SYLLABUS

DATE OF LAST REVIEW : 02/11/2013
CIP CODE: 47.0614
SEMESTER: Departmental Syllabus
COURSE TITLE: Hybrid/Electric Vehicle Batteries
COURSE NUMBER: AHEV0262
CREDIT HOURS: 3
INSTRUCTOR: Departmental Syllabus
OFFICE LOCATION: Departmental Syllabus
OFFICE HOURS: Departmental Syllabus
TELEPHONE: Departmental Syllabus
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KCKCC-issued email accounts are the official means for electronically communicating with our students.

PREREQUISITE(S): AUTT0262, AUTT0282 or approval by the instructor.

REQUIRED TEXT AND MATERIALS: Please check with the KCKCC bookstore, http://www.kckccbookstore.com for the required text for your particular class.

COURSE DESCRIPTION:
The student will learn the theory and operation of batteries in hybrid electric, electric and plug in hybrid vehicles. The content will cover battery safety, cooling systems, diagnosis and service. The course will emphasize the importance of safety due to the deadly nature of the high voltage environment. Students are required to purchase their own high voltage class 0 gloves to participate in live lab experiences. For every task in Hybrid Electric Vehicle Batteries, the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.
METHOD OF INSTRUCTION:
A variety of instructional methods may be used depending on content area. These include but are not limited to: lecture, multimedia, cooperative/collaborative learning, labs and demonstrations, projects and presentations, speeches, debates, and panels, conferencing, performances, and learning experiences outside the classroom. Methodology will be selected to best meet student needs.

COURSE OUTLINE:
All students must comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

I. High Voltage Electrical Safety
   A. Electric shock
   B. Tool and equipment usage and high voltage systems
   C. Electrical isolation
   D. Multimeters
   E. CAT III

II. High Voltage Vehicle Safety Systems
    A. Serial Interlock Loop (SIL)
    B. Local Interlock Loop (LIP)
    C. Service disconnect switch systems
    D. High voltage isolation fault detection
    E. Testing for isolation faults

III. DC-DC Converter Systems
     A. The Fundamentals of dc-dc converter operation

IV. Battery Cooling Systems
    A. Temperature sensors
    B. Model specific cooling systems

V. Battery Management Systems
    A. Battery interconnection
    B. Battery pack to power inverter cabling
    C. Battery pack current sensing
    D. Battery pack contactors (Relays)
    E. The battery pack controller
    F. Diagnostics

VI. Plug in Hybrid Electric Vehicles or PHEV
    A. Characteristics of PHEV operation
    B. Off the car charging stations
    C. Power variations from the charging station to the vehicle
    D. Components of the PHEV system
    E. Supply power from the power company
    F. Issues with modifications for the consumers home to supply power

VII. Battery Construction
     A. Lead acid battery families (Flooded and AGM)
B. Principles of flooded and AGM battery technologies  
C. Basic flooded battery technology  
D. Connecting batteries in series and parallel  
E. Service including proper replacement methods  
F. Disassembly of the battery module for component replacement

VIII. High Voltage Nickel Metal Hydride Technology  
A. Charge and discharge electrical characteristics  
B. Capacity and specifications  
C. Advantages and disadvantages  
D. Service

IX. High Voltage Lithium Based Batteries  
A. Charge and discharge electrical characteristics  
B. Capacity and specifications  
C. Advantages and disadvantages  
D. Service

X. High Voltage Batteries of other designs  
A. Sodium  
B. Zinc  
C. Other

XI. Other Related  
A. Ultra capacitors  
B. Future of battery technology

EXPECTED LEARNER OUTCOMES:  
A. The student will be able to demonstrate high voltage electrical safety procedures  
B. The student will be able to describe the high voltage vehicle safety systems  
C. The student will be able to explain how DC-DC converter systems work  
D. The student will be able to explain how battery cooling systems work  
E. The student will be able to explain battery management systems work  
F. The student will be able to understand the Plug in Hybrid Electric Vehicle or PHEV  
G. The student will be able to describe battery construction  
H. The student will be able to demonstrate service on high voltage nickel metal hydride technology  
I. The student will be able to demonstrate service on high voltage lithium based batteries  
J. The student will be able to discuss batteries of other designs  
K. The student will be able to discuss other HEV battery related information

COURSE COMPETENCIES:  

*The student will be able to demonstrate high voltage electrical safety procedures*  
1. The student will be able to define high voltage and explain the implications of human interaction  
2. The student will be able to explain the purpose of personal protection equipment and what they do
3. The student will be able to demonstrate how to wear high voltage personal protection equipment.
4. The student will be able to demonstrate when and where personal protection equipment will be worn.
5. The student will be able to demonstrate how to disable high voltage.

