Date Approved by DJUSD Board of Education: _____

Secondary Course Description

Course descriptions are updated and reviewed with all new text adoptions.

COVER PAGE

1. Course Title: Electric Vehicle Technology and Build

2. Transcript Title / Abbreviation: EV Tech and Build

3. Transcript Course Code / Number (Office Use Only):

4. School: Davis Senior High School

5. **District**: Davis Joint Unified School District

6. Department: CTE

7. Graduation Requirement it meets: Elective, CTE

8. Length of Course: One year

9. Graduation Credits: 10

10. School / District Web Site: http://www.djusd.net

11. CBEDS Course Code:

12. School Contact:

Name: Robert Thayer

Title/Position: Teacher, Auto Tech.

Phone: 530-757-5400 **Ext.:**

Fax:

E-mail: rthayer@djusd.net

13. Subject Area:

- [ ] History/Social Science
- [ ] English
- [ ] Mathematics
- [ ] Science
- [x] CTE
- [ ] Language other than English
- [ ] Visual & Performing Arts
- [ ] DJUSD Graduation Elective
- [x] College Prep Elective (will seek UC/CSU approval)

14. Grade Level(s): 10-12

15. UC/CSU Requirement:

16. Seeking "Honors" Distinction? [ ] Yes [x] No

17. GPA Types:

18. Credit Value:

- [ ] 0.5 (half year or semester equivalent)
- [x] 1.0 (one year equivalent)
- [ ] 2.0 (two year equivalent)
- [ ] Other: _____

19. Was this course previously approved by UC? [x] Yes [ ] No

If so, in what year? _____ **Under what course title?** _Electric Vehicle Design & Build_____

20. Pre-Requisites: none

Co-Requisites: none

21. Preliminary Approval - Secondary Site Principal Signature (Must be signed before proceeding to Step 22):

_____

22. Date Course Proposal with Preliminary Approval (Step 15) sent to Associate Superintendent, Educational Services: _____

23. Review & Approval:

Date		Signature
_____	**Site Curriculum and Instruction Leadership Team**	**Signature/Title** _____
_____	**Secondary Department Articulation/Collaboration**	**Signature/Title** _____

Secondary Principal Signatures: _____ _____

Date: _____ _____

BACKGROUND INFORMATION

Brief Course Description:
In this projected-based course, students initially cover a broad range of ideas and design considerations connected with electric vehicle technology. Through labs and technical activities, the key concepts of electric vehicle design are covered, and are then used in the construction of an electric vehicle. Students will study and understand the concepts behind, and practical hand-on application of, electric propulsion, circuitry systems, AC-DC converters, computerized system controllers, and energy management. Using knowledge base, students then assemble an electric car. All physics, engineering and professional activities performed in this course are industry-vetted and designed for workforce preparation.

Context for Course
List the State/District Standards addressed in this course:

Anchor Standard 1: Academics Analyze and apply appropriate academic standards required for successful industry sector pathway completion leading to postsecondary education and employment. Refer to the industry sector alignment matrix for identification of standards. Note: alignment listed within each sector

Anchor Standard 2: Communications Language Standard: Acquire and accurately use general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the (career and college) readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression. LS 9-10, 11-12.6

Anchor Standard 3: Career Planning and Management Speaking and Listening Standard: Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data. SLS 11-12.2

Anchor Standard 4: Technology Writing Standard: Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments and information. WS 11-12.6

Anchor Standard 5: Problem Solving and Critical Thinking Writing Standard: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem, narrow or broaden the inquiry when appropriate, and synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. WS 11-12.7

Anchor Standard 6: Health and Safety Reading Standards for Science and Technical Subjects: Determine the meaning of symbols, key words, and other domain-specific words and phrases as they are used in a specific scientific or technical context. RSTS 9-10 11-12.4

Anchor Standard 7: Responsibility and Flexibility Speaking and Listening Standard: Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners, building on others' ideas and expressing their own clearly and persuasively. SLS 9-10 11-12.1

Anchor Standard 8: Ethics and Legal Responsibilities Speaking and Listening Standard: Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the work. SLS 11-12.1d

Anchor Standard 9: Leadership and Teamwork Speaking and Listening Standard: Work with peers to promote civil, democratic discussions and decision making; set clear goals and deadlines; and establish individual roles as needed. SLS 11-12.1b Anchor

Standard 10: Technical Knowledge and Skills Writing Standard: Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information. WS 11-12.6

Anchor Standard 11: Demonstration and Application Standard: Demonstrate and apply the knowledge and skills contained in the industry-sector anchor standards, pathway standards, and performance indicators in classroom, laboratory, and workplace settings, and the career technical student organization.

