ENERGY & CONTROL SYSTEMS
TECH 204

Technology Education Program

Rhode Island College
Feinstein School of Education and Human Development
Department of Educational Studies

Spring 2009

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Office Hours: By Appointment and Tuesday 1:00 - 2:00 & Thursday 1:00 - 2:00

Communication Devices: Out of courtesy for other students and the instructor, please silence and place out of sight all communication devices (cell phones and pagers, etc.) during class time so that we may learn and work together without distraction.

I COURSE TITLE: TECH 204 - 01 *Energy & Control Systems* (3 credits)
CLASS HOURS: Tuesday & Thursday 10:00 – 12:00
CLASSROOM LOCATION: WH 100

II PREREQUISITES: None

III COURSE DESCRIPTION:

Energy sources and common energy processing techniques are introduced. Study includes control devices, energy transmission technology, and operation of energy conservation systems.

A. Relationship to Feinstein School and Professional Development

This course is designed to introduce a range of energy processing and energy control techniques. The study of energy processing and control systems will form awareness of the necessary resources and their manipulation to create energy. Historical and contemporary processing methods will be investigated to provide a view of innovation and invention. Issues related to impacts of energy processing and control and their relationships with the individual, society, and the environment will support appropriate problem solving and decision-making opportunities. The directed laboratory experiences emphasize the application of physical laws of science, data acquisition, and data analysis, giving participants appreciation and understanding of the basic mechanisms within energy processing and contemporary control systems.

Students will reflect on, analyze, select, and implement new and contemporary methods, activities, and curricula related to technology education. Students will be introduced to technological principles and cross- curricular opportunities to solve problems related to

energy processing. Students will be prepared to teach energy and control system topics using strategies appropriate for pre-service teachers.

Participants in this course shall benefit from consistent best practice scenarios and the intentional use of models that explore global attitudes and diverse student populations in the technology education classroom. This technology education course is grounded in FSHED's Conceptual Framework and the PAR Model embrace by Rhode Island College.

IV STANDARDS ACHIEVED:

Standards for Technological Literacy

The Nature of Technology

1: Students will develop an understanding of the characteristics and scope of technology

2: Students will develop an understanding of the core concepts of technology.

3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

Technology and Society

5:Students will develop an understanding of the effects of technology on the environment.

6: Students will develop an understanding of the role of society in the development and use of technology.

7: Students will develop an understanding of the influence of technology on history.

Design

8: Students will develop an understanding of the attributes of design.

9: Students will develop an understanding of engineering design.

10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

The Designed World

16. Students will develop an understanding of and be able to select and use energy and power technologies.

RIBTS

1.2; 2.2, 2.3, 2.4, 2.5, 2.7; 3.3; 8.1, 8.2, 8.3, 8.4

V COURSE GOALS:

As a result of participating in this course, students will be able to:

1. compare and contrast traditional and alternative sources of energy;
2. describe the ways that energy is transformed from one form to another;
3. explain the systems that are used to control and distribute energy;
4. use terminology and units of measurement related to energy processing and control systems;
5. outline the flow of resources, processes, and applications critical to the operation of energy processing & control systems;
6. describe growth patterns and trends in consumers' use of energy;
7. design, build, and test a variety of energy and control devices.

VI TEXT:

Litowitz, L. & Brown, R. (2007). ***Energy, Power, and Transportation Technology.*** ISBN 13: 978-1-59070-221-5

VII CLASS ATTENDANCE POLICY:

Students should attend all class meetings and are responsible for all class work and assignments. At the beginning of each semester, instructors will distribute a syllabus, which may include attendance and/or class participation as a component of the course grade. Students who are absent must take the initiative to determine from the instructor what course work can be made up. Students who are absent on the day of an examination should make every effort to call the instructor (or department office) before the scheduled test.

....All students who incur or anticipate an extended absence (five or more consecutive days or more) should call the Office of Student Life at 456 - 8061, so that notice (not an excuse) may be sent to instructors. (p. 38 RIC Student Handbook)

- The policy of this class is that after the THIRD absence the final grade will be dropped one letter grade.
- Six unexcused absences from this class will result in a final grade of (F).
- Absences are considered excused **only** when official documentation of the nature of the absence is supplied by the student. (i.e. attending physician's notice, court documents, obituaries, field trip memo)
- All exams and quizzes will be taken at the scheduled time. Make-up exams and quizzes may not be provided unless proper documentation is presented.

