Master Course Description for EE-456 (ABET sheet)

Title: Computer-aided Design In Power Systems

Credits: 4

UW Course Catalog Description

Coordinator: Daniel Kirschen, Professor, Electrical and Computer Engineering

Goals: This course provides seniors majoring in power system with significant design experience for large scale power systems.

Learning Objectives: At the end of this course, students will be able to:

1. *Propose*, formulate and solve open-ended design problems in the power systems area.
2. *Write* formal project reports.
3. *Make* formal project presentations.
4. *Work* in teams with heterogeneous knowledge and skills.
5. *Apply* engineering economics, power flow, and stability analysis computer tools to support design solutions.
6. *Demonstrate* an awareness of current issues in power system design.

Textbook: Class notes, technical papers and reports.

Reference Materials: None

Prerequisites by Topic:

1. Elementary power and energy concepts
2. Steady-state and dynamic analysis of power systems
3. Computer literacy with word processing, presentation and spreadsheet software, and running applications.

Topics:

1. Design in Power Systems - 1 week
2. Design of a Wind Farm Collector System - 3 weeks
3. Design for Transmission System Expansion - 3 weeks
4. Design for Stability and Economics - 4 weeks

Course Structure: The course is structured around the design projects. Each project has weekly progress meetings with the project team, an oral presentation and a written final report. Lectures are structured to provide or review knowledge specific to the projects, and later to cover some current topics in power systems related to the project (e.g. electric and magnetic field issues). A small amount of homework is assigned, and weekly quizzes to

improve retention of the lecture topics. Students work in teams on the projects. There is no final.

Computer Resources: Homework and software projects can be done on a PC. Analytical tools (programs) are provided to the students. Only minimal programming is required. For example, students may have to set up present worth calculations in a spreadsheet.

Laboratory Resources: None

Grading: Project work accounts for 100% of the course grade.

ABET Student Outcome Coverage: This course addresses the following outcomes:

H = high relevance, M = medium relevance, L = low relevance to course.

(1) *An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.* **(H)** The design problem presents itself as a series of interconnected engineering problems. In the open-ended design environment, the engineering problems are not explicitly stated, but must be identified by the design team before they can be solved. The design of electric power systems demands constant application of the principles of engineering, science and mathematics. The various components of the design interact in ways determined by science, described mathematically. The design of a system to a given set of objectives is a fundamental application of engineering knowledge.

(2) *An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.* **(H)** Teams must prepare extensive written project reports for each of the three projects, and make an oral presentation each project. Separate grades are given for writing quality, presentation quality, and technical content.

(3) *An ability to communicate effectively with a range of audiences.* **(H)** Students will present their projects to the class in written and oral form.

(4) *An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.* **(H)** Consideration of the effect of power system designs on the surrounding community and the environment, and economics including the old paradigm of serving the load at lowest cost and the newer maximizing of social welfare are embedded in the project requirements. Ethical issues are addressed directly with a seminar on ethics for engineers using power-system themed case studies, and certain aspects of the design problem statement pose ethical dilemmas.

(5) *An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.* **(H)** Students operate in teams of three to solve the design problem and

prepare a final report. Teamwork issues and participation is addressed in early course lectures. Team participation is individually graded.

(6) *An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.* **(M)** The design process has an inherent analysis step in which the students must design and conduct experiments, and interpret the results to determine whether their design meets specifications. This process occurs many times in the course of the design process. It is documented in the project report.

(7) *An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.* **(H)** The course material distributed does not contain all the information necessary to solve the design problems. Students must extensively consult reference sources and inform themselves concerning different aspects of the design problem. Students must also learn to use applications tools with less than complete guidance.

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