

9-2013

## NRGY 241.50: Alternative Fuels

Brian P. Kerns

*University of Montana - Missoula*

Let us know how access to this document benefits you.

Follow this and additional works at: <https://scholarworks.umt.edu/syllabi>

---

### Recommended Citation

Kerns, Brian P, "NRGY 241.50: Alternative Fuels" (2013). *Syllabi*. 325.  
<https://scholarworks.umt.edu/syllabi/325>

This Syllabus is brought to you for free and open access by the Course Syllabi at ScholarWorks at University of Montana. It has been accepted for inclusion in Syllabi by an authorized administrator of ScholarWorks at University of Montana. For more information, please contact [scholarworks@mso.umt.edu](mailto:scholarworks@mso.umt.edu).

**Course Title: ALTERNATIVE FUELS NRG 241.50**

[HTTP://INVENTORSPOT.COM/ARTICLES/HONDA FCX CLARITY NAMED WORLD GREEN CAR YEAR 2016](http://inventorspot.com/articles/honda-fcx-clarity-named-world-green-car-year-2016)

**Course Description:**

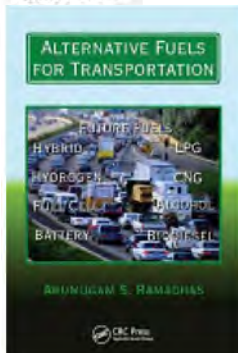
NRG241 Alternative Fuels (3 credits) investigates the range of non-conventional transportation fuels that have been explored or are currently in development and some that are still on the horizon.

**Course Overview:**

In an increasingly carbon and oil constrained world, much research is given towards an environmentally friendly, domestically produced fuel that can be used by our massive transportation fleet which includes not only cars and trucks, but also aircraft, ships, and railways. Many of these technologies have already been explored but the primal obstacle is the economic production and delivery of such fuels in competition with conventional petroleum based fuels.

**Prerequisites:**

Integrated Physical Sciences (SCN 175N), Intro to Energy Systems I & II (NRG 101 & 102) or equivalents with instructor permission.

**Textbook:**

Alternative Fuels for Transportation. (2011), edited by Arumugam S. Ramadhas, CRC Press ISBN 978-1-4398-1957-9. The Missoula College library has copies on order as of August 15. List price is \$94.95 for a new copy. Sometimes the bookstore has used copies but they had none when I checked. Amazon had new copies for \$71. If you use Kindle, you can rent a copy for \$22.

**Course Contributions to Program Objectives:**

This course helps satisfy the following objectives of the Energy Technology Program:

1. Develop professional fundamentals
2. Understand energy infrastructure
3. Comprehend traditional, alternative, and sustainable energy production technologies.

4. Work with alternative fuels.
5. Prepare for an alternative fueled economy.
6. Assess societal, economic, environmental, ethical, and legal impacts of alternative fuel systems.

As an upper level course in the Energy Technology Program, more computational rigor will be required from students and the homework problems will be designed to develop these skills. Also, at this point in the student's studies, practical applications and the synthesis of knowledge and acquired skills is very important and that is the focus of the field trip and term paper. Students must investigate, select, visit, interview and report upon an alternative fuel project of their choosing.

**Course Outcomes:**

1. Broad comprehension of alternative transportation fuels and their production technologies.
2. Advantages and disadvantages associated with each fuel.
3. Field experience of a commercial alternative fuel facility.
4. Environmental assessment of alternative fuels.
5. Economic considerations of alternative fuels.

**Important notice for this web-based class:**

With the exception of a field trip requirement, this class is completely web-based. Students are required to have the necessary computer knowledge and manipulation skills. Students should consult the UM On-line webpage and complete the [readiness assessment](#) to gauge how successful the student may be in the on-line environment. On-line classes are a uniquely different learning experience that demands sufficient student self-motivation. The class will be paced; that is the instructor will only make available instructional material and tests as the class advances along as a unit. Older material may be removed and will be inaccessible. **DO NOT MAKE THE COMMON MISTAKE THAT YOU CAN WAIT UNTIL THE CLOSING WEEKS OF THE SEMESTER TO CRAM-COMplete THIS COURSE AS PRIOR MATERIAL WILL NOT BE AVAILABLE TO YOU AND YOU WILL FAIL.** Students **MUST** log in to this class and report your presence to the instructor within the first week of class. Assignments will also be due during the first week of class. Email correspondence will be only through official UM email addresses. Students should consult the web course daily for any new announcements, assignments, etc. I try to make all reasonable accommodations to students with unavoidable schedule conflicts, but you must inform me IN ADVANCE about any other issue that impedes your progress through the class. Once the class completes exams or homework problems, I will post feedback in a public announcement and at that point, it will not be possible to make-up for the exam or assignment.