VIII COURSE CONTENT

I. Introduction
Orientation
A. Power defined
B. Energy processing
C. Historical events
D. Innovators & Inventors

II. Energy Resources
A. Types of Energy
1. Chemical
2. Electrical
3. Heat/Thermal
4. Light
5. Mechanical
6. Nuclear

B. Traditional Resource Estimates
(Hard Path)
1. Petroleum
a.Extraction
b.Transportation
c.Preparation
d.Combustion
e.Disposal
2. Natural Gas
3. Coal
4. Wood
5. Nuclear
6. Animal

C. Alternative Resource Estimates
(Soft Path)
1. Solar
2. Wind
3. Hydroelectric
4. Biomass
5. Geothermal

III. Thermodynamics
A. Terms and Concepts of the 1st Law
1. System
2. Boundary
3. Surroundings
4. Closed System
5. Open System
6. Isolated System

B. 1st Law of Thermodynamics
Energy can neither be created nor destroyed

C. Terms and Concepts of the 2nd Law
1. Property
2. State

3. Equilibrium
4. Process
5. Reversible Process
6. Irreversible Process
7. Isothermal Processes
8. Adiabatic Processes
9. Internal Energy

D. 2nd Law of Thermodynamics
Energy becomes random and loses its ability to work

IV. Units of Measure

A. Metric System (MKS)
1. Joule
2. Watt
3. Meter
4. Kilogram
5. Seconds
6. Newton
7. Degree Celsius
8. Degree Kelvin
9. Kilocalorie
10. Liter
11. Ampere
12. Volt

B. British Units
1. Horsepower
2. Foot
3. Second
4. Degree Fahrenheit (^{O}F)
5. Degree Rankine (^{O}R)=460^{O}F
6. Btu
7. Gallon

V. Conversion

A. Converting Systems
1. Resources
2. Systems design
3. Processing methods
4. Legal issues
5. Regulations/Monitoring

B. Human power
1. Simple machines
   a. Lever
   b. Inclined plane
   c. Wheel and Axle
   d. Wedge
   e. Pulley
   f. Screw
2. Actual Mechanical Advantage
3. Theoretical Mechanical Advantage
4. Efficiency

C. Windmills
1. Wind power
2. Maps
3. Isobars
4. Weather
5. Topography
6. Geography
7. Convection
8. Aerodynamics
9. Rotor requirements
10. Types
    a. Vertical-vaned windmill
    b. Post windmill
    c. Smock windmill
    d. Multi-vane windmill
11. Power
    a. Mechanical
    b. Electrical (D.C./ A.C.)
    c. Pumping

D. Water wheels
1. Water power
   a. Flow characteristics
   b. Depth
   c. Resource availability
   d. Mechanical power

2. Types
   a. Undershot
   b. Overshot
   c. Horizontal
   d. Water turbine
3. Power
   a. Grinding
   b. Stamping
   c. Hydroelectric

E. Heat Engines
1. External combustion
   a. Steam Engines
   b. Steam power
      i. Heat theory
      ii. Efficiency
      iii.Valve/Governor development
      iv. Rotary motion
2. Types
   a. Walking beam
   b. Vertical
   c. Horizontal
   d. Oscillating
3. Power
   a. Prime movement
   b. Locomotion
   c. Labor-saving devices
4. Internal combustion

a. Reciprocating engines
b. Fossil fuel~heat energy
c. Heat theory
d. Gas expansion
e. Cylinder development
f. Cylinder pressure

5. Types
   a. Two stroke cycle
   b. Four stroke cycle
      i. Gasoline
      ii. Deisel
      iii. Other

F. Solar Systems
1. Passive
2. Active
3. Photovoltaics
4. Solar Thermal Electricity
5. Control & transmission

G. Fluid Systems
1. Hydraulics
   a. Liquid
   b. System requirements
   c. Theory
   d. Transmission
2. Pneumatics
   a. Liquid
   b. System requirements
   c. Theory
   d. Transmission

H. Electrical
1. Principles
   a. Magnetism
   b. Conventional theory
   c. Electron theory
   d. Measurement
      i. amps
      ii. Ohms
      iii. Volts
2. Control & transmission
3. Circuit design
4. Storage systems
5. AC/DC Generators

VI. Mechanical transmission
A. Transmissions
B. Belt drives
C. Gear systems
D. Chain drives
E. Clutch systems
F. Braking systems
G. Cams
H. Variable speed drives

