



Department Project Information

Department Name	<i>MEES - Motorsports</i>	Date Submitted	<i>07/09/2026</i>
Project Title	<i>FSAE IC Chassis Simulations (FSAE_SIM)</i>	Planned Starting Semester	<i>Fall 2026</i>

Senior Design Project Description

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	Number	Discipline	Number
Mechanical	4-6	Electrical	
Computer	1-2	Systems	
Other ()			

Project Overview:

This is a new project. Every Formula SAE competition year requires the design and construction of a new car. While parts from prior cars may be reused and knowledge transfer from past years is encouraged to serve as the foundation of each year's effort, it must be understood that this Formula SAE project encompasses the entire design and build process of a new car.

Per the SAE International Formula SAE rulebook, "The Formula SAE® competitions challenge teams of university undergraduate and graduate students to conceive, design, fabricate, develop and compete with small, formula style vehicles. Formula SAE® is an engineering education competition that requires performance demonstration of vehicles in a series of events, both off track and on track against the clock. Each competition gives teams the chance to demonstrate their creativity and engineering skills in comparison to teams from other universities around the world."

Each student team designs, builds and tests a prototype based on a series of rules whose purpose is both to ensure onsite event operations and promote clever problem solving. The vehicle will be inspected in a series of tests to ensure it complies with the competition rules; in addition, the vehicle with driver will be judged in many performance tests on track. The rest of the judging is completed by experts from motorsports, automotive, aerospace and supplier industries on student design, cost and sales presentations. UNC Charlotte has separate teams competing in the Formula SAE Internal Combustion and Electric Vehicle



competitions. This senior design project is in support of the internal combustion team.

Complex simulations of mechanical vibrations and compliance are required for the development and analysis of the powertrain, chassis, and suspension systems of the competition vehicle. This project will develop two simulations. The first is a complex modal/frequency analysis of the transmission of engine vibrations throughout the chassis. The second is a virtual kinematics and compliance test that assesses the translations and rotations of chassis and suspension members under dynamic loading conditions.

Project Requirements:

This specific project will support the main competition team by developing and utilizing simulation tools for the mechanical powertrain, chassis, and suspension interactions. This project will work alongside the competition car team, but the progress, outcomes, and deliverables of each project will be evaluated independently. Data, designs, and models of current and past competition cars will be available to develop these simulations, and the simulations will be expected to be tested and validated on the data from current and past competition vehicles. The simulation programs are required to be completed in sufficient time to allow their use for analysis of the 2027 competition vehicle before it competes in May 2027.

The project team will produce two simulation programs. This project requires the production of specific simulation programs developed from existing software available to the competition teams. The programs will be used during this senior design cycle to assess the design of the 2027 competition vehicle, and this concurrent use will serve as testing and validation of the design. They will subsequently be available as tools for future competition teams.

One program will be an advanced finite element analysis for chassis vibrations. The mechanical powertrain system produces vibrations that are transmitted to the chassis in which it is mounted. The end product must take as an input vibration signals characteristic of the powertrain system and output a frequency and modal map throughout the chassis.

The other program will be a simulated kinematics and compliance test. These tests are physically performed in the real world, and a virtual equivalent is required to supplement the physical tests. This program must model the chassis and suspension members as a multibody system, take acceleration and load conditions as inputs and model as outputs deflections, bending, and rotations in the joints and members of the suspension and chassis systems.



Expected Deliverables/Results:

This is a simulation and software centric project. No physical build is required.

Deliverables include:

- All senior design course deliverables
- Two simulation tools packages: one for frequency and modal analysis of powertrain vibrations through the chassis, and one for a virtual kinematics and compliance test
- Analysis and data of the 2027 Formula SAE IC competition vehicle design relevant to these simulations
- Documentation and calculations
- User Guide instructing future team members on the use of this software

Disposition of Deliverables at the End of the Project:

Software developed, data produced, and documentation for use is the property of the mentor, competition team, and department.

List here any specific skills, requirements, specific courses, club affiliation, knowledge needed or suggested (If none please state none):

- Motorsports concentration – Not required, but motorsports concentration has priority
- Student Member of SAE and the FSAE student organization– Not required, but current membership has priority
- Experience with FEA and multibody dynamic simulations preferred
- Experience with automotive systems preferred