Engineering Student Technology Committee

http://www.engr.colostate.edu/ESTC

College of Engineering

Colorado State University

1. Title of Proposal: Thermofluids Laboratory Upgrades

2. Proposal Participants:

Primary Contact for Proposal

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Additional proposal participants

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3. Proposal Abstract (limit to 100 words):

The thermosciences laboratory is an integral part of both mechanical and civil engineering. The lab equipment has remained static for over a decade and desperately needs upgrades to properly service hundreds of students from both programs. We are offering a proposal for $49,545.75 in ESTC funds, matching $16,515.25 in departmental funds to essentially overhaul the six major experiments that are the highest priority to meet learning objectives. Upgrades will be coordinated between civil and mechanical engineering lab support to stretch resources further, and updates will be provided to the ESTC board during the upgrade to ensure objectives are being met.

4. Proposal Budget

List of items to purchase and cost of each

Thermofulids Laboratory Upgrades					
Scientific Equipment		**Cost Sharing**			
Item	Price	ESTC %	Department %	ESTC $	Department $
Engine Experiment Overhaul	$5,000.00	75%	25%	$3,750.00	$1,250.00
Wind Tunnel Force Balance	$10,000.00	75%	25%	$7,500.00	$2,500.00
Refrigeration Experiment	$16,061.00	75%	25%	$12,045.75	$4,015.25
Data Acquisition Station	$5,000.00	75%	25%	$3,750.00	$1,250.00
Heating Cooling Pressure Drop	$10,000.00	75%	25%	$7,500.00	$2,500.00
Flow Metering Experiment	$10,000.00	75%	25%	$7,500.00	$2,500.00
Measurement Equipment	$10,000.00	75%	25%	$7,500.00	$2,500.00
Total	$66,061.00			$49,545.75	$16,515.25
				ESTC $	Department $
			Total	$49,545.75	$16,515.25

Dollar or percentage amount requested from ESTC: $49,545.75

5. Full description of proposal:

The Thermofluids Lab course (MECH338) is a required junior year mechanical engineering course that bridges the disciplines of thermodynamics and fluid dynamics. This laboratory is shared with Civil and Environmental Engineering and supports hundreds of students each semester. Prerequisites for the MECH 338 course are Thermodynamics (MECH 337) and Fluid Dynamics (MECH342).

The format of the course is entirely laboratory based. Knowledge from Thermodynamics (MECH337), Fluid Dynamics (MECH342), and Heat and Mass Transfer (MECH344) are applied to laboratory experiments. These experiments include, among others, wind tunnel, engine, boiling, cross flow heat exchanger, refrigeration, Newtonian heating and cooling, one dimensional heat transfer, and tank blow down.

The equipment used in this laboratory provides a physical foundation for understanding the basics of thermodynamics and fluid dynamics, but the instruments used in the course have essentially remained static for over a decade and are becoming seriously outdated. Several pieces of equipment are lacking key components to maximize the learning objectives.

We have recently upgraded several teaching laboratories where National Instruments hardware has been implemented and interfaced with LabView software, our department has progressively invested ~$80k across these labs over the last three years. There are several tools readily available that would increase both the understanding and capabilities of our students. We have attached our overall budget for the lab upgrade and broken out the section where we are requesting $49,545.75 in CFT funds through the ESTC to a 25% departmental funds ($16,515.25 a 75/25 split).

The component selections for the hardware have been based off of research and conversations with subject matter experts. These updates are:

1) Engine Overhaul: The engine experiment needs an overhaul to ensure consistent and precise data and maximum lifetime.
2) Wind Tunnel Upgrade: Adding a force balance and stinger to the wind tunnel that will allow for lift, drag, pitch, yaw, and roll measurements as a function of attack angle for a proper aerodynamic analysis.

3) Refrigeration Experiment Overhaul: A new refrigeration experiment will allow for data to be measured directly into LabView and a more accurate analysis to be completed.
4) Data Acquisition Station: By adding another data acquisition station, the number of students in each group will be reduced from 5 to 3 allowing for the correct student to experiment ratio.
5) Pressure Drop Overhaul: Adding a heating and cooling section to the pressure drop experiment will maximize the learning objectives of the equipment by allowing students to look at the relationship between pressure and turbulence across various viscosities.
6) Flow Meter Additions: Currently there are no flow meters in this laboratory. Flow meters are a necessary component of any thermofluids laboratory. By adding new measurement equipment the students will be able to collect more accurate data and obtain more precise results.

All of these upgrades will drastically improve the functionally of either existing equipment or add needed functionality providing students the tools they need for future research or industry skills.

As with all CSU programs, we have been absorbing an increasing number of students into our courses which has translated into larger lab groups in each section. Where we typically had 3-4 people per group in 2012, we now routinely have 5. This large of a group is a hindrance to hands-on learning and our proposal is in line with a goal of reducing the lab groups to 3 by expanding the number of stations from 5 to 6. The extra hardware available would also position us to make lab resources more available to cross-departmental projects and classes, as well.

As we upgrade our technology in this lab, the overall goal is to both create additional capabilities for our students as well as increase access to the lab and technology. The hands-on aspects of CSU mechanical and civil engineering are what set us apart from other engineering programs, and a more capable themofluids lab allows us to better teach thermodynamics and fluids from the lecture courses up through Senior Design. The strategic vision is to move toward creating a uniform data acquisition package across all of our labs (NI hardware and LabView software), as well as creating collaborative opportunities with other departments and programs to develop new themofluid systems and components within the learning environment. The lab support engineering team will make themselves available to present this material and are happy to field any questions or concerns you may have as you consider this proposal.