EEE 463 Electrical Power Plants (3) [F]

Course (Catalog) Description:
Generation of electric power using fossil, nuclear and renewable, including solar, geothermal, wind, hydroelectric, biomass and ocean, energy sources. Power plant thermal cycle analysis. Cogeneration and combined cycles. Economics, operations, and design of electric power stations. Energy storage.
Lecture. Technical Elective.

Prerequisites:
CHM 114 (or 116); MAE 240 (or PHY 241); MAT 274 (or 275)

Textbook:
M. M. El-Wakil, *Powerplant Technology*, McGraw-Hill, 1984, reprinted 2002.

Supplemental Materials:
http://holbert.faculty.asu.edu/eee463/eee463.html.

Coordinator:
K.E. Holbert, Associate Professor

Prerequisites by Topic:
1. Chemistry
2. Thermodynamics
3. Differential equations

Course Objective:
Provide students with a broad understanding of electricity generation

Course Outcomes:
1. Students will have a basic understanding of conversion of coal, oil, gas, nuclear, hydro, solar, geothermal, etc. energy to electrical energy
2. Students will understand the operation and major components of fossil and nuclear power plants

Course Topics:
1. Energy sources, utilization and conversion (1 lecture)
2. Thermodynamics, Carnot and Rankine cycles (3 lectures)
3. Components and operation of fossil-fired power plants (1 lecture)
4. Fossil fuels, byproduct fuels, biomass (2 lectures)
5. Combustion (1 lecture)
6. Gas turbine and combined cycle plants including ICGCC (3 lectures)
7. Nuclear fission and light water reactors (1 lecture)
8. Environmental impact of electricity generation, global warming (1 lecture)
9. Electricity generation economics (1 lecture)
10. Geothermal, wind, and hydroelectric power (3 lectures)

11. Solar energy, photovoltaics, concentrating solar power (3 lectures)
12. Ocean energy: thermal, wave, tidal and current (2 lectures)
13. Electric energy storage (1 lecture)
14. Energy-water nexus, thermal cycle cooling, thermal pollution (1 lecture)

Computer Usage:
Computer use is integrated within the homework assignments. Students are allowed to use the computer tools of their choice including Excel, Matlab, Mathcad, etc. Typically, the types of homework assignments requiring computer use include solving transcendental equations, and performing numerical integration. In addition, students must use the computer tools to plot results from the analysis of reference data and from the solution of numerical problems.

Laboratory Experiments: None.

Course Contribution to Engineering Science and Design:
This course teaches engineering science through the application of scientific principles to engineering problems. For example, students use their chemistry knowledge to determine combustion products, reactant (fuel) mass flows, and energy production. This course also affords the student the opportunity to solve open-ended problems involving the selection of a suitable engineering option based upon constraints. For example, students compare and contrast various electric generation schemes for future construction based on political, environmental, regulatory and engineering constraints.

Course Relationship to Program Outcomes:
This course contributes to achieving the following program objectives:
a: Students must apply both mathematics and chemistry to understand and solve problems in this course.
c and **e:** Students perform design type analyses and solve engineering problems.
j: There are many aspects of contemporary issues addressed in this course, especially with regard to power plant environmental and siting issues.
k: Students utilize modern tools such as the computer to solve problems.

Person preparing this description and date of preparation: Keith Holbert, February 2015.