



US DOE Sponsored Graduate Automotive Technology Education (GATE) Program at Penn State Emphasizing High-Power In-Vehicle Energy Storage



Mission: Provide graduate engineering curriculum focused on high-power in-vehicle energy storage for hybrid electric and fuel cell vehicles covering the fundamental science and models for **batteries, capacitors, flywheels** and their combinations. Integrate system topics into energy storage curriculum including vehicle topologies, advanced combustion, fuel cells, power electronics, controls, alternative fuels, and vehicle fuel efficiency to prepare students for careers in the automotive industry and academia. Develop relationships between GATE students, faculty, employers and industry/research partners. Gate Students completing three course curriculum receive a GATE Certificate from DOE.



Penn State University
GATE Center of Excellence
In-Vehicle, High-Power Energy Storage

Joel R. Anstrom
Director, GATE Center

Robin Tabor
for Research Area

Debra Weaver
Staff Assistant

Chao-Yang Wang
Electrochemical Engines

Michael Laganas
Dissolved

Charles Bais
Composites Flywheels

Daniel Haworth
Advanced Vehicle Lab

Ande Boehm
Advanced Combustion

Heath Hofmann
Power Electronics

Group II—Core Energy Storage Courses

Group III—Advanced Vehicle Laboratory and High-Power Energy Storage Courses

Sean Branigan
Hardware-in-the-Loop Laboratory

Hardware-in-the-Loop Laboratory for Curriculum Integration

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GATE Core Curriculum
EMch/ME/MatSc 600 Thesis (6)

Group I (9 credits required)		Group IV (Advanced-Track Courses)	
Select from Department Math Requirement (3)	Select Numerical Methods Course (3)		Group IVa. Mathematics
			Group IVb. Power Electronics
Group II (6 credits required)		Group IVc. Dynamics, Vibrations, and Controls	
EMch/ME/MatSc 597F High-Power Energy Storage (3)	ME/EMch/MatSc 597B/A Advanced Vehicle Lab (3)	Group IVd. System Modeling and Design	
Group III (1 course required)		Group IVe. Manufacturing	
ME 597G Electrochemical Engines with Lab (3)	Emch 471 Engineering Composite Materials (3)	Group IVf. Business	
	MatSc 597 Electronic Property Characterization of Materials and Capacitors (3)	Group IVg. Alternative Fuels	
	ME 597F HIL Advanced Vehicles (3)	Group IVh. Drive Trains	
		Group IVi. Materials	
		Group IVj. Advanced Combustion	
		Group IVk. Chemistry	
		Group IVm. Fuel Cells	
		Group IVn. Solid Mechanics	