VII. Alternative Process Systems
A. Hydrogen Systems
B. Geothermal
C. Battery Storage Systems
D. Superconductors
E. Fuel Cells
F. Heat Storage

VIII. Conservation and Efficiency
A. Energy Demand
1. Residential Sector
2. Commercial Sector
3. Transportation Sector
4. Industrial Sector

B. Managing Energy
1. Smaller Renewable Sources
2. Supply Side Dominance
3. Demand Side Dominance
4. Energy Policy and Practice
5. Renewable Energy Sources
6. Increased Systems Efficiency

IX. Environmental Concerns of Energy Production
A. Air Pollution
1. Clean Air Act
2. Pollution Prevention
3. Gases and Other Emissions
   a. Carbon Dioxide (CO_2)
   b. Metahane
   c. Carbon Monoxide (CO)
   d. Hydrocarbons
   e. Ozone
   f. Sulfur Dioxide (SO_2)
   g. Chlorofluorocarbons (CFC)
   h. Nitrogen Dioxide (NO_2)

B. Water Use
1. State/Fed Regs
C. Point and non-point sources
D. Site Disruption
E. Effects on Health
F. Energy Debt
G. Waste Stream
H. Geopolitics

IX METHODS OF INSTRUCTION:

Instructional strategies will include:

- Lecture
- Multimedia
- Individual reports
- Group interaction
- Electronic media
- Discussion/Question and answer

X EVALUATION:

MID-TERM /QUIZES	10%	
ENERGY/CONTROL PRESENTATION		10%
FINAL PROJECT/ SIMPLE MACHINES		20%
(2) ENERGY REVIEW PAPERS		10%
PARTICIPATION/PROFESSIONAL BEHAVIOR	10%	
WIND TURBINE		10%
SOLAR ENERGY DEVICE		20%
ROBOT ARM PROGRAM		10%
TOT		100%

Final course grades are assigned on the basis of total points earned from exams, quizzes and projects. All points earned during the semester will be totaled and a percentage will be determined from the points earned. The final grade will be determined from the following percentages.

Grade Scale:

A	100% - 96%	C+	79% - 76%
A-	95% - 90%	C	75% - 73%
B +	89% - 86%	C-	72% - 70%
B	85% - 83%	D	69% - 60%
B-	82% - 80%	F	59% or less

Participation/Professional Courtesy : It is expected that all members of the class will conduct themselves in an appropriate manner. Students will respect the ideas and comments of others. Failure to behave in a mature manner and disregard for classroom rules will be dealt with by reducing the grade in the Participation/Professional Behavior Category 10 points for each infraction.

XI SELECTED BIBLIOGRAPHIC MATERIALS

Flavin, C. & Podesta, J. (2006). American Energy: The renewable Path to Energy Security. Worldwatch Institute and the Center for American Progress. Washington, DC: Worldwatch.

Flavin, C., Mastny, L., and Amanda Chiu. (2008). Low Carbon Energy: A Road Map. Worldwatch Report 178. Washington, DC: Worldwatch Institute. ISBN: 978-1-878071-87-3

Martinot, E., Junfeng, and Mastny, L. (2007). Powering China's Development: The Role of Renewable Energy. Worldwatch Report 175. Washington, DC: Worldwatch Institute. ISBN: 978-1-878071-83-5

Renner, M., Sweeney, S., and Kubit, J. (2008). Green Jobs: Working for People and the Environment. Worldwatch Report 175. Washington, DC: Worldwatch Institute. ISBN: 978-1-878071-86-6

XII WEB SITES:

Hydro electric:
Hydro Power: http://www.hydroquebec.com/en/index.html (Learning)
Bonneville Dam Area, Oregon: https://www.nwp.usace.army.mil/op/b/home.asp
Bonneville Curriculum guide: https://www.nwp.usace.army.mil/op/b/tpak.asp
BC Hydro: http://www.bchydro.com/powersmart/
Water Power Curriculum: http://www.fwee.org/TG/nwaterpwr.html

Wind:
Kid Wind Project: http://www.kidwind.org/
Wind Turbines: http://www1.eere.energy.gov/windandhydro/wind_how.html
Savonius Wind Turbine: http://www.angelfire.com/ak5/energy21/microsavonius.htm
Danish Wind Power Association: http://www.windpower.org/en/core.htm
Energy for Kids: http://www.alliantenergykids.com

