AEEE361 - Sustainable Energy I

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<tr><td>Course Title</td><td colspan="5">Sustainable Energy I</td></tr>
<tr><td>Course Code</td><td colspan="5">AEEE361</td></tr>
<tr><td>Course Type</td><td colspan="5">Core</td></tr>
<tr><td>Level</td><td colspan="5">BSc (Level 1)</td></tr>
<tr><td>Year / Semester</td><td colspan="5">3 (Fall)</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>-</td></tr>
<tr><td>Course Purpose</td><td colspan="5">The course highlights the importance and necessity for sustainable energy taking into consideration the modern way of living, energy requirements, future energy forecasts, future trends and the need for energy saving. The aim is to also stimulate students and acquaint them with the various elements that constitute the road towards a sustainable energy future. All the above is in conjunction and related to the targets for lower carbon emissions and renewable energy penetration.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">By the end of the course, students must be able to:
1. Differentiate between conventional and distributed electrical energy generation.
2. Relate smart and micro-grids to sustainable energy.
3. Recognize the necessity for low carbon sectors and identify low carbon technologies.
4. Describe the importance of energy storage and identify energy storage technologies
5. Appreciate the role of electric vehicles for sustainable energy.
6. Familiarization with multi-generation methods and their relation to sustainable energy.</td></tr>
<tr><td>Prerequisites</td><td colspan="2">none</td><td colspan="2">Co-requisites</td><td>none</td></tr>
<tr><td>Course Content</td><td colspan="5">1. Conventional versus dispersed (distributed) generation: advantages and disadvantages, multi-generation (cogeneration, micro CHP, waste heat recovery, tri-generation, heat storage, heat networks), steady- state operation of distributed generation systems, full-system energy flows to/from supply and to/from loads, selection of technologies and configurations, system reliability and condition monitoring.
2. Smart grids and micro-grids: introduction, transmission and distribution perspectives, design, voltage and frequency control, distributed generation and active network management, present and future challenges.
3. Low carbon emissions and technologies: introduction, climate mitigation and adaptation, bio-renewables (bio-energy, bio-chemicals, bio-materials), production and conversion of biomass.</td></tr>
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	4. **Energy storage technologies:** introduction, battery principles-design and operation, hydrogen transmission and storage infrastructure, solar thermal storage, pumped-hydro storage, energy storage for cooling, energy storage in organic fuels. 5. **Electric Vehicles:** introduction and definitions, plug-in concept and relation to smart grids, electric vehicles with fuel cells, electric vehicles with batteries (lead acid based, nickel based, sodium based, lithium based, metal-air based), hybrid vehicles, power management techniques of electric vehicles, efficiency of electric vehicles. 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	• Smart Grids: Advanced Technologies and Solutions, Borlase S, CRC Press, 2nd edition, 2017 • Sustainable Energy, Dunlap R.A, Cengage Learning, 2nd edition, 2018 • Smart Grid: Fundamentals of Design and Analysis, James Momoh, Wiley-IEEE Press, 1st edition, 2012 • Large Energy Storage Systems Handbook, F.S. Barnes, J.G. Levine, CRC Press, 2011 • Distributed Multi-Generation Systems: Energy Models and Analyses, P. Mancarella (editor), G. Chicco (editor), Nova Science Pub Inc, 2008 • Electrochemical Systems, J. Newman, K.E.Thomas-Alyea, 3rd edition, Wiley, New York, 2004 • Electrochemical methods: fundamentals and applications, A.J. Bard, L.R.Faulkner, 2nd edition, Wiley, 2001 • A. Boyle, Godfrey. Renewable energy. ISBN: 0199261784 • R. Huggins, Energy Storage, Springer, 2010

	• T. Reddy, Linden's Handbook of Batteries, 4th Edition, McGraw-Hill, 2010 • Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Ehsani M., Gao Y., Longo S., Ebrahimi K., CRC Press, 3rd edition, 2018 • Electric Vehicle Technology Explained, J. Larminie, 2nd edition, Wiley, 2012
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**