AEEE523 - Power System Analysis

Course Title	Power System Analysis				
Course Code	AEEE523				
Course Type	Compulsory				
Level	MSc (Level 2)				
Year / Semester	1 /1				
Teacher's Name	Dr Nicholas Christofides				
ECTS	8	Lectures / week	3	Laboratories/week	-
Course Purpose	Apply circuit analysis techniques and theorems to analyse electrical networks such as those encountered in power systems. Furthermore, apply numerical analysis methods for solving the nodal equations and power-flow problems.				
Learning Outcomes	By the end of the course, students must be able to: 1. Recall basic power systems concepts 2. Apply circuit analysis techniques and theorems to determine the bus admittance matrix of electrical networks. 3. Apply circuit analysis techniques and theorems to determine the bus impedance matrix of electrical networks. 4. Analyse electrical networks to calculate the node voltages of an electrical network. 5. Apply numerical methods for performing laod flow studies of electrical networks.				
Prerequisites	none	Co-requisites	none		
Course Content	1. **Basic power systems concepts:** Power in Single-Phase AC Circuits, Complex Power, The Power Triangle, Direction of Power Flow, Voltage and Current in Balanced Three-Phase Circuits, Power in Balanced Three-Phase Circuits, Per-Unit Quantities, Node Equations, The Single-Line or One-Line Diagram, impedance and Reactance Diagrams 2. **The Admittance model:** Branch and Node Admittances, Mutually Coupled Branches in Y-bus, An Equivalent Admittance Network, Modification of Y-bus, The Network Incidence Matrix and Y, The Method of Successive Elimination, Node Elimination (Kron Reduction), Triangular Factorization, Sparsity and Near-Optimal Ordering 3. **The Impedance Model:** The Bus Admittance and Impedance Matrices, Thevenin's Theorem and Z_{bus}, Modification of an Existing Z_{bus}, Direct Determination of Z_{bus}, Calculation of Z_{bus} Elements from Y_{bus}, Mutually Coupled Branches in Z_{bus}.				

	4. **Power-Flow Solutions:** The Power-Flow Problem, The Gauss-Seidel Method, The Newton-Raphson Method, The Newton-Raphson Power-Flow Solution. 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, 2nd edition, 2016 • 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 • 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 Systems Analysis and Design, J. Duncan Glover, T. Overbye, M.S. Sarma 6th edition, 2020. • Power Systems Analysis, Saadat H., McGraw Hill, 3rd edition, 2011
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

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<tr><td></td><td>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:

• 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.</td></tr>
<tr><td>Language</td><td>English</td></tr>
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