**Drop/Add Policy**

The policy can be [reviewed here](#).

**Academic Honesty Policy**

*All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University.*

*All students need to be familiar with the [Student Conduct Code](#).*

**Students with disabilities**

Students with disabilities will receive reasonable accommodations in this online course. To request course modifications, please contact me as soon as possible. I will work with you and Disability Services in the accommodation process. For more information, visit the [Disability Services website](#) or call

406.243.2243 (Voice/Text); videophone 406-203-0591 for calls from Montana phone numbers or 877-890-6935 for calls from out of state numbers.

**Topics:****UNIT 1. INTRODUCTION.**

- 1.1 Definitions
- 1.2 History
- 1.3 Overview of fuels

**UNIT 2. VEGETABLE OILS**

- 2.1 Introduction
- 2.2 Characterization
- 2.3 Preparation of fuels
- 2.4 Pros & cons

**UNIT 3. BIODIESEL**

- 3.1 Methods of production
- 3.2 Properties
- 3.3 Quality
- 3.4 Challenges

**UNIT 4. METHANOL**

- 4.1 Production
- 4.2 Properties
- 4.3 Health & safety issues
- 4.4 Engine tests
- 4.5 Pros & cons

**UNIT 5. ETHANOL**

- 5.1 Introduction
- 5.2 Production
- 5.3 Properties
- 5.4 Flex fuel
- 5.5 Challenges

**UNIT 6. DIMETHYL ETHER**

- 6.1 Introduction
- 6.2 Production
- 6.3 Applications
- 6.4 Safety

**UNIT 7. LIQUIFIED PETROLEUM GAS**

- 7.1 Production
- 7.2 Modeling & tests
- 7.3 Material compatibility
- 7.4 Economics
- 7.5 Safety

**UNIT 8. COMPRESSED NATURAL GAS**

- 8.1 Properties
- 8.2 Storage
- 8.3 Distribution
- 8.4 Safety

**UNIT 9. HYDROGEN**

- 9.1 Production

- 9.2 Properties
- 9.3 Fuel cells
- 9.4 Spark engines
- 9.5 Safety

#### **UNIT 10. ELECTRIC VEHICLES**

- 10.1 Principles
- 10.2 Battery storage
- 10.3 Charging
- 10.4 Solar vehicles

#### **UNIT 11. FUEL CELL VEHICLES**

- 11.1 Operating principle
- 11.2 Fueling options
- 11.3 Manufacturers' developments
- 11.4 Market

#### **UNIT 12. HYBRID VEHICLES**

- 12.1 Configurations
- 12.2 Operations
- 12.3 Trends

#### **UNIT 13. FUTURE FUELS**

- 13.1 Evolution of biofuels
- 13.2 Conversion strategies
- 13.3 Algae biofuels
- 13.4 Compressed air

#### **Class Flow**

This course is organized on a weekly format where we'll study one topic which usually correlates to one textbook chapter. Chapter notes are presented in the weekly notes tab in Moodle. Assignments consist of a weekly discussion topic, homework problem, and weekly quiz. All these materials are available under the weekly tab in Moodle and also collected for ALL weeks in the "Course Menu" area on the left side of the Moodle screen. The class flow will consist of the new lesson activated on Monday, discussion due Wednesday, homework problem due Friday and unit exam due Sunday. Assignments are typically due by 11:55 pm on the given day. Homework should be submitted via the Moodle submission process. Quizzes are usually 10 questions with a time limit of 35 minutes. You can use all academic means at your disposal (books, notes, internet, etc.) but copying others' work or consulting with others will be considered as academic dishonesty. A self-directed field trip or a student-designed experiment is an important part of this class and a term paper based on this experience will be a large part of your grade. The field trip and term paper are due by the end of Week 13 (see schedule below). The tables below show how I will grade your assignments:

| <b>Paper Grading</b>                                | <b>Points</b> | <b>% of Grade</b> |
|---|---------------|-------------------|
| Content   | 40            | 40%               |
| Grammar (sentence structure, spelling, etc.)        | 30            | 30%               |
| Length (1500 to 2000 words – use word count, I do!) | 15            | 15%               |
| References (Minimum of 3)                           | 15            | 15%               |
| <b>Total</b>  | <b>100</b>    | <b>100%</b>       |

