

## Power Systems Analysis

1. **Course number and name:** 020ANRES4 – Power Systems Analysis
2. **Credits and contact hours:** 4 ECTS credits, 2x1:15 contact hours per week
3. **Instructor's or course coordinator's name:** Hadi Kanaan
4. **Instructional materials:**
  - a. **Textbook:** Hadi Saadat, *Power Systems Analysis*, McGraw-Hill, 1999
  - b. **other supplemental materials:** Notes, exercises, PowerPoint presentations
5. **Specific course information**
  - a. **Catalog description:**

This course introduces the students to the physical aspects of the electric transmission lines. It shows how to determine their equivalent mathematical model and calculate their structural parameters. Based on such model, performance study is elaborated in both permanent and transient regimes (power losses, voltage regulation, power factor, transient overvoltage). Compensation techniques to improve the power factor are presented. Numerical methods and algorithms for calculating the power flow are also explained and applied. Short-circuit analysis is detailed, and power system stability following short-circuit disturbance is discussed. In addition, methods for the selection of isolators and protection devices are exposed. Finally, the benefits of DC transmission systems and its technical aspect are presented.
  - b. **prerequisites or co-requisites:** none
  - c. **Required** for EE students.
6. **Educational objectives for the course**
  - a. **Specific outcomes of instruction:**

The students will be able to:

    - ✓ Select a line for a given transmission power system.
    - ✓ Determine its electric equivalent model and calculate its parameters.
    - ✓ Analyze the line performance in terms of power efficiency and voltage regulation.
    - ✓ Design series or shunt compensators.
    - ✓ Analyze short-circuit faults and grid stability.
    - ✓ Apply numerical methods for power flow calculation.
    - ✓ Implement calculation algorithms in Matlab.

**b. PIs addressed by the course.**

PI	1.1	1.2	1.3	3.1	3.2	4.2	6.3	6.4	7.1
Covered	x	x	x			x	x	x	
Assessed		x	x	x	x		x	x	x
Give Feedback		x	x		x		x	x	x

**7. Brief list of topics to be covered:**

- ✓ Introduction on power systems: Chronological evolution, components, per unit model (2.5 hours)
- ✓ Line resistive effect: basic expression, impact of temperature and frequency (1.25 hour)
- ✓ Line inductive effect: GMR, GMD, group of conductors (2.5 hours)
- ✓ Line capacitive effect (1.25 hour)
- ✓ Line performance study in permanent regime: equivalent model, mathematical equations (5 hours)
- ✓ Line compensation (1.25 hour)
- ✓ Short-circuit faults analysis (3.75 hours)
- ✓ Stability analysis (2.5 hours)
- ✓ Power flow analysis: Gauss-Seidel and Newton-Raphson algorithms (3.75 hours)
- ✓ Exercises (6.25 hours)