ME 492 TP: VEHICLES AND SUSTAINABLE ENERGY

CATALOG DATA:

ME TP: Vehicles and Sustainable Energy (3-0) 3 credits
This is an overview course on integrating sustainable energy systems into vehicle design and vehicle performance implications. Fuel sources and conversion techniques (both from a vehicle perspective and more general); vehicle dynamics and design considerations; storage and transfer; safety issues, economics and optimization.

REFERENCES: (recommended)

T.D. Gillespie, *Fundamentals of Vehicle Dynamics*, SAE, Warrendale, PA; OSBN 1-56091-199-9
F.M. Vanek and L.D. Albright, *Energy Systems Engineering: Evaluation and Implementation*, McGraw-Hill, NY; ISBN 978-0-07-149593-6

INSTRUCTORS:

Dr. Dan Dolan, CM 207, 394-1273, Fax: 394-2405, Daniel.Dolan@sdsnt.edu
Office Hours: as posted weekly.
Dr. U.A. Korde, CM 130, 355-3731, Fax: 394-2405, Umesh.Korde@sdsmt.edu
Office Hours: MWF 11 AM-12 PM, M 2-3 PM, T 10-11 AM, and by prior arrangement.

CLASS SCHEDULE: T 1-4 PM; CB 329

ADA INFORMATION:

Students with special needs or requiring special accommodations should contact the instructors, and/or the campus ADA coordinator, Jolie McCoy at 394-1924 at the **earliest** opportunity.

FREEDOM IN LEARNING STATEMENT:

Under Board of Regents and University policy student academic performance may be evaluated solely on an academic basis, not on opinions or conduct in matters unrelated to academic standards. Students should be free to take reasoned exception to the data or views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled. Students who believe that an academic evaluation reflects prejudiced or capricious consideration of student opinions or conduct unrelated to academic standards should contact the dean of the college which offers the class to initiate a review of the evaluation.

ENTRANCE EXPECTATIONS:

Students are expected to have:

1. an ability to apply Newton's laws to rigid bodies, the laws of thermodynamics, and the basic principles of solid and fluid mechanics,

COURSE OBJECTIVES:

Completion of this course will favorably position the student for a career wherein he/she will:

1. demonstrate the ability to analyze engineering systems/designs from an energy standpoint,
2. demonstrate and sustain a balanced view of energy solutions and challenges,
3. demonstrate an understanding of acceleration, braking, ride, and handling of ground vehicles from a design standpoint for a realistic range of design parameters.
4. Demonstrate an understanding of energy demands and losses, showing sensitivity to the tradeoffs between size and energy consumption, with attention to safety, lifecycle costs, and environmental impact.

COURSE OUTCOMES:

Upon completion of this course, students will have demonstrated the ability to:

1. use fundamentals-based analysis to quantify energy conversion rates for some energy sources, systems, and converter designs;
2. use a balanced engineering approach in evaluating various energy conversion methods;
3. for any acceleration mode, calculate normal and longitudinal loads (for 2-wheel, 3-wheel, and 4-wheel vehicles), energy use, and energy losses;
4. calculate power necessary for any cruise condition including powertrain, tire and aerodynamic losses and estimate ride quality based on simplified road input spectra;
5. for any braking scenarios, calculate the normal and longitudinal forces on all wheels, energy lost and recoverable energy;
6. for steady-state cornering, determine normal, longitudinal, and lateral loads and steering angles for maximum holding capacity for all wheels;
7. complete projects illustrating the complex nature of energy problems.

RELATION OF COURSE OUTCOMES TO PROGRAM OUTCOMES*:

The following table indicates the relative strength of each course outcome in addressing the program outcomes (on a scale of 1 to 4, 4 indicating strong emphasis).

ME 492		ME Program Outcomes					
		Objective 1			Objective 2		
Program Outcome		1	2	3	4	5	6
Course Outcomes	(1)	4	3		3		
	(2)	4	3		3		
	(3)	4	3		4		
	(4)	4	4		4		
	(5)	4	4		4		
	(6)	4	4		4		
	(7)	4	4	3	4	4	

***** (Page 4 lists the objectives and outcomes for the School of Mines BSME program.)

TOPICS: (may be adjusted during the semester.)

I. **Introduction and Overview (1 week)**: energy conversion analysis for vehicles
II. **Conversion (5 weeks):** energy conversion fundamental limits, resource and resource extraction, combustion; environment, fossil fuels (petroleum), perspective on electric and hybrid vehicles, motors, fuel cells, energy storage; nuclear energy, solar resource and conversion, wind and wave; energy transfer
III. **Dynamics and Design (5 weeks):** acceleration: energy loss (mass sensitivity), load transfer, traction/power limited; cruise: energy requirement (mass and size sensitivity), drag, road load; braking: lost energy (mass sensitivity), potential for recovery (regenerative braking) with mass sensitivity, load transfer, brake bias; ride: effect of mass; handling: effect of mass, steering, steady-state cornering (roll: moment and its distribution, roll centers, moment take-up in springs, balancing with anti-roll bars)
IV. **Safety (2 weeks)**: safety implications of conversion technology, lightweight, storage and transfer technology
V. **Economics and Optimization (1 week)**: Economics of energy conversion processes, of vehicles, systems approach
VI. **Integration (all semester)**: Project integrating II-V.

COMPUTER USAGE:

Students will use computers for homework and project assignments.

LABORATORY:

There is no specific laboratory component for this course.

ASSESSMENT AND EVALUATION:

Course Objectives

The course objectives will be evaluated by the following methods:

1. Vehicle projects, current and new
2. FE Exam
3. Exit assessment

Course Outcomes

The final grade will be based on the following:

Homework (weekly)	10%
Quizzes (weekly)	10%
Tests* (3)	40%
Projects	40%
Final	

(Optional; may be used to replace one of the tests.)

- Test 1: October 3, Test 2: October 31, Test 3: December 3

OBJECTIVES/OUTCOMES: BSME Program

OBJECTIVE 1: Lead and/or manage effective engineering design analyses
Outcomes:

1. Apply skills in engineering, science, and mathematics (a, e)
2. Practice effective analysis (g, k)
3. Conduct data analyses and analyses verification (b, f)

OBJECTIVE 2: Lead and/or manage effective engineering design teams
Outcomes:

4. Apply effective engineering design skills (c, f, h)
5. Demonstrate teaming proficiency (d, g, j)
6. Participate in research and professional development (f, i, j)

ABET a-k

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs
(d) an ability to function on multi-disciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice