I. Basic Course Information

A. Course Number and Title: ENVI 103 - Energy and the Environment

B. New or Modified Course: Modified Course

C. Date of Proposal: Semester: Fall Year: 2016

D. Effective Term: Fall 2017

E. Sponsoring Department: Science and Engineering

F. Semester Credit Hours: 3

G. Weekly Contact Hours: 3 Lecture: 3 Laboratory: 0 Out of class student work per week: 6

H. Prerequisites/Corequisites: MATH 020 Elementary Algebra or a satisfactory score on the placement test

I. Laboratory Fees: none

J. Name and Telephone Number or E-Mail Address of Department Chair at time of approval: Sarah Imbriglio, Ext 8241, sarah.imbriglio@raritanval.edu

II. Catalog Description

Prerequisites: MATH 020 Elementary Algebra or a satisfactory score on the placement test

Description: This course provides a broad introduction to energy and energy issues as they relate to generation options, utilization and environmental impacts. Topics include overviews of traditional carbon based energy sources, nuclear options and alternative energy technologies such as solar, wind, biofuels and hydrogen. The crucial link between energy and climate change will be examined. The environmental consequences of energy choices on local and global scales will be discussed and integrated throughout the course. Topics will be evaluated by applying basic scientific principles and the scientific method to real world problems. Policy options and understanding energy in a societal context will also be explored.
III. Statement of Course Need

A. Energy, the environment and climate are topics of national interest and concern. They are in the news daily. Everyone has a stake in our energy choices and the known or plausible consequences of the future technologies we support.

Informed decisions regarding future energy systems requires knowledge. There are crucial links between energy choices, resources and a sustainable future, and this class will provide students the opportunity to explore these interdependent relationships on local and global scales. The approach will involve inquiry into the basic principles and scientific information relevant to such an investigation, along with many real-world examples.

This course can potentially lead to professional opportunities for students in virtually any field of study. Regardless of a person’s academic major, society needs a spectrum of citizens, communicators, policy makers and specialists with a fundamental understanding of energy, possible energy futures and associated environmental effects. This course meets that need.

B. The course has no lab component.

C. Course transferability:
   a. This course may transfer as a General Education course in Science (Non-Lab).
   b. This course may transfer as a program requirement for Environmental Studies A.A. and Environmental Science A.S. majors.
   c. This course may transfer as a program elective.

IV. Place of Course in College Curriculum

A. Free Elective

B. This course serves as a General Education course in Science (Non-Lab).

C. This course meets a program option for Environmental Science A.S. and the Environmental Studies A.A.

D. This course meets a program requirement for Environmental Control Technology A.A.S. and Environmental Control Technology Certificate

E. To see course transferability: a) for New Jersey schools, go to the NJ Transfer website, www.njtransfer.org; b) for all other colleges and universities, go to the individual websites.

V. Outline of Course Content

A. Introduction to Earth’s Energy Endowment
1. Earth’s beginnings
2. The long term carbon cycle
3. Current and potential energy sources
4. Planetary energy flows and useable fuels

B. Forms of Energy
1. Gravitational, Electromagnetic, Nuclear
2. Generating electricity
3. Quantifying energy, work, power
4. Estimating energy use

C. Heat and internal energy
1. Heat transfer
2. Insulation and radiation principles
3. Entropy and the 2\textsuperscript{nd} Law of Thermodynamics

D. Fossil Fuels
1. Coal, oil, natural gas
2. Fossil fuel reserves
3. Gas engines, hybrids, electric vehicles
4. Carbon tax vs. cap-and-trade policy options

E. Environmental impacts of burning carbon fuels
1. Air pollution and greenhouse gas emissions
2. Strip mining, acid drainage, water pollution
3. Ecosystem, health and economic costs
4. Clean Air Act and Clean Water Act as policy tools

F. Nuclear Energy
1. Basics of radioactivity, fission and fusion
2. Reactor and fuel options
3. Nuclear waste, storage, MOX
4. Costs and efficiencies
5. Environmental and health impacts/concerns

