**The University of Jordan**
**School of Engineering**
**Department of Electrical Engineering**
1st Semester – A.Y. 2017/2018

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| **Course code:** | **0923783** |
| **Course title:** | **Power system stability and control** |
| **Credit hours:** | 3 |
| **Course describtion:** | • Synchronous machine characteristics: steady-state and Transient's analysis, introduction to power system stability: rotor angle stability, voltage stability, long and short term stability. Stability problem: swing equation, steady state stability, small disturbances, and transient stability, multi-machine systems, multi-machine transient stability. Power system control: introduction to basic control loops. Load frequency control: generator model, load model, prime mover model, governor model. Automatic generation control. Reactive power and voltage control: amplifier model, exciter model, generator model, excitation system stabilizer rate feedback. Excitation system stabilizer PID controller. |
| **Prerequisites by Course:** | None |
| **Prerequisites By Topic:** | Students are assumed to have a background in the following topics:<br>• Basic circuit analysis techniques.<br>• Basic electromagnetic and machines concepts.<br>• Basic control theory concepts. |
| **Textbook:** | **Power system stability and control, P.Kundur, 1994, McGraw-Hill.** |
| **References:** | • *Power System Analysis, Hadi Saadat, 2nd Edition, McGraw-Hill.*<br>• *Power system analysis, W.D. Stevenson & J.J. Grainger, 1994, McGraw-Hill.*<br>• *Power generation, operation and control, A.J. Wood and B.F. Wollenberg, 1983, Wiley.*<br>• *Power system dynamics, stability and control, J. Machawski, J. Bialek, J. Bumby, 2008, Wiley.*<br>• *Dynamic simulation of electric machinary using MATLAB/SIMULINK, C. Ong, 1998, PTR Prentice-Hall.* |
| **Schedule & Duration:** | 16 Weeks, 42 contact hours (50 minutes each) including exams. |
| **Minimum Student Material:** | Textbook, class handouts, scientific calculator, and an access to a personal computer. |
| **Minimum College Facilities:** | Classroom with whiteboard and projection display facilities, library, and computational facilities with MATLAB. |
| **Course Objectives:** | This is an advanced course to Power systems stability provided by the department of Electrical Engineering for the Electrical Engineering masters students. It is designed to achieve the following objectives:<br>• Introduce the concept of power system stability problem.<br>• Study the synchronous machine internal and external characteristics.<br>• Understand the advanced topics of power systems control.<br>• Solve simulation-based stability and control problems. |

## Course Learning Outcomes and Relation to Program Learning Outcomes:

Upon successful completion of this course, a student should:

1. Understand the stability problem and its importance to the system availability (stability). [i,ii]
2. Realize the relationship between the stability problem and power system relaying. [i,iii ]
3. Review the basic concepts in state space control and matrices transformation. [i,iii]
4. Be familiar with power system components: the generator, excitation systems, controllers, loads, and relaying systems. [iii ]
5. Be able to design excitation system stabilizers. [iiii]
6. Be familiar with synchronous machine external and internal problems. [i,ii]
7. Recognize the concept of AGC control. [iii]

## Program learning outcomes

**i** Demonstate a sound, in-depth and up-to-date technical knowledge in the field of specialization.

**ii** Ability to identify and solve engineering problems in their chosen field of study.

**iii** Acquir the skills for continued professional development and independent self-study.

**iv** Demonstrate the ability to communicate technical informatiom effectively and professionally both orally and in writing..

## Course Topics:

| | Topic Description | Hrs |
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| 1. | Synchronous machine characteristics: Steady-state and transients analysis, Parks' transformation, transient phenomena, balanced three phase short circuit, unbalanced short circuit. | **9** |
| 2. | Introduction to power system stability problem: Rotor angle stability, voltage stability, long and short term stability. | **3** |
| 3. | Stability problem: Swing equation, steady state stability, small disturbances, transient stability: Equal area criterion. | **9** |
| 4. | Numerical solution for the swing equation, multi-machine systems, multi machine transient stability. | **6** |
| 5. | Power system control: Introduction to basic control loops. | **3** |
| 6. | Load frequency control: generator model, load model, prime mover model, governor model. Automatic generation control (AGC): AGC in a single area system, AGC in multiarea systems. | **9** |
| 7. | Reactive power and voltage control: Amplifier model, exciter model, generator model, excitation system stabilizer rate feedback. Exciatation system stabilizer PID controller. | **6** |

**Ground Rules:** **Attendance is mandatory** and highly encouraged. To that end, attendance will be taken every lecture. All exams (including the final exam) should be considered **cumulative**.

**Assessments:** Exams, Projects, and term Papers.

**Grading policy:**

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| Projects and term papers | **30 %** |
| Midterm Exam | **30 %** |
| Final Exam | **40 %** |
| Total | **100%** |

**Last Updated:** 3/27/17