ALBERT NERKEN SCHOOL OF ENGINEERING
VERTICALLY INTEGRATED PROJECTS (VIP)

We are pleased to announce the new Vertically Integrated Projects (VIP). VIP is an undergraduate research initiative in which students work in multidisciplinary teams led by faculty, contributing to their research, innovation, and/or design efforts.

The Cooper Union has joined 36 schools around the world offering students the new type of course structure, a concept pioneered by professors at Purdue University.

Undergraduate students that join VIP teams earn one credit each semester for their participation in design/discovery efforts that enable them to explore their interests through long term projects. Students are encouraged to participate for at least three consecutive semesters and up to six semesters total, providing deeper learning experiences and leadership opportunities.

The long-term nature of VIP creates an environment of mentorship, with faculty and graduate students mentoring teams, experienced students mentoring new members, and students moving into leadership roles as others graduate.

Currently we have 3 sections this Fall 2020 Semester:

1. **VIP381-Section A: Smart Cities**

   The Autonomy of "Smart" Cities is a cross-disciplinary course that is dedicated to finding technology-based solutions to some of the most pressing issues that are currently facing our cities. This course will focus on closed-loop systems in order to explore a more sustainable transportation, energy, and urban agricultural structures that promote the autonomy of our communities and enhance the livability of our cities. Students will be expected to develop complete solutions (design and implementation) integrating ideas and concepts from different disciplines such as: design, ML, Robotics, IoT, hardware design, vision, lighting, and control theory.

   Example Projects:

   - Self-Drive: an autonomous vehicle project.
   - Net-Zero-Surrey: designing a sustainable transportation solution for more livable future cities.
   - Urban Agriculture: enabling the urban community to produce their own food.
   - Robotics Arms: modeling human motion with robotics arms.
   - Drones: sling load and cooperative drones

Advisors: Neveen Shlayan (EE), Mili Shah (Math), Dirk Luchtenburg (ME), Ben Davis (ChE)

2. VIP381-Section B: Solar Decathlon

The Solar Decathlon course forms a cross-disciplinary team that engages in a design phase and a build phase of highly efficient and innovative buildings powered by renewable energy. Students are expected to prepare creative solutions for real-world issues in the building industry. The focus of this course will be High-performance building design includes comprehensive building science, energy efficiency, optimized structural and mechanical systems, indoor air quality, resilience, and water conservation while maintaining the highest spatial design standards. Engineering students will be working closely with Architects to design an efficient and innovative system to support the functional and aesthetic characteristics of their projects while experimenting with the use of standard as well as unconventional materials. Students will be taught the basics of statics, strength of materials, structural analysis, and design. Teams will be expected to participate in the Solar Decathlon Design and Build Challenge: https://www.solardecathlon.gov/about.html.

Course Objectives:

- Introduce students to state of the state-of-the-art industry standard technology to better prepare them to enter the workforce.
- Allow students to engage with their specialized knowledge and skills in the contexts of a team-based research project.
- Provide students with the opportunity to conduct research at an early stage to better prepare them for possible academic careers.
- Enable students to work in multidisciplinary teams in the pursuit of designing effective solutions to modern complex issues.

Advisors: Cosmas Tzavelis (CE), Lorena Del Rio (Arch), David Wootton (ME), Neveen Shlayan (EE)

3. VIP381-Section C: Motorsports

The goal of the VIP Motorsports is to successfully participate in the Formula SAE® competitions that challenge teams of university 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.

Teams are to assume that they work for an engineering firm that is designing, fabricating, testing, and demonstrating a prototype vehicle. The vehicle should have high performance and be sufficiently durable to successfully complete all the events at the Formula SAE competitions. Additional design factors include aesthetics, cost, ergonomics, maintainability, and manufacturability. Each design will be judged and evaluated against other competing designs in a series of Static and Dynamic events to determine the vehicle that best meets the design goals and may be profitably built and marketed.

On a more detailed level, desired outcome of the project is that students will be able to:

- design a racecar that meets specified needs under cost constraints,
- design for manufacturing and subsequently manufacture and assemble a racecar,
- function effectively on a team, including project management, leadership, and collaboration, and
- develop and conduct appropriate experimentation, both on component level and for the whole vehicle.

Advisor: Sven Haverkamp (ME)

Website: http://fsae.cooper.edu/

The courses are open to **all** Cooper students from all majors (Art, Architecture, and Engineering), but students must be pursuing their undergraduate degree in order to enroll in VIP for credit. Enrollment is based on a rolling application process with a decision made before the beginning of each semester.

Students:

- In the first semester, they will familiarize themselves with the project, gain knowledge/skills, and begin making meaningful contributions
- In the second semester, they will begin to master the foundations within the discipline, pursue needed knowledge/skills, make meaningful contributions, and assume technical/leadership responsibilities.
- In the third semester, they will have mastered the foundations within the discipline, pursue further knowledge/skills, make meaningful contributions, and assume significant technical/leadership responsibilities.
- In the fourth semester, they will pursue needed knowledge/skills, make meaningful contributions, provide leadership in technical area and team management.

The teams are:

- *Multidisciplinary* - drawing students from all disciplines on campus.

- *Vertically-integrated* - maintaining a mix of freshmen through senior students each semester.
- *Long-term* - each undergraduate student may participate in a project for up to three years.

The continuity, disciplinary depth, and professional breadth of these teams intend to:

- Provide the time and context necessary for students to learn and practice many different professional skills, make substantial technical contributions to the project, and experience many different roles on a large, multidisciplinary design/discovery team.
- Support long-term interaction between the students and faculty on the team. The more senior students mentor the undergraduates as they work on the
- design/discovery projects embedded in the course.
- Enable the completion of large-scale design/discovery projects that are of significant benefit to faculty members' research.

Currently, we are in the process of creating two additional VIP courses: F1 and Steel Bridge. However, these courses are not on the schedule yet. For inquiries regarding the **new VIP teams**, contact VIP Coordinator and Professor of Electrical Engineering Neveen Shlayan at neveen.shlayan@cooper.edu.