G. Geothermal, Tidal and Solar Energy Sources
1. Geothermal heat pumps
2. Harnessing the energy of tides, waves, currents
3. Solar insolation
4. Passive and active solar heating
5. Photovoltaics
6. Grid contributions and efficiencies
7. Environmental impacts
H. Water, Wind and Biomass
   1. Hydropower
   2. Wind turbines
   3. Energy from wastes and biofuels
   4. Grid contributions and efficiencies
   5. Challenges and environmental impacts

I. Energy carriers
   1. The conventional power grid vs. hydrogen
   2. Managing peak power needs
   3. Energy storage and density
   4. Producing hydrogen
   5. Fuel cells and durability issues
   6. The challenges of H₂ infrastructure and an H₂ economy

J. The Science of Climate
   1. The structure of the atmosphere
   2. Absorption/Radiation Laws
   3. Earth’s energy balance
   4. Earth’s natural thermostats
   5. The Greenhouse effect
   6. A tale of 3 planets: Earth, Venus and Mars

K. Climate forcing
   1. Natural and anthropogenic forcings
   2. Effect of incoming/outgoing radiation imbalances
   3. Climate sensitivity
   4. Doubling CO₂
   5. Positive and negative feedbacks

L. Taking Earth’s Temperature
   1. Global temperature variations in context
   2. Climate proxies
   3. Temperature changes through geologic time
   4. Temperature changes in the modern era
   5. Satellite and Argo data

M. Future climates
   1. Modeling climate
   2. Computer projections
   3. Likely future scenarios
   4. Risks of global climate change
5. Costs/benefits of mitigation

N. Energy and Climate: breaking the link
   1. Options for reducing carbon emissions now
   2. Geo-engineering
   3. Carbon sequestration
   4. Alternative energy sources
   5. Improved efficiencies
   6. Economic concerns
   7. A strategy for a sustainable future

VI. General Education and Course Learning Outcomes

A. General Education Learning Outcomes:

   At the completion of the course, students will be able to:
   1. Identify and critically evaluate sources of scientific information. (GE-NJ IL, 1, *)
   2. Use the scientific method to evaluate a problem and generate conclusions. (GE-NJ 3)
   3. Compose oral and written reports on scientific topics using research methods.
      (GE-NJ 1, 4)
   4. Discuss the ethical implications of technological choices and think critically about
      the impacts of science and technology on society and the natural world. (GE-NJ ER, 3, *)

      (* embedded critical thinking)

B. Course Learning Outcomes:

   At the completion of the course, the student will be able to:
   1. Demonstrate a basic understanding of energy, its sources, transformations and
      efficiencies.
   2. Analyze the societal and environmental impacts of various energy technologies. *
   3. Discuss and cogently evaluate traditional energy sources and the challenges and
      advantages of renewable alternatives. *
   4. Apply basic conceptual and quantitative reasoning to understand and interpret
      energy and climate related problems.

      (* embedded critical thinking)

C. Assessment Instruments

   A. HW (required)
   B. Research paper utilizing scientific method (required)
   C. Quizzes
   D. Tests
   E. Exams (required)
F. Presentations

VII. Grade Determinants

A. HW assignments (required)
B. Tests
C. Midterm/Final Exam (required)
D. Research project utilizing scientific method (required)
E. Discussions
F. Optional presentation

Primary formats, modes, and methods for teaching and learning that may be used in the course:
A. lecture/discussion
B. small-group work
C. computer-assisted instruction
D. documentaries/video
E. guest speakers
F. student oral presentations
G. independent study

VIII. Texts and Materials

B. Free online MODTRAN climate model through University of Chicago: http://climatemodels.uchicago.edu/
C. NOAA & NASA websites
D. Film and video
E. Other web and computer based sources

(Please Note: The course outline is intended only as a guide to course content and resources. Do not purchase textbooks based on this outline. The RVCC Bookstore is the sole resource for the most up-to-date information about textbooks.)

IX. Resources

A. Libraries
B. Computer with online access for research

X. Honors Options

Not applicable