About Team IIT Roorkee Motorsports

We are a team of highly motivated **Inter-Disciplinary Engineering students** who want to lead the nation's technological advancements in the field of hybrid and electric automobiles.

We **design, fabricate, analyse, test and run a formula style race car** to represent India at prestigious International Collegiate Motorsport Competitions namely FSAE and Formula Student.

Every aspect of the project is completely managed by the students; from **initial design, manufacturing and testing of the car to marketing and gathering finances for the project**. This is done by them **without compromising with their academic commitments.**

What are the Formula Student FSAE competitions?

Formula Student and Formula Society of Automotive Engineers are one of the most established educational motorsport competitions which aim to inspire and develop enterprising and innovative young engineers. These competitions are backed by the many professionals from the motorsport industry who views them as a platform for identifying engineering talent.

The concept behind these competitions is that a fictional manufacturing company has contracted a student design team to develop a small Formula-style race car with the non-professional weekend autocross racer as its potential target market. The prototype race car is to be evaluated for its potential as a large scale production item.

So each student team participating in the competition is challenged to design and build a single-seat prototype race car which takes them out of the classroom and allows them to apply textbook theories to real work experiences.

Their design is required to incorporate a series of rules which ensures on-track safety while at the same time giving them the liberty to develop ingenious solutions and designs.

The prototype is judged in a number of different events:

Static Events	Dynamic Events
Presentation Event	Acceleration Event
Design Event	Skidpad Event
Cost and Manufacturing Analysis Event	Autocross Event
	Fuel Economy Event
	Endurance Event

These competitions promote careers and excellence in engineering as the competitions encompass all the aspects of the automotive industry including **research, design, manufacturing, testing, developing, marketing, management and finances.**

Our Achievements So far…

We have participated at Formula Student twice in the last four years: first in 2011 and then in 2013.We made our debut with an Internal Combustion engine car at **FSAE Australasia, 2011** which was held **Calder Park Raceway, Melbourne.**

Our performance highlights in Melbourne:

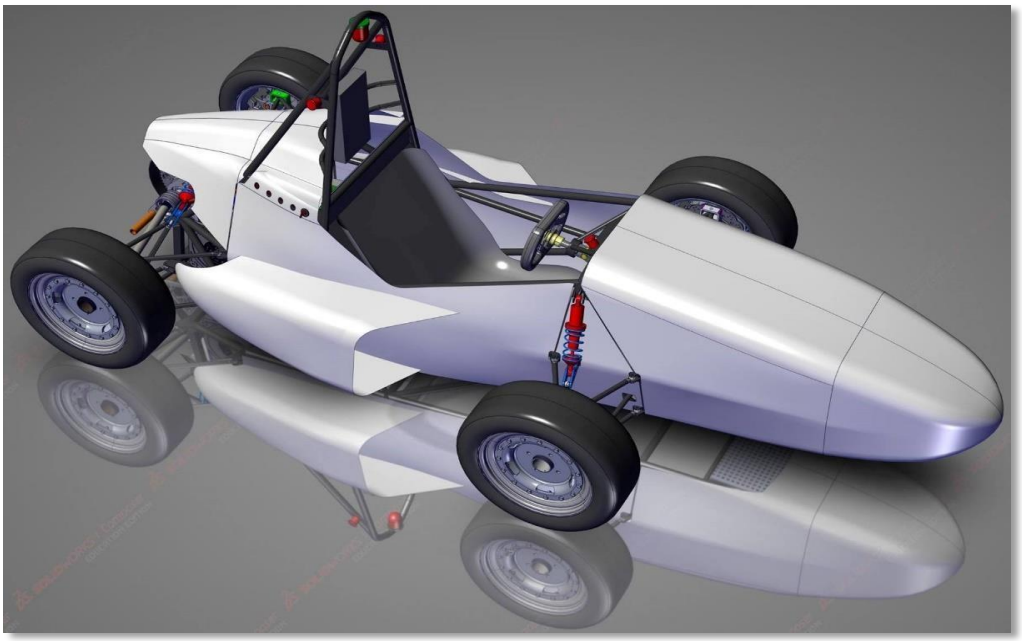
- The only Indian team among the 30 registered international teams to participate in the competition.
- Our car was declared as the **most fuel efficient car** among all the competing ones.
- 6th in the cost presentation event and 16th in the final endurance race event.
- The first Indian car to finish the final, grueling 32 lap race in Australia.

In 2013, we participated at **Formula Student UK** held at the **Silverstone circuit in London** with a petrol-electric hybrid car.

