SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE TITLE:	Wind, Geothermal and Biofuel Energy Systems Installation		
CODE NO. :	RET 106	**SEMESTER:**	2
PROGRAM:	Renewable Energy & Green Construction Techniques		
AUTHOR:	John Barbeau		
DATE:	January 2011	**PREVIOUS OUTLINE DATED:**	
APPROVED:	*"Corey Meunier"* **CHAIR**		**DATE**
TOTAL CREDITS:	4		
PREREQUISITE(S):	RET 102, RET 103		
HOURS/WEEK:	4		

For additional information, please contact Corey Meunier, Chair
School of Technology & Skilled Trades
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I. COURSE DESCRIPTION:

The course is divided into three sections, each with practical and theoretical learning components:

Section 1: Biofuels

Theoretical Component
Student groups will complete a feasibility study to assess the technical and economic viability of a simulated biofuel manufacturing facility (i.e. biodiesel or wood pellet). The results of the feasibility study will be presented to the class.

The feasibility study will include the following details:
1) Market assessment
2) Feedstock/resource assessment
3) Technology assessment
4) Manufacturing parameters
5) Capital and operating cost estimates
6) Financial analysis
7) Regulatory analysis
8) Community impacts
9) Recommendations

Practical Component
Students will be introduced to fuel safety concepts, emission control requirements and manufacturer's warranty policies for both gasoline (i.e. ethanol) and diesel (i.e. biodiesel) engines.

Using test engines and exhaust emissions analysis equipment they will carry out the following tests:
1) Compare emissions from an engine burning ultra-low sulfur diesel and biodiesel
2) Compare emissions from an engine burning regular unleaded gasoline and E85 ethanol

Section 2: Geothermal

Theoretical Component
Student groups will conduct a cost-benefit analysis to evaluate the economic and environmental advantages and disadvantages of residential geothermal energy systems compared to conventional home heating/cooling systems. They will use energy modeling and project analysis software (RETScreen 4) to simulate annual heating and cooling requirements and greenhouse gas emissions for a residential application and use the net-present value approach to evaluate the financial outcomes of the project.

Practical Component
Students will be given an overview of heat pump technology and applications as well as the different types of heat pumps, their regulations and standards.

Section 3: Wind

Theoretical Component
Student groups will conduct a wind resource assessment using actual time series wind speed data to evaluate the wind regime at a candidate wind generation site and select an appropriate wind turbine technology to estimate annual electricity generation and revenue potential.

The assessment will include the following details:

- Mean hourly wind speed
- Wind speed frequency distribution (i.e. Weibull)
- Wind rose diagram
- Wind power density distribution
- Wind turbine power curve
- Wind turbine energy output
- Annual revenue potential under power purchase agreement

Practical Component
This component is designed to give the student practical knowledge needed in dealing with mechanical components in various wind turbine systems. Students will be exposed to bearings, couplings, shafts, gear drives, basic hydraulic systems and drive motors that may be encountered in any typical wind turbine. Discussions will include theory, design, maintenance and troubleshooting. The component is based on gaining valuable hands on experience while performing practical assignments on equipment similar to components found on wind turbines.

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

Upon successful completion of this course, the student will:

1. Understand and have a working knowledge of the methods used to assess the technical and economic feasibility of commercial biofuel production projects.

2. Have a basic understanding of fuel safety concepts, emission control requirements and manufacturer's warranty policies for both gasoline (i.e. ethanol) and diesel (i.e. biodiesel) engines.

3. Understand and have a working knowledge of the cost benefit analysis approach to assessing the economic and environmental advantages and disadvantages of residential geothermal energy systems relative to conventional (i.e. natural gas, oil, electric) home heating/cooling systems.

4. Understand the science behind heat pumps, how they operate, where they are used and the regulations and standards associated with their use.

5. Understand and have a working knowledge of how to characterize the wind regime and estimate the potential for electricity generation at a candidate wind project site.

6. Discuss and demonstrate Anti-Friction Bearings
    - Discuss most common types of anti-friction bearings
    - Discuss types of loads
    - Discuss and demonstrate bearing installation and removal
    - Perform bearing assignments
    - Discuss and demonstrate basic maintenance practices

7. Discuss and demonstrate various couplings/shafts
    - Discuss and demonstrate coupling/shaft types
    - Install and remove various couplings
    - Discuss and demonstrate coupling maintenance
    - Discuss and demonstrate coupling/shaft alignment procedures
    - Perform coupling/shaft assignments

8. Discuss and demonstrate gear drives
    - Discuss and demonstrate common types of gear drives
    - Perform gear drive assignments
    - Understand various gear types found in gear boxes
    - Perform gear reducer/overdrive assignments
    - Discuss basic maintenance procedures

9. Discuss and demonstrate basic hydraulic systems
    - Discuss how hydraulics may be used in wind turbines
    - Understand how a simple circuit works
    - Perform a practical hook up on a hydraulic trainer
    - Demonstrate how hydraulic braking systems works
    - Understand basic hydraulic maintenance

III. TOPICS:

1. Introduction to Microsoft Excel for the organization, manipulation and analysis of data
2. Feasibility assessment of a simulated biofuel manufacturing facility
3. Fuel safety requirements
4. Manufacturer's warranty policies for biofuels
5. Fuel economy and exhaust emission comparison for ultra-low sulfur diesel and biodiesel and regular gasoline and E85 ethanol
9. Cost-benefit analysis of a residential geothermal energy system
10. Introduction to heat pump technology
11. Heat pump applications and associated regulations
12. Wind resource assessment of a wind energy site
13. Anti-friction bearings
14. Couplings and shafts
15. Gear drives, reducers and overdrives
16. Basic hydraulics

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

There are no textbooks for this course. Students will be given handouts and assigned readings throughout the course. PPE safety wear is required for the practical learning sessions.

V. EVALUATION PROCESS/GRADING SYSTEM:

Section 1 – Biofuels	*% of Final*
Theoretical Component	
Attendance & Microsoft Excel tutorials	5%
Assignments	5%
Feasibility study report & presentation	22%
Peer evaluation	3%
Practical Component	
Attendance	4%
Assignments	9%
Subtotal	**48%**

Section 2 – Geothermal	*% of Final*
Theoretical Component	
Assignments	13%
Practical Component	
Attendance	13%
Subtotal	**26%**

Section 3 – Wind	*% of Final*
Theoretical Component	
Assignments	13%
Practical Component	
Attendance	13%
Subtotal	**26%**
GRAND TOTAL	100%

The following semester grades will be assigned to students:

Grade	**Definition**	**Grade Point Equivalent**
A+	90 – 100%	4.00
A	80 – 89%	
B	70 - 79%	3.00
C	60 - 69%	2.00
D	50 – 59%	1.00
F (Fail)	49% and below	0.00

CR (Credit)	Credit for diploma requirements has been awarded.
S	Satisfactory achievement in field /clinical placement or non-graded subject area.
U	Unsatisfactory achievement in field/clinical placement or non-graded subject area.
X	A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.
NR	Grade not reported to Registrar's office.
W	Student has withdrawn from the course without academic penalty.

VI. SPECIAL NOTES:

Attendance:
Sault College is committed to student success. There is a direct correlation between academic performance and class attendance; therefore, for the benefit of all its constituents, all students are encouraged to attend all of their scheduled learning and evaluation sessions. This implies arriving on time and remaining for the duration of the scheduled session.

VII. COURSE OUTLINE ADDENDUM:

The provisions contained in the addendum located on the portal form part of this course outline.