AUTO 193 Course Outline as of Spring 2013

CATALOG INFORMATION

Dept and Nbr: AUTO 193 Title: ELECTRIC VEHICLES
Full Title: Electric Vehicles
Last Reviewed: 4/21/2008

Units		Course Hours per Week		Nbr of Weeks	Course Hours Total	
Maximum	4.00	Lecture Scheduled	2.00	17.5	Lecture Scheduled	35.00
Minimum	4.00	Lab Scheduled	6.00	17.5	Lab Scheduled	105.00
		Contact DHR	0		Contact DHR	0
		Contact Total	8.00		Contact Total	140.00
		Non-contact DHR	0		Non-contact DHR	0

Total Out of Class Hours: 70.00 Total Student Learning Hours: 210.00

Title 5 Category:	AA Degree Applicable
Grading:	Grade or P/NP
Repeatability:	00 - Two Repeats if Grade was D, F, NC, or NP
Also Listed As:	
Formerly:	

Catalog Description:
This course covers the fundamentals of electric vehicle (EV) theory, EV conversion, EV construction, EV restoration, and EV maintenance. Also provides training for technicians interested in expanding their repair skills to include multiple EV platforms emerging as a viable alternative to Internal Combustion Engine (ICE) vehicles.

Prerequisites/Corequisites:

Recommended Preparation:
Eligibility for ENGL 100 or ESL 100

Limits on Enrollment:

Schedule of Classes Information:
Description: This course covers the fundamentals of electric vehicle (EV) theory, EV conversion, EV construction, EV restoration, and EV maintenance. Also provides training for technicians interested in expanding their repair skills to include multiple EV platforms emerging as a viable alternative to Internal Combustion Engine (ICE) vehicles. (Grade or P/NP)
Prerequisites/Corequisites:

Recommended: Eligibility for ENGL 100 or ESL 100
Limits on Enrollment:
Transfer Credit:
Repeatability: Two Repeats if Grade was D, F, NC, or NP

ARTICULATION, MAJOR, and CERTIFICATION INFORMATION:

AS Degree:	**Area**	Effective:	Inactive:
CSU GE:	**Transfer Area**	Effective:	Inactive:
IGETC:	**Transfer Area**	Effective:	Inactive:

CSU Transfer:	Effective:	Inactive:
UC Transfer:	Effective:	Inactive:

CID:

Certificate/Major Applicable:
Both Certificate and Major Applicable

COURSE CONTENT

Outcomes and Objectives:

OBJECTIVES
Upon successful completion of the course students will be able to:
1. Select an appropriate vehicle for conversion from ICE to EV.
2. Match the selected vehicle to the appropriate conversion strategy.
3. Make informed decisions about costly battery purchases based on knowledge of battery chemical platforms and characteristics.
4. Describe the importance of re-gearing conventional drive systems to better fit the EV drive platform.
5. Apply electrical and electronic theory to EV vehicle conversion, construction, restoration, and maintenance.
6. Utilize a variety of metal forming strategies in the fabrication of EV components.
7. Locate and utilize current information on EV research, invention, and innovation.

Topics and Scope:

I. Building and Fabricating in a safe manner in a safe environment
   A. Respect for High Voltage when working around batteries
   B. Eye and Ear protection when working with metal fabrication tools
II. Making the transition from an ICE vehicle to an EV
   A. Evaluating driving range
   B. Alternate municipal and private recharge/refuel sites
   C. Evaluating up front cost vs. motivation for making transition to EV

D. Researching the latest EV breakthroughs
   1. Where the innovative work is being done
   2. Sources of information
E. Considering environmental impact in the building and the disassembly of an EV

III. Choosing a Vehicle
A. Vehicle weight vs. energy capacity demand
B. Vehicle weight vs. range demand
C. Vehicle weight vs. payload demand
D. Vehicle weight vs. horse power demand

IV. Matching Vehicle to EV Conversion Strategy
A. Acceleration parameters
B. Range parameters
C. Alternating Currant (A.C.) drive systems
D. Direct Current (D.C.) drive systems
E. Conversion cost and limitations
F. Choosing a prefab EV kit vs. making your own kit
G. Retailers

V. Building a safe product
A. Gross Vehicle Weight (GVW)
B. Weight distribution / vehicular balance
C. Suspension requirements, limitations, modifications
D. Braking requirements, limitations, modifications
E. Incorporating regenerative braking into braking strategy
F. Maintaining the integrity of factory designed crumple zones
G. Modern safety equipment

