ME 44000
Automotive Prime Movers: Green Engines and Clean Fuels

Course Outcomes [Related ME Program Outcomes in brackets]

1. Relate processes in automotive prime movers to engineering fundamentals [A1, A2, A3, A4]
2. Study low-carbon emitting, and LEV, ULEV, SULEV, PZEV, and ZEV prime mover designs [A2, A3, A4, A5, A6, A7]
3. Study prime mover designs that are alternatives to conventional combustion engines [A2, A3, A4, A5, A6, A7]
4. Study cleaner alternatives to conventional fossil fuels. [A1,A2, A3,A4]
5. Carry out analysis of prime mover designs and fuel alternatives to identify cost and energy tradeoffs [A2, A3, A5, A6, A7]

Motivation/ Performance Parameters (1 wk)
1. Classification of prime movers, vehicles
2. Performance parameters of prime movers

I.C. Engines (4 wks)
1. Clean diesels
2. DI SI engines
3. HCCI engines
4. Alternate designs
5. Aftertreatment

Hybrid and Fuel Cell Engines (5 wks)
2. Hybrid system design and integration with vehicles.
3. Fundamental of PEM fuel cells
5. Integration with vehicles

Clean Fuels (3 wks)
1. Fuel chemistry and heating values
2. Fossil fuels, including natural gas
3. Hydrogen
4. Biofuels: sources, production, utilization

Cost and Energy Balance (2 wks)
1. Well-to-wheel analysis methodologies
2. Well-to-wheel analysis of alternate engine designs, including fuels
3. Estimates of life-cycle emissions
4. Cost analysis of alternate engine designs

Laboratory Experiments
1. Engine tear-down and re-assembly (2 weeks)
2. Spark-ignition engine performance with gasoline and gasoline/ethanol blends (2 weeks)
3. Compression-ignition engine performance with diesel and biodiesel (2 weeks)
4. Hybrid engine component performance and comparison with I.C.e engine (2 weeks)
5. Fuel cell performance (1 week)
6. Hybrid engine system arrangements (1 week)
7. Impact of driving cycle on hybrid engine performance (1 week)

Revision Date:
May 14, 2010
1. COURSE NUMBER AND NAME: ME 44000 Automotive Prime Movers: Green Engines and Clean Fuels

2. CREDITS AND CONTACT HOURS: 3 credits
   a. Lecture – 2 meetings per week at 50 minutes for 16 weeks
   b. Laboratory – 1 meeting per week at 110 minutes for 16 weeks

3. COURSE COORDINATOR OR INSTRUCTOR:
   J. Abraham

4. TEXTBOOK:
   Class Notes

5. SPECIFIC COURSE INFORMATION:
   a. Catalog Description: Internal combustion engines (ICE), hybrid engines (HE), fuel-cell engines (FCE), and alternative/renewable fuels. ICEs topics - engines with advanced combustion systems such as clean diesels, direct-injection spark-ignition engines (DISI), and low-temperature combustion (LTC) compression-ignition. HE topics - different components of hybrid engines and the powertrain design. FCE topics - fundamentals of fuel cells and automotive applications. Clean fuel topics - biofuels, hydrogen, and natural gas, as well as, other cleaner fossil fuels for automotive applications. Well-to-wheel energy and cost analysis of prime mover designs/fuels. Includes lab. Typically offered in spring.
   b. Prerequisites:
      ME 30000 Thermodynamics
   c. Status: Elective

6. SPECIFIC GOALS FOR THE COURSE
   a. Course Outcomes:
      [Related ME Program Outcomes in Brackets]
      1. Relate processes in automotive engines to the engineering fundamentals. [A1, A2, A3, A4]
      2. Study low-carbon emitting and LEV, ULEV, SULEV, PZEV, & ZEV engine designs [A2, A3, A4, A5, A6, A7]
      3. Study prime mover designs that are alternatives to conventional combustion engines [A2, A3, A4, A5, A6, A7]
      4. Study cleaner alternatives to conventional fossil fuels. [A1, A2, A3, A4]
      5. Carry out analysis of prime mover designs and fuel alternatives to identify cost and energy tradeoffs [A2, A3, A5, A6, A7]
   b. Related ME Program Outcomes:
      [Related ABET Outcomes Listed in Brackets]
      A1. Engineering Fundamentals; B3. Prof/Ethical Responsibility;
      A3. Experimental Skills; B5. Life-Long Learning;
      A4. Modern Engr Tools; C1. Leadership,
      A5. Design Skills; C2. Global Engineering Skills;
      A6. Impact of Engr Solns; C3. Innovation;
      B1. Communication Skills; C4. Entrepreneurship
      B2. Teamwork Skills

7. LIST OF TOPICS: See following page.