_The student will be able to describe the high voltage vehicle safety systems_.
6. The student will be able to demonstrate the coupling and uncoupling of the interlock loop.
7. The student will be able to demonstrate proper disconnect/reconnect procedure of the service disconnect.
8. The student will be able to demonstrate testing for isolation faults.

_The student will be able to explain how DC-DC converter systems work_.
9. The student will be able to explain how the dc to dc converter works and why.
10. The student will be able to describe how the converter charges the low voltage battery.

_The student will be able to explain how battery cooling systems work_.
11. The student will be able to demonstrate temperature sensor output on scan tool.
12. The student will be able to describe how battery cooling systems work on three common hybrid vehicles.

_The student will be able to explain battery management systems work_.
13. The student will be able to demonstrate battery cable removal procedures.
14. The student will be able to explain operation of battery pack contactors.
15. The student will be able to describe current sensing PIDs from scantool.
16. The student will be able to identify battery pack controller and its operation.
17. The student will be able to demonstrate procedure for scanning vehicle modules for data.

_The student will be able to understand the Plug in Hybrid Electric Vehicle or PHEV_.
18. The student will be able to explain the characteristics of PHEV operation.
19. The student will be able to explain off the car charging station power requirements for the consumer.
20. The student will be able to explain power variations from the charging station to the vehicle.
21. The student will be able to explain components of the PHEV system.
22. The student will be able to explain issues with power grids and supply power from the power company.
23. The student will be able to explain issues with modifications for the consumers home to supply power.
24. The student will be able to describe battery construction

25. The student will be able to demonstrate basic testing for high and low voltage batteries

26. The student will be able to demonstrate high and low voltage battery bus connection methods

27. The student will be able to demonstrate high and low voltage battery replacement methods

28. The student will be able to disassemble and reassemble a complete battery module

29. The student will be able to demonstrate service on high voltage nickel metal hydride technology

30. The student will be able to demonstrate service on high voltage lithium based batteries

31. The student will be able to explain the characteristics of charging and discharging while in normal operation

32. The student will be able to describe the advantages and disadvantages of nickel metal hydride batteries

33. The student will be able to demonstrate battery removal and installation

34. The student will be able to explain the characteristics of normal charging and discharging

35. The student will be able to discuss the specifications and types of lithium batteries

36. The student will be able to explain the advantages and disadvantages of lithium batteries

37. The student will be able to describe service techniques for lithium batteries

38. The student will be able to explain how ultra capacitors can take the place of batteries

39. The student will be able to discuss the future of battery technology

40. The student will be able to describe how to dispose of hazardous material

41. The student will be able to describe how to deal with batteries that are damaged

ASSESSMENT OF LEARNER OUTCOMES:
Student progress is evaluated by means that include, but are not limited to, exams, written assignments, and class participation.

SPECIAL NOTES:
This syllabus is subject to change at the discretion of the instructor. Material included is intended to provide an outline of the course and rules that the instructor will adhere to in
evaluating the student’s progress. However, this syllabus is not intended to be a legal contract. Questions regarding the syllabus are welcome any time.

Kansas City Kansas Community College is committed to an appreciation of diversity with respect for the differences among the diverse groups comprising our students, faculty, and staff that is free of bigotry and discrimination. Kansas City Kansas Community College is committed to providing a multicultural education and environment that reflects and respects diversity and that seeks to increase understanding.

Kansas City Kansas Community College offers equal educational opportunity to all students as well as serving as an equal opportunity employer for all personnel. Various laws, including Title IX of the Educational Amendments of 1972, require the college’s policy on non-discrimination be administered without regard to race, color, age, sex, religion, national origin, physical handicap, or veteran status and that such policy be made known.

Kansas City Kansas Community College complies with the Americans with Disabilities Act. If you need accommodations due to a documented disability, please contact the Director of the Academic Resource Center, in Rm. 3354 or call at: 288-7670.