Solar:
USA Million Solar Roofs.com: http://www.millionsolarroofs.com/
Solar Energy Experiments: www.need.org/needpdf/ExploringSolarTeacher.pdf
Photovoltaics: http://www.need.org/needpdf/PhotovoltaicsTeacher.pdf
Exploring Solar Energy: http://apps1.eere.energy.gov/education/lessonplans/plan.cfm/lpid=268
NASA Solar Energy Guide:
www.nasa.gov/pdf/163008main_SESE_TeachersGuide__Part_dc3.pdf

Nuclear:
How Nuclear Power Works: http://www.howstuffworks.com/nuclear-power.htm
International Atomic Energy Association: http://www.iaea.org/worldatom/

Water Power:
Harpers Ferry Photo Archive: http://www.nps.gov/hafe/waterpwr/wheel.htm
Sheffield Water Wheels: http://www.tilthammer.com/water/
Slater Mill Links: http://www.woonsocket.org/slaterlinks.html
Water Wheel Images: http://images.google.com/images?q=Water+Wheels&hl=en&lr=&ie=UTF-8&sa=N&tab=wi
Water History: http://www.waterhistory.org/gallery/waterwheels

Energy:
Fossil Fuel Energy Guide:
http://fossil.energy.gov/education/energylessons/Study_Guides_and_Activities.html
International Energy Agency: http://www.iea.org/
Pipeline (oil) Choke points: http://www.eia.doe.gov/emeu/cabs/choke.html
National Renewable Energy Laboratory: http://www.nrel.gov/
Alternate Fuels Data Center: http://www.afdc.energy.gov/afdc/
New England Profile: http://www.eia.doe.gov/emeu/reps/abstracts/new_eng.html

Coal:

Kentucky Coal Education Association: http://www.coaleducation.org/
Kentucky Coal Facts: http://www.coaleducation.org/Ky_Coal_Facts/
Coal Energy for Kids: http://www.eia.doe.gov/kids/energyfacts/sources/non-renewable/coal.html

Transportation:
USDOT: http://www.dot.gov/
Bureau of Transportation Statistics: http://www.bts.gov/gis/ntatlas/facilities.html

Tentative Schedule
Spring 2009

Energy and Control Systems
TECH 204-01

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Office Hours: Tuesday & Thursdays 1 - 2 and by Appointment

Week	Date	Activity/Topic	Readings
January			
1	20 - 22	Introductions/Syllabus/Schedule Energy & Power *Review Paper Assignment*	 pp. 24 - 38 *Handout*
2	27 -29	Intro to Energy **January 27th Review Paper 1 Due** *Energy Presentation Intro*	pp. 39 - 53 *Handout*
February			
3	3 - 5	NON- Renewable Resources Petroleum Resources Petroleum Supplies/Production Natural Gas Resources Supplies & Measurement Coal Availability Coal/Electricity Coal and the Environment	56 – 73 Handout Powerpoint Powerpoint Handouts
4	10 - 13	*Wind Energy Intro* Wind Turbine Wind Power	 pp. 111 - 114 Powerpoint
5	17 - 19	OPEN LAB WIND DEVICE CONSTRUCTION *Energy presentation progress*	
6	24 - 26	***ENERGY PRESENTATIONS***	
March			
7	3 - 5	Nuclear Energy Reactor Types Impacts of Nuclear Power **MID-TERM/March 3** ***TURBINE DUE MARCH 5TH***	pp. 76 - 96
8		**SPRING BREAK MARCH 9 – 16TH**	
9	17 - 19	Renewable Energy Intro	pp. 98 - 120

		Review paper 2 Due March 12th	
10	24 - 26	Solar Energy	pp. 122 - 143
11	31	Active and Passive Systems	Handouts
April	2	Power Systems Simple Machines	pp. 144 – 162 pp. 202 - 219
12	7 - 9	Electrical Conversion & Storage Systems Power Conversion	pp. 163 - 201 pp. 299 - 322
13	14 - 16	Robotic Arm Introduction Fluid Control Systems **Solar Device Due April 16th**	QuesTech Handouts pp. 228 - 255
14	21 - 23	Control and Automation Robot Programming **Program & Editing Due** **Simple Machines Lab**	pp. 256 - 277
15	28 - 30	FINAL ACTIVITY DUE ***SIMPLE MACHINES***	