Performance highlights:

- The **only hybrid car** to participate at the competition.
- We won the **IMechE Formula Student award** of 2500 GBP
- Stood **first in Cost and Business Presentation** among all the Indian Teams.
- Secured second position overall as well as in design among all the Indian teams.
- Stood 30th in cost efficiency out 90 participating teams
- Stood 31st in the Business Case out of 90 participating teams

Our Current Project



The model of the current car developed using SolidWorks software

With the rising cost of gasoline and its ever depleting reserves, the **future of conventional vehicles is bleak. Vehicles running on alternative fuels** like electricity, CNG, etc. **provide a promising solution** to the problem. The long term aim of the team is **to advance the technology associated with electric vehicles** so that they may become **cheaper and more efficient** compared to gasoline powered conventional cars.

With this aim in mind and with the experience and confidence gained from the last two competitions, the team is developing an **all-electric vehicle for participating in FSAE Australasia 2015**.

The car design has been finalised **after rigorous simulation and analysis of mechanical and electrical systems** using software like **Ansys, SolidWorks, ADAMS, MATLAB, Labsim and Multisim**. With improvements in every aspect of the car, we are confident of building an even more competitive vehicle for our next competition.

Specifications

Top Speed	100 kmph
Acceleration	0.5 g
Peak Power	30 kW/ 40 HP
Continuous Power	12 kW/ 16 HP
Max Torque	90 Nm
Range	35 – 40 km depending on terrain
Battery Capacity	8.6 kWhr
Charging Time	9 hrs
Weight (excluding driver)	240 kg

Safety Features

- The car is designed to **monitor the insulation** between the battery terminals and the chassis ground and disconnect the battery pack in case of insulation failure.
- Senses current, voltage and temperature of the battery pack and disconnect the battery pack in case these parameters exceed the prescribed limits.
- In case of high velocity impact, the battery pack is disconnected so as to prevent it from catching fire.
- The car does not start **unless all the safety systems are working properly.**
- **Impact attenuator** reduces the impact damage in case of head-on collision.
- Side impact structure of the vehicle is reinforced to provide more protection to the driver.
- In case of any mishap the **tractive system can be manually disconnected** externally.
- The car is designed in such a way that **in case of roll-over the roll-cage will protect the driver.**
- If the Lateral acceleration exceeds 6g power shuts down.
- The driver cockpit is protected using a fire-resistant material (lexan).

