



## Course Number and Title: NRG 124 Energy Efficient Methods

**Campus Location:**

Georgetown, Dover, Stanton

**Effective Date:**

2018-51

**Prerequisite:**

NRG 101, OAT 152, MAT 153, SSC 100 or concurrent

**Co-Requisites:**

None

**Course Credits and Hours:**

3.00 credits

2.00 lecture hours/week

2.00 lab hours/week

**Course Description:**

This course covers the physics and calculations used in energy analyses including the basics of alternating current (AC) and direct current (DC) power, electromagnetism, motor operation, single- and three-phase power calculations, as well as inductive and capacitive reactance as it applies to power factor. Topics include interpolation and extrapolation methodology used in energy calculations.

**Required Text(s):**

Obtain current textbook information by viewing the [campus bookstore - https://www.dtcc.edu/bookstores](https://www.dtcc.edu/bookstores) online or visit a campus bookstore. Check your course schedule for the course number and section.

**Additional Materials:**

Scientific calculator (preferably TI-83 or TI-84+), Notebook

**Schedule Type:**

Classroom Course

Hybrid Course

**Disclaimer:**

None

**Core Course Performance Objectives (CCPOs):**

1. Solve energy efficiency problems to include interpolation, right triangle functions, appropriate use of significant figures, and factor label method. (CCC 2, 6; PGC 2)
2. Employ the basic electrical concepts and equations needed for energy efficiency calculations. (CCC 2, 6; PGC 2)
3. Employ energy/power equations and appropriate units to solve efficiency calculations for the four major energy systems: mechanical, fluid, electrical, and thermal. (CCC 2,6; PGC 2)
4. Develop energy savings recommendations with simple paybacks for the modification or replacement of the following energy/power conversion devices: furnaces, domestic hot water heaters, motors, fans, pumps, air conditioners, and heat pumps. (CCC 2, 6; PGC 2)

See Core Curriculum Competencies and Program Graduate Competencies at the end of the syllabus. CCPOs are linked to every competency they develop.

### Measurable Performance Objectives (MPOs):

Upon completion of this course, the student will:

1. Solve energy efficiency problems to include interpolation, right triangle functions, appropriate use of significant figures, and factor label method.
  1. Defend a value obtained for an energy efficiency calculation using interpolation or extrapolation by hand and with a spreadsheet program.
  2. Use the appropriate level of accuracy by employing significant figures when manipulating and expressing numerical data.
  3. Differentiate among the right triangle trigonometric functions, and demonstrate their use in energy efficiency problems.
  4. Use factor label method (also called dimensional analysis or ratio method) for unit conversion.
2. Employ the basic electrical concepts and equations needed for energy efficiency calculations.
  1. Explain the skills and workplace habits to ensure safe work practices.
  2. Define current, voltage, energy, and power and identify their units of measure.
  3. Use Ohm's law to calculate resistance, voltage, or current using the proper number of significant digits.
  4. Apply Ohm's law and the power equation to determine unknown quantities.
  5. Calculate electrical values such as total voltage, voltage drops, current, resistance, and power dissipation of series, parallel, and series-parallel circuits.
  6. Use test equipment to measure the voltage, current, and resistance of a circuit.
  7. Identify a sinusoidal waveform and measure its characteristics.
  8. Explain the principles of a magnetic field.
  9. Compute the value of impedance in an AC circuit.
  10. Describe the construction and operation of a typical transformer.
  11. Perform voltage and current calculations for step-up and step-down transformers.
  12. Explain how motors convert electrical energy into rotational motion.
  13. Identify and explain the operation of various DC and AC motors.
3. Employ energy/power equations and appropriate units to solve efficiency calculations for the four major energy systems: mechanical, fluid, electrical, and thermal.
  1. Compare linear and rotational mechanical power.
  2. Analyze the mechanical power working equations and how they relate to motors.
  3. Analyze how motor load factor is calculated and how it is related to motor efficiency.
  4. Determine the load factor of a working motor.
  5. Describe the operation of motors, fans, and pumps.
  6. Examine the fluid power working equations and how they apply to fans and pumps.
  7. Employ fan tables and fan laws to calculate fan efficiency.
  8. Differentiate between electric horsepower, brake horsepower, and air horsepower.
  9. Apply the conservation laws (momentum, mass, energy) to fluid flow problems.
  10. Calculate changes in fluid flow velocity due to area difference using Bernoulli's equation.
  11. Calculate the frictional losses imparted on fluid flow due to piping and duct size and arrangements.
  12. Employ Ohm's law and the electric power equation to solve energy efficiency problems.
  13. Identify the heat of combustion of common fuels.
  14. Differentiate between heat engines and furnaces.
4. Develop energy savings recommendations with simple paybacks for the modification or replacement of the following energy/power conversion devices: furnaces, domestic hot water heaters, motors, fans, pumps, air conditioners, and heat pumps.
  1. Recognize methods to measure equipment efficiency, including annual fuel utilization efficiency (AFUE), energy factor (EF), coefficient of performance (COP), energy efficiency ratio (EER), seasonal energy efficiency ratio (SEER), and heating season performance factor (HSPF).
  2. Construct written energy savings recommendations to include, simple payback period, and collected and researched data for the following energy/power conversion devices: furnaces, domestic hot water heaters, motors, fans, pumps, air conditioners, and heat pumps.
  3. Compare the energy consumption of different pump/pipe or fan/duct combinations.

### Evaluation Criteria/Policies:

Students must demonstrate proficiency on all CCPOs at a minimal 75 percent level to successfully complete the course. The grade will be determined using the Delaware Tech grading system:

92	-	100	=	A
83	-	91	=	B
75	-	82	=	C
0	-	74	=	F

Students should refer to the [Student Handbook - https://www.dtcc.edu/handbook](https://www.dtcc.edu/handbook) for information on the Academic Standing Policy, the Academic Integrity Policy, Student Rights and Responsibilities, and other policies relevant to their academic progress.

**Core Curriculum Competencies (CCCs are the competencies every graduate will develop):**

1. Apply clear and effective communication skills.
2. Use critical thinking to solve problems.
3. Collaborate to achieve a common goal.
4. Demonstrate professional and ethical conduct.
5. Use information literacy for effective vocational and/or academic research.
6. Apply quantitative reasoning and/or scientific inquiry to solve practical problems.

**Program Graduate Competencies (PGCs are the competencies every graduate will develop specific to his or her major):**

1. Utilize building systems and energy technology hardware and software to gather data on energy efficiency and building system operations.
2. Analyze the interaction between energy consuming building systems and make recommendations for improved energy management based on that analysis.
3. Evaluate the energy use patterns for residential and commercial buildings and recommend energy efficiency and alternative energy solutions for high-energy consuming buildings.
4. Construct energy evaluation technical reports and make presentations for potential project implementation.

**Disabilities Support Statement:**

The College is committed to providing reasonable accommodations for students with disabilities. Students are encouraged to schedule an appointment with the campus Disabilities Support Counselor to request an accommodation needed due to a disability. A listing of campus Disabilities Support Counselors and contact information can be found at the [disabilities services - https://www.dtcc.edu/disabilitysupport](https://www.dtcc.edu/disabilitysupport) web page or visit the campus Advising Center.