History of Course Development:
As DJUSD engages with the community to make learning more relevant, career focused, and based on demands of industry we noted potential within our auto tech program. Our advisory group and community partners at the Community Colleges and local businesses support student learning to include newer vehicle builds and models. This included intensive training of the teacher and the design of this course and pathway.

COURSE GOALS AND/OR MAJOR STUDENT OUTCOMES

Proficiency in automotive skills in all eight industry sectors
Reading, writing, and verbal skills required to be successful in the industry.
Demonstrable knowledge of environment and work place safety laws, regulations, and practices
A resume, portfolio, and letters of recommendation
Potential eligibility for internships

COURSE OBJECTIVES

To provide students with understanding and allow them to apply a broad range of ideas and design considerations connected with electric vehicle technology.

To develop interest in automotive technology as it evolves with new technology and considerations of environmental impacts.

Key concepts of electric vehicle design are covered, and are then used in the construction of an electric vehicle.

To provide students with a lab to study and understand the concepts behind, and practical hand-on application of, electric propulsion, circuitry systems, AC-DC converters, computerized system controllers, and energy management.

Students will assemble an electric car.

To promote physics, engineering and professional activities performed in this course that are aligned with industry-and workforce preparation.

COURSE OUTLINE

Unit 1: Shop Safety & Orientation
Students will complete thorough automotive shop safety and pollution prevention training, including a detailed orientation of shop tools, equipment, policies and procedures. Students will complete written and hands on assignments designed to provide a basic understanding of and aptitude in the use of basic tools and service and maintenance of automotive brakes, steering and suspension systems.
Unit 1 Assignments:
Shop safety; pollution prevention; basic hand tools; basic power tools; lifting equipment; automotive steering; brakes; suspension; tires; wheels; alignment angles; basic electrical theory and practice.

Unit 2: Why an electric vehicle?
This unit covers the ideas and topics associated with electric vehicles and their viability in today's environment. Students will study environmental, economic, and political aspects, comparing and contrasting electric vehicles with their fossil fuel counterparts. Students will summarize the key pros and cons of each technology and predict possible future trends.
Unit 2 Assignments:
Students will identify the basic concerns regarding electric vehicles (convenience, range, expense, speed) and respond to each with a dissenting point of view. Student teams will develop a presentation for interested car buyers describing the benefits of Electric Vehicle ownership, and debate the relative merits of electric vehicle technology with that of the conventional internal combustion engine.

Unit 3: Electric Vehicles and the Environment
In this unit students will study worldwide environmental issues associated with vehicles using both internal combustion engines (ICE) and electric motors. Students will compare electric power to other power forms and review the history of the

development of electrical power. Key issues such as air pollution, and the other effects on both local and global ecosystems will be covered, and an appraisal of the environmental effects in different regional situations compared.
Unit 3 Assignments:
In groups, students will review data from the early history of motorized transport showing that electric vehicles outnumbered internal combustion (ICE) powered vehicles 2:1. Reviewing historical events, students will present theses as to why the situation is so different today. Students will identify critical inventions that changed the ICE powered vehicle, availability of electric energy and environmental conditions and social attitudes. Students will present data, hypotheses and conclusions as part of their 'group' portfolio on the electric vehicle.

Unit 4: Chassis and Design
In this unit, vehicle designs will be reviewed to identify features that are intended to improve mileage, reduce energy consumption, whilst retaining key safety features.
Students will identify key features of chassis design, make a parts list, and build a chassis based on these criteria.
Unit 4 Assignments:
Following the selection of a design, students will begin construction by building the basic chassis installing the beams, floor, and swing arms. Students will be guided in the process of chassis inspection to ensure all parts are properly reviewed and mounted and that industry safety standards are employed.