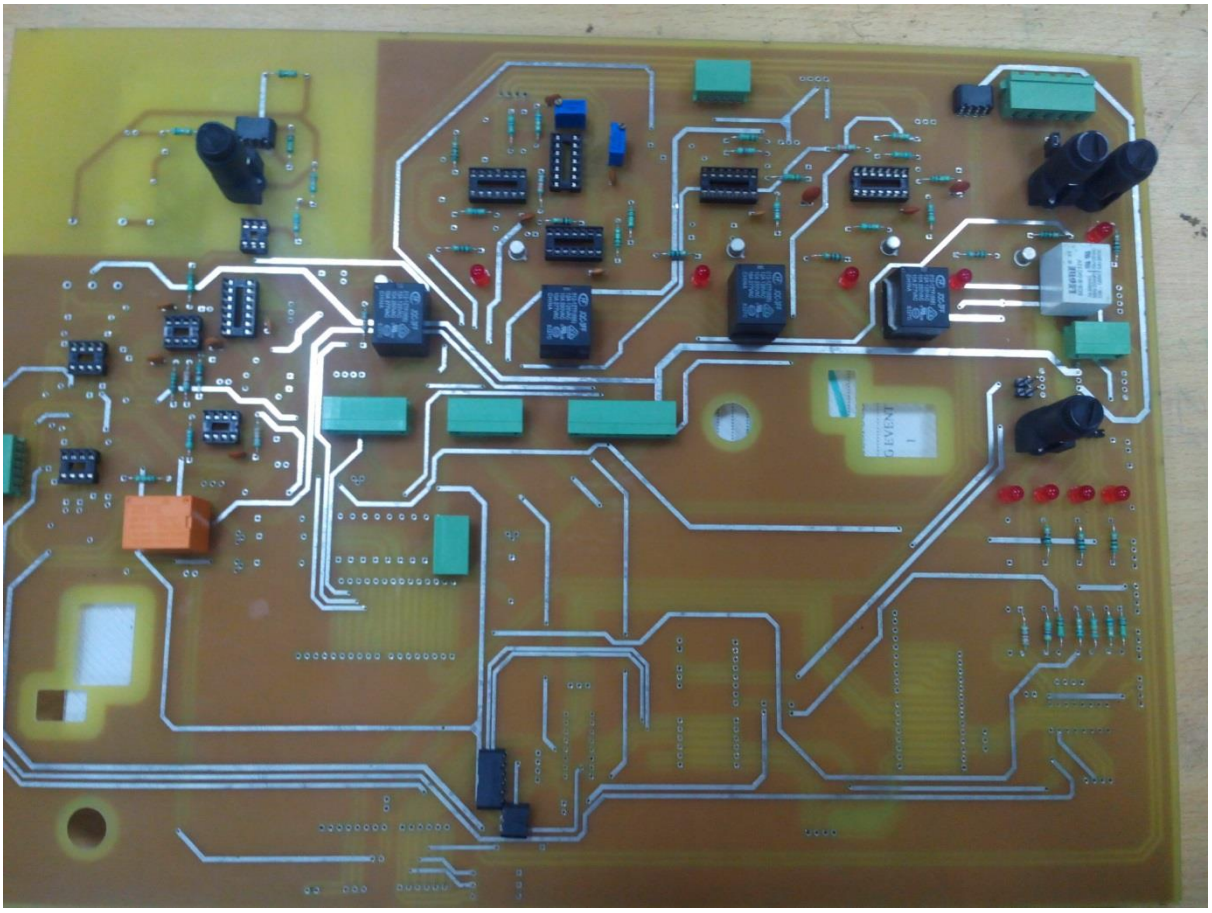
Other Special Features

- A part of brake-pedal travel is used in Regenerative-Braking which recharges the batteries increasing the range of the car.
- Carbon-fibre body is used for weight reduction of the car.
- As opposed to suspension systems (Mac-Pherson Strut) used in passenger cars, push-rod type suspension systems are used which have very low ground clearance and are easily adjustable.
- The car is designed in such a way that the power train can be easily changed with the motor and battery pack replaced by another set, without any changes in the structural design of the car. This gives us the flexibility to only change the power train of the car as per requirements of the market.
- The car can take turns of 2.5m radius at speed of about 40 kmph whereas normal passenger car can only go at maximum speed of 20 kmph for the same turn.

Research Projects and future plans

Since this is the first electric car being developed by the team, the team's focus is to perfect the safety system and reliability of the car. Presently, the components like motor, battery management system and controller have been selected from the products available in the market but the team aims to manufacture these products in-house for the future projects.

There have been 10 iterations of testing of the safety circuits making them completely reliable. These safety circuits which we have developed can be directly used in our next projects.



The Finalised PCB of the Safety Circuits Used in the Current Project

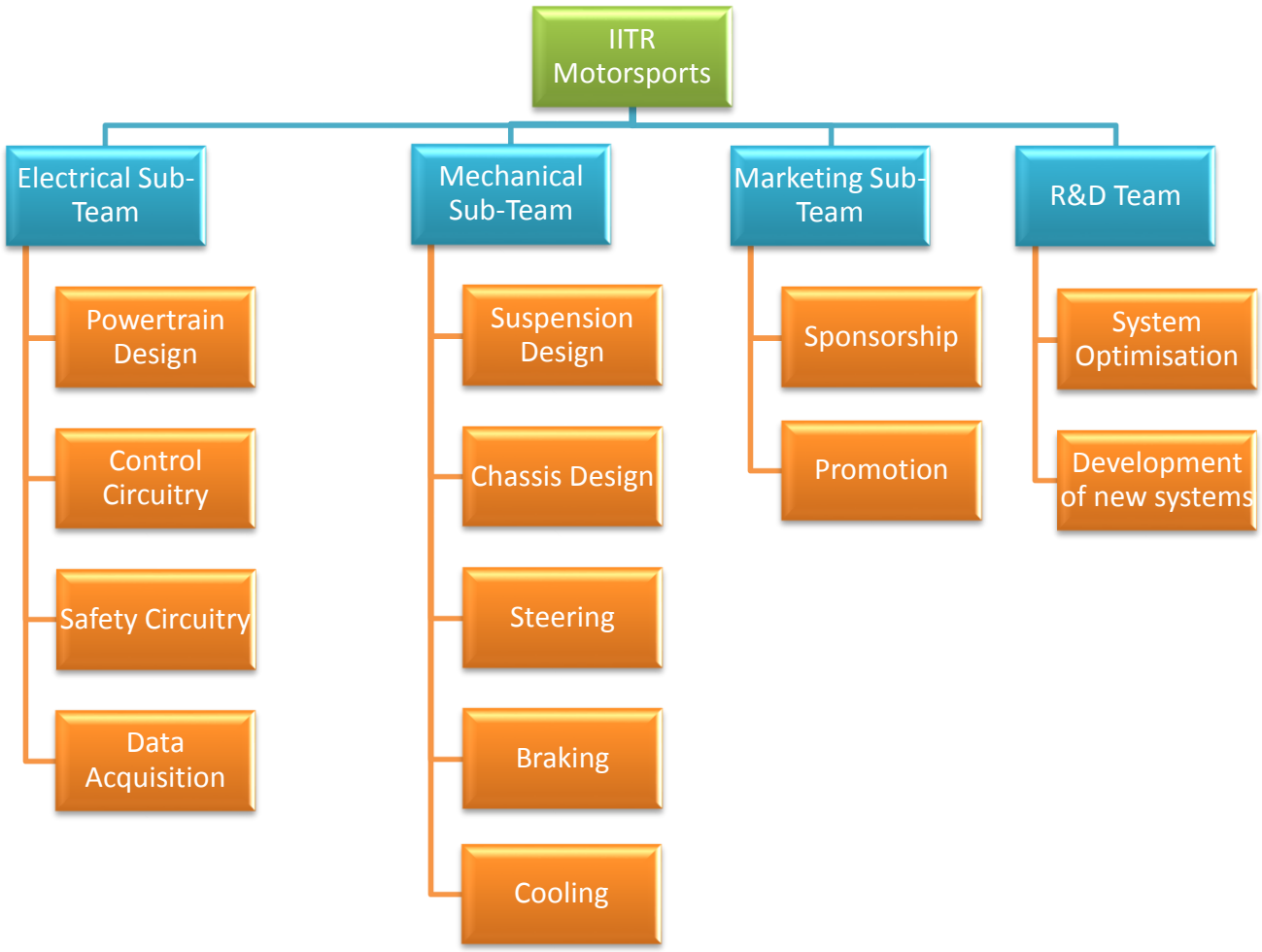
With the safety system perfected, the team has undertaken some research projects, both in electrical and mechanical departments with a view to develop highly efficient in-house products which can improve the performance of our future projects and extend the frontiers of our knowledge and technology . The final year students in the team lead these research projects with the second year students assisting them. This way knowledge is transferred to the younger members and the projects improve steadily.

