SYLLABUS

DATE OF LAST REVIEW : 02/11/2013
CIP CODE: 47.0614
SEMESTER: Departmental Syllabus
COURSE TITLE: Hybrid /Electric Vehicles Inverters, Converters and Electric Motors
COURSE NUMBER: AHEV0282
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 electric motors, converters, inverters and chargers used to power hybrid, electric, and plug in hybrid vehicles. 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 Inverters Converters and Electric Motors 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
   C. High voltage safety rules
   D. Electrical isolation
   E. Service disconnect switch systems
   F. CAT III environment

II. AC theory
    A. Sine-wave
    B. Frequency
    C. Amplitude
    D. Inductance
    E. Capacitance
    F. Diode operation
    G. Transistor operation
    H. rectification

III. Motor Design categories
     A. Series design
     B. Parallel design
     C. Series parallel design
     D. BAS design
     E. Electric vehicles
     F. DC motors
     G. AC motors
     H. Traction and motor generators

IV. AC Induction Motor Components
    A. Electric vehicle system components
    B. Rotor and stator
    C. IM components
    D. Mutual induction

V. Power Inverter Systems
    A. Motor controls
    B. Power inverter
C. Hybrid and electric power systems
D. Motor power control strategies
E. PWM sine waves
F. Waveforms
G. Regenerative braking
H. Charging reactor

VI. Operation of three-phase AC motors
A. Field interaction
B. Motor controllers
C. Motor control theory

VII. Sensing Systems
A. Motor speed sensing
B. Resolver
C. Motor load current sensing
D. Throttle pedal position sensing

VIII. Plug in Hybrid Electric Vehicle (PHEV)
A. Explain on board car charging systems that plug into off car power
B. Home power requirements
C. Components of PHEV’s
D. View scantool data from charging system

IX. Electric motor and power inverter cooling
A. Cooling system types by model
B. Why we need cooling on inverter

EXPECTED LEARNER OUTCOMES:
A. The student will be able to explain the elements of high voltage electrical safety
B. The student will be able to describe electrical and AC theory
C. The student will be able to identify motor design categories
D. The student will be able to identify AC motor components
E. The student will be able to describe the operation of three-phase AC brushless electric motors
F. The student will be able to describe characteristics of sensing systems
G. The student will be able to describe Plug in Hybrid Electric Vehicle (PHEV) operation and service
H. The student will be able to explain motor and power inverter cooling

COURSE COMPETENCIES:
The student will be able to explain the elements of high voltage electrical safety
1. The student will be able to define high voltage and explain the implications of human interaction
2. The student will be able to demonstrate correct usage of tools and equipment
3. The student will be able to understand the rules for high voltage
4. The student will be able to demonstrate how to wear high voltage personal protection equipment
5. The student will be able to demonstrate how to identify and use service disconnect systems
The student will be able to describe electrical and AC theory

6. The student will be able to define sine-wave, frequency, amplitude, inductance, and capacitance
7. The student will be able to explain diode operation, transistor operation and rectification

The student will be able to identify motor design categories

8. The student will be able to explain the differences between series, parallel and series parallel systems
9. The student will be able to explain the operation of DC motors and their use
10. The student will be able to explain the operation of three-phase AC motors and their use
11. The student will be able to define traction motor and motor generator

The student will be able to identify AC motor components

12. The student will be able to remove and install electric motors from a transmission case
13. The student will be able to remove and install the rotor and stator from an electric motor
14. The student will be able to identify and describe associated motor components

The student will be able to describe the operation of three-phase AC brushless electric motors

15. The student will be able to describe induction and field interaction
16. The student will be able to explain the operation of the motor controller
17. The student will be able to explain how motor controls interact with the electric motor

The student will be able to describe characteristics of sensing systems

18. The student will be able to describe the purpose of a resolver
19. The student will be able to explain the use of motor load current sensing
20. The student will be able to explain how motor speed sensing occurs and why it is necessary
21. The student will be able to measure and explain throttle pedal position sensing

The student will be able to describe the operation of power inverter systems

22. The student will be able to explain how motor controls interact with the electric motor
23. The student will be able to explain how a power inverter interacts with the battery and electric motors
24. The student will be able to remove and install a inverter system and examine components
25. The student will be able to describe motor control strategies
26. The student will be able to read and interpret pulse width modulation and sine wave structures
27. The student will be able to describe the use of wave forms
28. The student will be able to describe how regenerative braking works in different vehicles

_The student will be able to describe Plug in Hybrid Electric Vehicle (PHEV) operation and service_

29. The student will be able to explain on board car charging systems that plug into off car power

30. The student will be able to discuss power requirements for the home issues regarding use of the power grid

31. The student will be able to describe the components of PHEV’s

32. The student will be able to view scantool data showing information from off car charging system

_The student will be able to explain motor and power inverter cooling_

33. The student will be able to remove and install components of an inverter cooling system

34. The student will be able to explain why cooling systems are necessary

**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.