Unit 5: Electric Motors
In this unit, students will learn about the principles and operation of various types of electric motors used in electric vehicles. Students will review alternating current (AC) and direct current (DC) motors and identify the advantages and disadvantages of both. Students will identify various types of DC and AC Motors, their main components, and study efficiency of each major type of motor.
Unit 5 Assignments:
In groups, students will be provided various motor components and be able to identify the individual components and, when provided the component parts, be able to reconstruct the motor.
After completing research on both AC and DC motors, students will identify the efficiency and practicality of each type. Students will collaborate and discuss the ideal characteristics of a motor for their vehicle.

Unit 6: Batteries and Controllers
In this unit, students will study the chemistry driving all electrochemical cells. They will identify the components of a battery and its construction. Students will learn safety issues such as overcharging and short circuits.
Students will understand the purpose of an electric vehicle's controller, which takes power from the batteries and delivers it to the motor and the relationship of the battery size and controller type for best efficiency.
Students will learn about battery management systems including voltage and resistance. Students will understand correct battery wiring to avoid injury and damage.
Unit 6 Assignments:
Students will safely assemble a battery pack and arrange cells by correct polarity. Students will be able to describe the various lithium battery options and rate each one in terms of power density, safety, and initial cost and lifetime costs.
Given a set of parameters such as voltage, power and current rating, students will be able to determine cell capacity, weight, and size appropriate for each vehicle.
Students will research pulse width modulation (PWM) and prepare a written report describing it purpose and function in relation to the controller.

Unit 7: Electrical Systems
In this unit, the principles of electricity will be reviewed to determine correct wire sizes, connections, and types of chargers necessary for maximum efficiency.
Students will review the charging cycle, wire gauge, and proper connecting techniques.
Unit 7 Assignments:
In groups, students will connect and balance various size battery packs by connecting cells in series and parallel and wiring systems.
Students will research various charging systems and identify the optimum system for different situations.

Unit 8: EV Construction, Troubleshooting, and Measuring Performance
This unit is dedicated to assembling a vehicle for entry in an adjudicated competition. All previous decisions and subsystems regarding components, along with the research, will be used to build the electric vehicle. A build schedule will be developed and students will be given specific roles to ensure completion.
Students will be tasked will troubleshooting and making repairs and, in the event of delays, will be tasked with communicating to make adjustments.
Unit 8 Assignments:
Students will complete an itemized construction schedule including a Program Evaluation Review Technique (PERT) with benchmarks. Industry professionals will review progress at each benchmark and students will identify challenges and alternatives.
Through field testing, students will identify opportunities for improvements and determine ways to incorporate these enhancements.
Students will take part in a competition against other vehicles with the same basic design criteria, and record performance in their group portfolio.

Unit 9: Final Performance Assessment, Analysis and Improvements
In this unit, students will analyze the performance of their vehicle in relation to their own predictions, and in relation to other vehicles in the competition.
Students will chart their progress and compare their vehicle to others, examine areas of improvement, and present the results in both a class presentation and a performance conclusion in their group portfolio.
Unit 9 Assignments:
Students will prepare a group report describing their initial vision, key design decisions, summary of construction process, measured performance and analysis, assessment of their group's process, and areas of group growth.
Students will also write an individual reflection on their personal experience, areas of strength, and areas of growth.

TEXTS AND SUPPLEMENTAL INSTRUCTIONAL MATERIALS

Title, Author, Publisher, Edition:
Build Your Own Electric Vehicle,
Seth Leitman and Bob Brant,
McGraw-Hill Education,
3rd Edition/2016

Previously Adopted? ☐ **Yes** ☒ **No (If no, provide information directly below)**

Cost per book	Total Cost	Budget Source

Other:

Modern Electric, Hybrid Electric, and Fuel Cell Vehicles
Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz Ebrahimi
CRC Press
3rd Edition/2018

DIFFERENTIATED INSTRUCTIONAL METHODS AND/OR STRATEGIES

ASSESSMENT METHODS AND/OR TOOLS

ASSESSMENT CRITERIA

HONORS COURSES ONLY

Indicate how this honors course is different from the standard course.