The research projects are:

- Smart Charger: The aim is to develop a low cost- high efficiency smart charger for the battery pack used in the car which can greatly reduce the charging time of the batteries.
- Battery Management System: This project aims at developing a system to manage the overall performance of the battery pack according to the requirements.
- Suspension and Steering Optimization using Genetic Algorithms: Under this project, the team aims to determine the best possible orientation for the steering and suspension systems using genetic Algorithms
- Torque Vectoring: The objective is to develop a control Technique so as to implement two wheel and/or four wheel drives. This greatly improves acceleration and steering of the car resulting in better handling of the car.
- Car Simulation and Data Acquisition: This project aims to develop a mathematical model of the car based on the data collected from the sensors of the Data Acquisition System.
- Vibration Analysis of Open Wheeled Chassis: The objective is to identify the sources of vibration within the car using sensors and to determine their causes. This can help in improving the design to reduce these vibrations.

Team Structure

The team has 75 students having engineering backgrounds in: Electrical, Mechanical, Chemical, Production and Industrial, Biotechnology and Architecture working together. The team recruits students based on their zeal irrespective of their engineering backgrounds. This gives students a chance to work on things they are interested in and provides the team with students having different skill sets. This ensures that the team can come up with innovative solutions to a myriad range of problems faced in the course of the project.



Benefits to the society

The electric vehicle sector is very new to India with very little attention being given to it by the automobile sector due to high material costs and low demand. Also there is lack of active research going on in this field. The team aims to change this by developing highly reliable electric cars and associated systems at low costs.

Considering the thrust put by the Government in this regard by schemes like National Electric Mobility Mission Plan, it is expected that the requirement of trained engineers in this field will grow manifold, and the experience that the students gain in this project is exactly what the companies sought.

The experience gained by working in the team makes the students better employees. So the team members can make great contributions at their workplace in the future.

From their experience of working in this team, some of our former members have started a startup Solarwale.com which aims to harness solar energy for domestic purposes at minimum costs and they have been able to get substantial funding.

Another alumni of the Electrical Sub-Team, is currently working with a startup, involved in the manufacturing of hybrid buses. He is the head of the electric department and applying the knowledge and experience to solve problems faced by the eco-friendly mass transportation sector.

The products developed by the team also have extensive applications in various industries. The products currently being used by electric vehicle manufactures are expensive and have to be imported, which increases their procurement time. Instead, our systems are extremely cheap and reliable and can be used directly.

How the members benefit from the team?

The team is a platform for campus students interested in vehicle design and manufacturing to come together and work on building a high tech prototype race-car.

Students work on different systems of the car from initial technical design to fabrication to final testing and debugging. This gives them an opportunity to apply the concepts learned in classrooms to real world problems and in the process strengthen their understanding of the subject.

The members also work on the marketing and financing of the project and in the process are required to communicate with various professionals from the industry. This improves their communication and negotiation skills which are extremely indispensable in the real world environment.

Working in a team develops their soft skills like leadership and team management. The team members have cumulatively put in more than 20,000 man-hours to complete the project; working at neck-break speeds and with limited resources. So team members gain some invaluable skills by working on the project.

Conclusion

This project is acting as a nurturing ground for engineers who have the potential to act as the flag bearers in the electric vehicle revolution in the Indian automobile market. All that is required is some encouragement.