AEEE455 - Power System Control and Stability

Course Title	Power System Control and Stability				
Course Code	AEEE455				
Course Type	Technical Elective				
Level	BSc (Level 1)				
Year / Semester	4 (Fall or Spring)				
Teacher's Name	Dr Nicholas Christofides				
ECTS	6	Lectures / week	3	Laboratories/week	-
Course Purpose	The course investigates the requirements for a reliable electrical power delivery within the context of power system disturbances and their consequences to the system stability. Control of the main systems parameters such as power, voltage and frequency are analysed.				
Learning Outcomes	By the end of the course, students must be able to: 1. Identify the importance of power system control and stability. 2. Associate the physical aspects of different categories of power system stability phenomena. 3. Identify factors causing different stability problems and analyse techniques used to deal with stability problems. 4. Investigate methods for power system stability and control. 5. Analyse synchronous generator characteristics and investigate simulation models in relation to power system stability studies. 6. Investigate transients and small signal analysis problems.				
Prerequisites	AEEE349, AEEE351	Co-requisites	none		
Course Content	1. **Introduction to Power System Stability**: Requirements of a reliable electrical power service, Consequences to system stability after a disturbance on the system. 2. **Control of Real Power and Frequency:** power and frequency control, the turbine governor, division of load between generators, Power-frequency characteristic of an interconnected system, small capacity systems. 3. **Control of Voltage and Reactive Power:** voltage control, reactive power control, Generation and absorption of reactive power, Relationship between voltage, power and reactive power, tap-changing transformers, reactive power injection, Voltage collapse and consequences, Voltage control in distribution networks, long transmission lines. 4. **Power System stability:** The stability problem, Rotor dynamics, swing equation, power angle equation, Synchronizing power coefficients, Equal area criterion of stability, Multi-machine stability studies, Step by step procedure of the swing curve.				

	5. **Transient and Small Signal Analysis:** rotor angle, Consideration of time, Computer calculation methods for transient stability studies, Factors affecting transient stability. The Department, through its Research Policy acknowledges the importance of the synergies between research and teaching. As a result, students can be assigned to investigate further on a topic in order to better interpret something or identify current/new methods and practices. Through such activities, students can enter in the research culture and environment with the overall aim being to make them aware and to trigger ideas for the master thesis and future postgraduate studies. Where just and fit, students are encouraged to participate in research projects that could complement their master thesis requirements.
Teaching Methodology	The course is taught through lectures (3 hours per week) in classrooms or lectures theatres supported by the whiteboard and the overhead projector. Examples on subject delivered during the lectures are solved and open-ended discussion is encouraged. Further exercises can be assigned for practise or as homework. The lecture presentations are available on the e-learning platform for students to download along with other peripheral material such as past tests and exams, links and guides. Students are expected to take in-class hand-written notes. Students are also advised to use the subject's main textbook or reference books for further reading and practice in solving related exercises. Further literature research is encouraged by assigning to students a specific problem related to some issue and they are expected to gather relevant scientific information about how others have addressed the problem and report this information in written or orally.
Bibliography	• Power System Analysis, Grainger J., Stevenson, W.D., Chang G.W., McGraw Hill, 2016 • Hughes Electrical and Electronic Technology, 12th edition, Edward Hughes, John Hiley, Ian McKenzie-Smith, Keith Brown, Pearson, 2016 • Power System Control and Stability, Vittal V., McCalley J.D., Anderson P., Fouad A., 3rd edition, Wiley-IEEE Press, 2019 • Power System Dynamics: Stability and Control, J. Machowski, J. Bialek, J.Bumby, WileyBlackwell, 2nd edition, 2008 • Electrical Power System Essentials, Pieter Schavemaker, Lou van der Sluis, Wiley, 2nd edition, 2017 • Power Systems Modelling and Fault Analysis, N. Tleis, Newnes, 2nd edition, 2019 • Electrical Machinery Fundamentals, S. Chapman, McGraw Hill, 5th edition, 2011 • Electrical Power Systems Quality, Dugan R.C., Santoso S, McGraw-Hill Professional, 3rd edition, 2012 • Power Systems Electromagnetic Transients Simulation, Arrillaga, J., Watson, N, Institution of Engineering and Technology, 1st, 2002 • Electric Power Systems, Weedy B. M., Cory B.J. et all, 5th edition, Wiley, 2012

	• Power System Dynamics and Stability, Sauer P. and Pai M., Wiley-IEEE press, 2nd edition, 2017
Assessment	The assessment is continuously via mid-term tests and mini-assignments with the respective assessment weight, date and time being set at the beginning of the semester via the course outline or aurally discussed. Students are prepared for the final exam by revision and recapitulation and by solving exercises. The final assessment of the students is formative and summative and is in line with the subject's expected learning outcomes and course level. The coursework and the final exam grades are weighted 40% and 60%, respectively, and compose the final grade of the course. Various approaches are used for the continuous assessment of the students, such as mid-term written tests, oral presentations, quizzes, design assignments and design projects. An indicative weighted continuous assessment of the course is shown below (this is indicative and not supposed to add up to 100%): • Assignment 10-15% • Homework 10% • Mid-Term written exams 60-70% • Mini design project 15-20% • Presentation 10-15% The criteria considered for the assessment of each type of the continuous assessment and the final exam of the course are: (i) the comprehension of the fundamental concepts and theory of each topic, (ii) the application of the theory in solving related problems and (iii) the ability to apply the above knowledge in more complex design problems.
Language	**English**