VEHICLE** |

# Team Information

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No** | **First name/Last name** | **Role** | **Department** | **Year** |
| 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |
| 5 |  |  |  |  |

# 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 |  |
| Supercapacitor\* | yes/no |  |
| You must fill in the fields related to your category. |  |  |

*\*Hydromobile category only*

# 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** | **☐** |
| 1. **Passenger seat manufacture**
 | **Optional** | **☐** |

*\* Hydromobile category only*

# Motor

1. Comparison Table

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **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. 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** |

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** | **:** |  |  |

# Battery Management System (BMS)

1. Comparison Table

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **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** | **:** |  |  |

#

# Battery Packaging

# Embedded Recharging Unit

1. Comparison Table

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **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** | **:** |  |  |

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

1. Comparison Table

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **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** | **:** |  |  |

# Electronic Differential Application

1. Comparison Table

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **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** | **:** |  |  |

# Telemetry System

# Vehicle Control Unit (VCU)

1. Comparison Table

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **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

1. Comparison Table

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **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

# Passenger Seat Manufacturing

# 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

# Drag Race