**Discussion Forum Grading**

|  |   |      |
|--|---|------|
| Content  | 3 | 60%  |
| Interaction (responds to at least 2 other posts) | 2 | 40%  |
| Total  | 5 | 100% |

**Homework Grading**

|   |   |      |
|---|---|------|
| Problem set up (rationale, data organization, flow) | 3 | 60%  |
| Computational correctness                           | 2 | 40%  |
| Total   | 5 | 100% |

**Late Assignments:**

For discussion forums and homework assignments, lose 1 point/day for maximum of 2 days after which assignment will not be accepted. For term paper, lose 5 points/day for maximum of 6 days after which assignment will be refused. This does not apply to excused situations.

**Grade Determination:**

|  | Points | % of Grade |
|--|--------|------------|
| Unit Quiz (13 quizzes, 10 pts. each)           | 130    | 36.0%      |
| Discussion Postings (13 postings, 5 pts. each) | 65     | 18.1%      |
| Field Trip/experiment and Class Paper          | 100    | 27.8%      |
| Homework Problems (13 probs., 5 pts. each)     | 65     | 18.1%      |
| Final Comprehensive Exam                       | none   |            |
| Total  | 360    | 100.0%     |

**Note on Moodle Grading:**

This will be the first time for all of us using the upgraded Moodle 2.0. Hopefully Moodle will have improved the capabilities of their grade book because the previous version could not handle bonus points. I usually like to include a bonus question in my quizzes but the way Moodle scores them is goofy. Don't worry – grades are determined base on the total point score. Typical quizzes are 10 points with a 1-point bonus question. Total points are 11, but if you get 10 points, that's 100 % but Moodle used to score based on a total of 11, so a perfect 10 will show a score of 90.1. Like I said, hopefully this is corrected in version 2.0 – we'll find out quick enough. Your grade is ultimately determined by the scoring matrix below.

| Grade | Total Points       |
|-------|--------------------|
| A     | $324 \leq x$       |
| B     | $288 \leq x < 324$ |
| C     | $252 \leq x < 288$ |
| D     | $216 \leq x < 252$ |
| F     | $x < 216$          |

**Course Schedule:**

| <b>Week</b> | <b>Monday's Date</b> | <b>Learning Unit</b>                | <b>Forum Postings due by 11:55 pm</b> | <b>Homework due by 11:55 pm</b> | <b>Unit exams Due by 11:55 pm</b>        |
|-------------|----------------------|-------------------------------------|---------------------------------------|---------------------------------|--|
| 1           | 8/26                 | Introductions                       | 8/28                                  | 8/30                            | 9/1                                      |
| 2           | 9/2                  | Vegetable Oils                      | 9/4                                   | 9/6                             | 9/8                                      |
| 3           | 9/9                  | Biodiesel                           | 9/11                                  | 9/13                            | 9/15                                     |
| 4           | 9/16                 | Methanol                            | 9/18                                  | 9/20                            | 9/22                                     |
| 5           | 9/23                 | Ethanol                             | 9/25                                  | 9/27                            | 9/29                                     |
| 6           | 9/30                 | Dimethyl Ether                      | 10/2                                  | 10/4                            | 10/6                                     |
| 7           | 10/7                 | Liquefied Petroleum Gas             | 10/9                                  | 10/11                           | 10/13                                    |
| 8           | 10/14                | Compressed Natural Gas              | 10/16                                 | 10/18                           | 10/20                                    |
| 9           | 10/21                | Hydrogen                            | 10/23                                 | 10/25                           | 10/27                                    |
| 10          | 10/28                | Electric Vehicles                   | 10/30                                 | 11/1                            | 11/3                                     |
| 11          | 11/4                 | Fuel Cells                          | 11/6                                  | 11/8                            | 11/10                                    |
| 12          | 11/11                | Hybrid Vehicles                     | 11/13                                 | 11/15                           | 11/17                                    |
| 13          | 11/18                | Field trip/Experiment<br>Term Paper | none                                  | none                            | <b>Term paper due<br/>midnight 11/24</b> |
| 14          | 11/25                | Thanksgiving Break                  | none                                  | none                            | none                                     |
| 15          | 12/2                 | Future Fuels                        | 12/4                                  | 12/6                            | 12/8                                     |
| 16          | 12/9                 | Finals Week                         | none                                  | none                            | none                                     |

**Prepared by:** Brian P. Kerns**Revised:** August 15, 2013