RARITAN VALLEY COMMUNITY COLLEGE
ACADEMIC COURSE OUTLINE

ENVI 103 – Energy, the Environment and Climate Change

I. Basic Course Information

A. Course Number and Title: ENVI 103 – Energy, the Environment and Climate Change

B. New or Modified Course: Modified Course

C. Date of Proposal: Semester: Spring Year: 2021

D. Effective Term: Fall 2021

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

Name and Telephone Number or E-Mail Address of Department Chair and Divisional Dean at time of approval:
Department Chair: Ed Carr, Edward.Carr@raritanval.edu
Divisional Dean: Sarah Imbriglio, sarah.imbriglio@raritanval.edu

II. Catalog Description

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

Description: ENVI 103 provides a broad introduction to energy issues as they relate to generation options, utilization and environmental impacts. Topics include overviews of traditional carbon-based energy sources, nuclear options and sustainable 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 to real world problems. Existing and potential energy policy options at an international, national, state and local level will

also be explored.

III. Statement of Course Need

A. Energy, the environment and climate change 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:
   1. This course may transfer as a General Education course in Science (Non-Lab).
   2. This course may transfer as a program requirement for Environmental Studies A.A. and Environmental Science A.S. majors.
   3. 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, Electric Utility Technology, AAS and Automotive Technology, AAS

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 2nd Law of Thermodynamics
    4. Heat Engines and Types of Combustion Power Plants

D. Energy Use
    1. Global Energy Use and Trends per Economic Sector
    2. National Energy Use and Trends per Economic Sector
    3. Local Energy Use and Trends per Economic Sector
    4. Relationship between Energy and the Complexity of Societies
    5. Ethics of Energy Use

E. Fossil Fuels
    1. Coal, oil, natural gas
    2. Fossil fuel reserves
    3. Gas engines, hybrids, and electric vehicles

F. Environmental impacts of fossil fuels
    1. Strip mining, acid drainage, water pollution, fracking, methane pollution
    2. Transportation of fossil fuels
    3. Air pollution and greenhouse gas emissions from combustion of fossil fuels
    4. Ecosystem, health, and economic costs

G. 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

H. Geothermal, Tidal and Solar Energy Sources

1. Geothermal ground source (geothermal) heat pumps
2. Geothermal power
3. Harnessing the energy of tides, waves, currents
4. Solar insolation
5. Passive and active solar heating
6. Photovoltaics
7. Environmental impacts

I. Water, Wind and Biomass
   1. Hydropower
   2. Wind turbines – onshore and offshore wind
   3. Energy from wastes and biofuels
   4. Challenges and environmental impacts

J. The Potential Hydrogen Economy
   1. Hydrogen as an Energy Carrier – advantages and disadvantages
   2. Production of grey hydrogen vs green hydrogen
   3. The opportunities and challenges of H_2 infrastructure and an H_2 economy

K. The Grid
   1. History of electricity and the grid
   2. Architecture of the grid – generation, transmission, distribution
   3. Existing grid management – Utilities, Public Utility Commissions (NJBPU), Regional Transmission Organizations/Independent System Operators (PJM), FERC, NAERC
   4. Calculating Capacity Factors
   5. Managing power needs with variable renewable energy
   6. Changes to the grid to accommodate sustainable energy – new transmission, distributed generation, storage, smart grid

L. 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. Natural and anthropogenic forcing
   7. Positive and negative feedbacks

M. Taking Earth's Current and Future Temperature
   1. Global temperature variations in context
   2. Climate proxies
   3. Temperature changes through geologic time

4. Temperature changes in the modern era
5. Future Climate Scenarios/ IPCC models

N. Approaches to address Environmental Impacts of Energy
   1. Command and Control versus Market-Based Approaches
      - Carbon Tax
      - Carbon Credits, Cap and Trade, other Credit Systems
      - Clean Air Act
      - Clean Water Act – Waters of the United States
   2. International Agreements – COP 25 (Paris Agreement)
   3. National Initiatives – Clean Air Act, Build Back Better Plan (TBD)
   4. State and City Initiatives – DEP 80 x 50 plan, BPU Energy Master Plan, Sustainable Jersey

O. Energy and Climate: breaking the link
   1. Economics of a clean energy system
   2. Options for reducing carbon emissions now – collective versus individual actions
   3. Geo-engineering
   4. Natural Climate Solutions
   5. "Electrifying everything"
      - Transportation Sector
      - Commercial and Residential Sectors (Space heating)
      - Industrial Sector
   6. Energy Efficiency and Energy Conservation
   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. 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, *)
3. Use the scientific method to evaluate a problem and generate conclusions. (GE-NJ 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

A. Suggested reading: Climate Change: What Everyone Needs to Know, by Joseph Romm, 2018
B. Energy Information Administration, New Jersey DEP, New Jersey BPU, NOAA & NASA websites
C. Film and video
D. Other web and computer-based sources in Canvas course module

(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