ECE 662
POWER SYSTEMS ANALYSIS AND CONTROL
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References:

1. *Energy Systems: Analysis and Operation, by* A. Gómez-Expósito, A. J. Conejo and C. A. Cañizares*, CRC Press, July 2008, ISBN 0849373654.*
2. Power System Analysis and Design, by Glover, Sarma and Overbye, 5th edition, Thomson, 2011.
3. *Power System Analysis*, by J. J. Grainger & W. D. Stevenson, Jr., 1994, McGraw Hill Pub., ISBN: 0070612935
4. *Power System Analysis*, by A. R. Bergen and V. Vittal, Prentice Hall, 2nd Edition, 2000
5. *Power generation, operation and control*, by Wood & Wollenberg, Wiley-Interscience, 2nd Edition, 1994, ISBN 0-471-58699-4
   The above references (1-5) are the course reference books, covering in more depth some of the topics touched on in the text.
6. *Lecturer Notes and Journal Papers*

Objective:

The main course goal is to provide students with a complete overview of interconnected power system operation. At the completion of the course students should be able to develop appropriate models for an interconnected power system, and know how to calculate the voltage, power and reactive power in the system under normal and abnormal operating conditions. Students should also be able perform power flow analysis, fault analysis, and transient stability analysis and to write a basic power flow and/or short circuit analysis computer program.

Prerequisites:

Open to electrical engineering graduate students. Basic understanding of circuit analysis, electrical machines and transformers and some basic familiarity with MATLAB are assumed.

Content:

No. of Weeks	Topics	Sub-Topics
1	**Basic Concepts**	Review of Phasors; Balanced 3 Phase (ϕ) Systems; Complex Power; Reactive Compensation; The per Unit System; Power transfer and reactive power; Useful network theory
2	**Power System Components**	**Synchronous Machines:** Characteristics; Equivalent circuit, The operation of a generator on infinite bus; Salient-pole generator **Transmission Lines:** Types and Parameters; Representation of Transmission Lines; Transmission Line Models **Power Transformers:** Ideal transformer; Practical transformer; connection of 3 Phase transformer and phase shift; per-phase equivalent circuit; Autotransformer **Loads:** Load types; Load models.
2	**Power Flow Analysis and Control**	**Basic Power Flow(PF) Problem:** Basic bus types; Equality and inequality constraints; Problem solvability **Solution of the PF Problem:** Newton-Raphson (NR) method; NR applied to PF Equations; **PF Approximations:** Dishonest NR; Decoupled power flow; Fast decoupled power flow; DC power flow **Power System Control:** Indirect transmission line control; Analytic calculation of sensitivities; Analytic sensitivities; Operating areas; Area control error (ACE); Automatic generation control (AGC)
2	**Symmetric and Asymmetrical Fault Analysis**	Fault types; Generator modeling during faults; Fault analysis solution techniques; Calculation of 3 phase balanced fault current; Methods of symmetrical components; Representation of a system in the phase sequence networks; Fault level in a typical system; Systematic methods for fault analysis in large networks; Bus impedance (short-circuit matrix) method; Neutral grounding
2	**System Stability**	Definition and classifications of stability; Simplified model of synchronous machine; The swing equation; Transient stability analysis; Transient stability solution methods; Equal area criteria; Transient stability calculations by computers
2	**Compensation of Power Transmission Systems**	Introduction; ideal shunt compensator; ideal series compensator; improvement of the voltage profile, power-angle characteristics, stability margin and damping to power oscillations using both types of compensators.
2	**Voltage Stability**	Definitions. Voltage collapse: Basic concepts.

		Control and protection: Compensation; secondary voltage regulation; under-voltage relays. Voltage regulation: Basic concepts. Practical applications: A real blackout analysis.

Projects:

1. Newton–Raphson power flow and short circuit analysis of the IEEE 14-bus test system using MATLAB Power System Analysis Toolbox (PSAT) PSAT software.
2. Stability analysis of the IEEE 14-bus test system using PSAT software.

Evaluation:

Assignments	20%
Projects	40%
Final examination	40%
Total	100%