VI. Proactive Planning and ICE Vehicle Disassembly Strategies
A. Preemptive research
B. Having a well thought out plan before start
C. Having a well thought out budget before start
D. Reading the instructions and performing all measurements before disassembly
E. Verifying availability of all parts and replacement parts before start
F. Verifying component integrity
G. Verifying component support and warranty
H. Verifying product history and company history

VII. Metal Cutting, Forming, and Fabrication
A. Mig, Arc, Tig, welding
B. Electric plasma cutting design
C. Component layout, alteration, relocation
D. Three dimensional bracket design, development, and fabrication
E. Machine shop milling, shaping and forming of aluminum and steel componentry
F. Heating and bending of steel forms, battery boxes, and numerous small shapes

VIII. Choosing a Battery
A. Battery evolution, technology, innovation
B. Slow charging vs. high speed pulse charging
C. Battery cost vs. expected life, stability, durability, watt/hour capacity

D. One hour discharge rate vs. 12 hour discharge rate
E. Battery chemical platforms
F. Battery management systems: care, rebuilding/reincarnation, and protection
G. Charging from regenerative braking

IX. EV Component Placement
A. Battery placement
B. Motor geometry
C. Vehicular balance - 50/50 weight ratio
D. Crumple zones
E. Component cooling
F. Ease of serviceability
G. Weather, moisture, heat sealed
H. Shock proof
I. Proper clearance from road, moving parts, suspension, steering, and passengers
J. Suspension load and modification

X. Braking
A. Regenerative braking from AC drive systems
B. Lack of regenerative braking from DC drive systems
C. Removal of the compression braking characteristics
D. High demand racing and off road braking update kits
E. Brake Fade

XI. Ideal Parameters for EV Drive System vs. Conventional Gearing.
A. Transmission choice, automatic, manual, single drive
B. Final drive, reworking Ring and Pinion
C. Relatively flat torque curve of an electric motor
D. Wasted mechanical energy transmitting through flywheel, clutch, and driveline differential
E. Reaching the ideal RPM for an Electric Motor vs. the stock transmission
F. Keep or disregard the clutch
G. Adaptor plate

XII. EV electrical componentry
A. Modern single piece motor controls
B. DC to DC converter
C. On board chargers
D. Pot box
E. Relay systems
F. Battery cable and resistance
G. Soldering
H. Battery Management
I. Auto shut down, shunts, overload protection
J. Heat sinks and electronic overheating protection
K. Electron flow

XIII. Electron Flow/Electricity
A. Magnetic fields being manipulated into mechanical energy
B. Alternating current
C. Direct current
D. Electro Magnetic Fields (EMF) and canceling EMF noise
E. Meshing the different voltage parameters of OEM manufacturing with the aftermarket componentry of a kit

XIV. Technician Training
A. Diagnosing EV drivability issues
B. Familiarizing technicians with multiple EV platforms
C. Becoming as comfortable around EVs as a technician is around ICE vehicles

Assignment:

Representative assignments:
1. Readings (approximately 5-10 pages per week).
2. Lab:
a. EV conversions
b. EV restorations
c. Diagnostics on EV vehicles
d. Building and EV vehicle
3. Lab notes for each lab session, written in the form of an instruction manual to be used by the next student working on the project.
4. Group research presentation (oral).
5. Midterm and final exam.

Methods of Evaluation/Basis of Grade:

Writing: Assessment tools that demonstrate writing skills and/or require students to select, organize and explain ideas in writing.

Lab notes	Writing 15 - 20%

Problem Solving: Assessment tools, other than exams, that demonstrate competence in computational or non-computational problem solving skills.

Lab activities	Problem solving 15 - 25%

Skill Demonstrations: All skill-based and physical demonstrations used for assessment purposes including skill performance exams.

Class performances, Performance exams	Skill Demonstrations 35 - 45%

Exams: All forms of formal testing, other than skill performance exams.

Multiple choice, True/false, Matching items, Completion, Short answer	Exams 15 - 25%

Other: Includes any assessment tools that do not logically fit into the above categories.

Attendance and participation; class presentation	Other Category 10 - 20%

Representative Textbooks and Materials:
Convert It! Brown, Michael. South Florida Electric Auto Association 2nd edition: 1993.
Build Your Own Electric Vehicle. Brant, Bob. Tab Books; 1st edition: 1993.
Electric Vehicle Technology Explained. Larminie, James and Lowry, John. Wiley, John & Sons, Incorporated, 2003.
Instructor prepared materials.