

How to Design Electric Vehicles (EVs)

IAP 2015 Non-Credit Course

Instructors

Sanjay Sarma, Professor of Mechanical Engineering, MIT Mechanical Engineering
Ryan Chin, Managing Director & Research Scientist, MIT Media Lab, City Science Initiative

Guest Instructors

Rick Chamberlain, Chief Technology Officer, Boston-Power Inc.
Eric Carlson, Senior Fellow, Boston-Power, Inc.
Craig Carlson, Automotive Consultant, Craig Carlson LLC

Course Description:

If you are interested in designing and building electric vehicles (EVs), then this IAP class is for you.

This hands-on course brings together industry experts, MIT faculty, staff, and students to present the basic building blocks to EVs including: battery systems, electric motors, motor controllers, and the overall vehicle systems integration. Each session will delve into practical engineering issues through interactive presentations by instructors and guest speakers. There will also be working sessions conducted by student mentors. The course will address the following questions:

- How to specify batteries, motor controllers, and motors to satisfy vehicle performance and efficiency goals
- How to integrate cooling, electrical, and communications systems that are crucial to the operation of EVs
- How to evaluate technology options
- How to make design decisions related to overall system and subsystem specification and selection

Guest speakers include industry experts from Boston-Power, Protean Electric, Sevcon, Ford Motor Company, and Nest. The last session will focus on current market trends, cost challenges, competitive technologies, and future applications including urban mobility, EV infrastructure, energy storage for utilities, and the role of policy and incentives.

Schedule – Jan 20 (9am-4pm), Jan 22 (9am-12pm), Jan 27 (9am-12pm), Jan 29 (9am-12pm)

Location – E15-341

Enrollment – Advance sign-up required by Jan. 15th, 2015. Class size limited to 40 participants.

Prospective students can sign up here: <http://goo.gl/forms/RmZbhNUM8I>

Prerequisites – Permission of Instructor

Attendance – Participants welcome at individual sessions

Sponsors – Media Arts and Sciences, Mechanical Engineering

Website – <http://cp.media.mit.edu/workshops/>

Contact – Ryan Chin, E15-368D, rchin@media.mit.edu

Student Mentors

Michael Lin, PhD Candidate, MIT Media Lab
Dylan Erb, PhD Candidate, MIT Mechanical Engineering
Roberto Melendez, Student Clubs and Teams Coordinator

Course Sessions

(1) Intro, Batteries, Safety, Hands-on session (Jan. 20)

This session will introduce the goals of the overall course, provide an in-depth understanding of EV battery systems (battery packs, chemistry, battery management systems), safety guidelines in handling high-voltage battery systems, and provide a hands-on work session. The class will begin in E15-341 and will take a tour of the International Design Center (IDC) after a noontime lunch break.

Speakers: Sanjay Sarma, Ryan Chin, Rick Chamberlain, Eric Carlson, J.R. Linna, Rui Frias

Mentors: Dylan Erb, Michael Lin, Roberto Melendez

(2) Controllers, Electric Motors (Jan. 22)

This session will be lead by guest speakers from Sevcon (Controllers) and Protean Electric (Electric Motors).

Guest Speakers:

Pete Barrass, Sevcon

Chris Hilton, CTO, Protean Electric

Ken Stewart, VP, Business Development, Protean Electric

(3) Overall Integration (Jan. 27)

This session will provide an automotive OEM perspective on overall vehicle integration for EVs. Guest speakers will be announced shortly.

Guest Speakers:

OEM (1) – TBA

Ford Motor Company (2) – TBC

(4) Applications and Markets (Jan. 29)

This session will cover trends and existing/future markets for traditional EVs, new urban vehicles, vehicle-to-grid, second life EV battery re-use, and new markets (e.g., home energy management systems).

Speakers: Craig Carlson, Ryan Chin

Guest Speaker: Praveen Subramani, Energy Partnerships, NEST

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IAP 2015 Non-Credit Course Schedule (E15-341)

Tuesday, January 20th

9:00-9:15am	Instructor, mentor, and student introductions, course logistics
9:15-9:45am	“How to Design Electric Vehicles” – Sanjay Sarma
9:45-10:45am	“Battery Systems for EVs” – Eric Carlson (Boston-Power)
10:45-11:00am	Break
11:00-12:00pm	“Mechanical Design of EV Packs” – JR Linna (Boston-Power)
12:00-1:00pm	Lunch Break (including walk from E15 to N51)
1:00-2:00pm	“Safe Handling of Battery Systems” – Rui Frias (Boston-Power)
2:00-2:30pm	Tour of International Design Center (IDC) – Dylan Erb
2:30-2:45pm	Break
2:45-3:00pm	“EV Design Challenge” – Class Exercise
3:00-4:00pm	“Hands-on Design Session” – Dylan Erb, Michael Lin, Roberto Melendez

Thursday, January 22nd

9:00-10:00am	“Electric Motors for EVs” – Chris Hilton, Ken Stewart (Protean Electric)
10:00-10:15am	Break
10:15-11:15am	“Motor Controllers for EVs” – Peter Barrass (Sevcon)
11:15-12:00pm	Team Formation and Early Ideation – Class Exercise

Tuesday, January 27th

9:00-10:00am	“EV Integration at Automotive OEM” – TBA
10:00-10:15am	Break
10:15-11:15am	“EV Integration at Ford” – TBC (Ford Motor Company)
11:15-12:00pm	Synthesize Ideas Session – Class Exercise

Thursday, January 29th

9:00-9:45am	“EV Market Trends” – Craig Carlson
9:45-10:30am	“EVs & Urban Mobility” – Ryan Chin
10:30-10:45am	Break
10:45-11:30	“Off-Vehicle Applications” – Praveen Subramani (Nest)
11:30-12:00pm	“EV Pitch” session (60 seconds by each team) – Class Exercise