AEEE352 - Electrical Machines

<table>
<tr><td>Course Title</td><td colspan="5">Electrical Machines</td></tr>
<tr><td>Course Code</td><td colspan="5">AEEE352</td></tr>
<tr><td>Course Type</td><td colspan="5">Compulsory</td></tr>
<tr><td>Level</td><td colspan="5">BSc (Level 1)</td></tr>
<tr><td>Year / Semester</td><td colspan="5">3 / 2</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">Dr Nicholas Christofides</td></tr>
<tr><td>ECTS</td><td>6</td><td>Lectures / week</td><td>3</td><td>Laboratories/week</td><td>1</td></tr>
<tr><td>Course Purpose</td><td colspan="5">To examine and analyse the steady-state performance of transformers, induction motors, synchronous generators and dc machines. The laboratory part of the course complements the theoretical part. Students obtain practical experience with measuring instruments, star/delta loads, transformers and induction motors and photovoltaics.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">By the end of the course, students must be able to:
1. Examine and analyse magnetic circuits and air-gap effects.
2. Examine and analyse the elements and operation of Power Transformers.
3. Examine and analyse the elements and operation of asynchronous machines.
4. Examine and analyse the elements and operation of synchronous machines.
5. Investigate in laboratory environment the characteristics of transformers, induction motors, photovoltaics and 3Φ loads connected in star and delta arrangements</td></tr>
<tr><td>Prerequisites</td><td colspan="2">AEEE349</td><td colspan="2">Co-requisites</td><td>none</td></tr>
<tr><td>Course Content</td><td colspan="5">1. Magnetic circuits: magnetic fields, magneto-motive force, magnetic flux density, magnetic flux, magnetic field strength, permeability, reluctance, magnetic circuit by analysis techniques, variation of B with H.

2. Transformer steady-state description, theory and analysis: application of transformers, operation principle, equivalent model, analysis under load/no-load, voltage regulation, inductance, ideal transformer, transformer losses, EMF equation of a transformer, leakage flux, efficiency, open / short circuit tests, current transformers, auto transformers.

3. Asynchronous Machines - Induction Motors: terminology, applications of IM, elements, of IM, rotor construction types, operation principles, synchronous speed, rotor speed, concept of slip, effect of number of poles, equivalent circuit, powers in IM, torque, starting of IM</td></tr>
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	4. **Synchronous Machines - Generators:** terminology, applications and elements of SM, rotor construction types, operation principles, synchronous speed, rotor speed, effect of number of poles, equivalent circuit, powers in SM, torque, voltage regulation, synchronous impedance, power angle. 5. **DC Machines – DC Motor:** terminology, advantages/disadvantages, DC machines as generators and motors, applications and elements of DC machines, compound/series/shunt would rotor construction, operation principles, speed of motor, torque of motor, speed and torque characteristics, speed control, equivalent circuit. 6. **Laboratory exercises:** 3 Φ, 3 Wire Star and Delta Connected Loads, Photovoltaic Trainer – Grid connected and Stand-alone PV Systems, Solar energy measurement, study of the open circuit voltage, determination of cells distribution on a solar panel, Single-phase Transformers, Three-phase Transformers, 3Φ Induction Motor: Connection and Rotation Reversal, 3Φ Induction: Load Characteristics 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 senior project and future postgraduate studies. Where just and fit, students are encouraged to participate in research projects that could complement their senior project 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. The laboratory part of the course complements the theoretical course on electrical machines. Students obtain practical experience with measuring instruments, star/delta loads, transformers and induction motors and photovoltaics. Characteristics of transformers, induction motors, load connection arrangements, dc and ac machines are for example studied within

	the framework of the 13 weeks of the semester. Students setup the experiments themselves, choose the appropriate instruments for the measurements, understand the overall aims and decide on the necessary measurements/results needed to meet the objectives of the experiments.
Bibliography	• Hughes Electrical and Electronic Technology, 12th edition, Edward Hughes, John Hiley, et all, Pearson, 2016 • Electrical Engineering Principles And Application, 6th edition, Hambley AR, Pearson, 2016 • Electric Machinery Fundamentals, Stephen Chapman, McGraw Hill, 5th edition, 2011 • Electrical Machines, Drives and Power Systems, Theodore Wildi, Pearson, 6th edition, 2013 • Electric Machinery, E. Fitzgerald, Charles Kingsley, Jr., Stephen Umans, McGraw Hill, 6th edition, 2005 • Lucas-Nülle electrical machines training system laboratory manual
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, design projects and laboratory experiments which are aurally assessed for objective evaluation. 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 20-30% • Mini design project 15-20% • Presentation 10-15% • Laboratory (aural assessment) 50-60% 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**