Course unit title:	Analysis of power generation technologies		
Course unit code:	ME410		
Type of course unit:	Compulsory		
Level of course unit:	Bachelor (1st Cycle)		
Year of study:	4		
Semester when the unit is delivered:	8(Spring)		
Number of ECTS credits allocated :	6		
Name of lecturer(s):	Dr. Charalambos Chasos		
Learning outcomes of the course unit:	1. List fossil fuels. List the types of thermal power plants. Describe basic processes in gas turbines, steam turbines, combined cycle power plants, and nuclear power plants. Describe combustion processes, emissions production and pollution and heat transfer processes. 2. Describe renewable energy sources which can be used for power generation and list the technologies which utilise renewable energy sources 3. Calculate thermodynamic data, construct graphs of thermodynamic cycles and carry out energy balance of gas turbines, steam turbines, combined cycle plants and internal combustion engines of various types. 4. Analyse the performance of thermal power plants, nuclear power plants, hydrodynamic power plants and wind power plants. 5. Apply methodologies for analysis of power plants and analyse thermal power plants, combined solar thermal power plants and basic components configuration. 6. Describe distributed power generation and energy storage technologies. Explain emissions production and environmental pollution and list emissions reduction technologies. Describe the economical feasibility of different power generation technologies.		
Mode of delivery:	Face-to-face		
Prerequisites:	ME200, ME202	Co-requisites:	None
Recommended optional program components:	None		
Course contents:	**Introductory aspects for power generation:** Thermodynamics principles and laws, combustion theory and emissions/pollution, heat transfer. Fuels (Heavy fuel oil, Diesel, Coal, Natural Gas). Renewable Energy Sources **Thermal power plants:** Components and different types of gas turbines (closed circuit, open circuit). For different types, various flow processes phenomena. Flow processes in the gas turbine components. Components and different types of steam turbines (superheat, reheat, regenerative and supercritical cycles). For different types, various flow processes phenomena. Flow processes in the steam turbine components. Components and types of the combined-cycle power plants. For different types, various flow processes phenomena. Flow processes in the components of combined-cycle power plants. Different types of Internal Combustion Engines for power generation. For different types, various flow processes phenomena. Nuclear power plants, types of nuclear reactors, nuclear fusion and environmental considerations. **Power plants utilising renewable energy sources:** Different types of hydraulic machines and construction of the machinery, aspects of their operation, including head, discharge, power, efficiency and cavitation factors. Different types of wind turbines, wind sites, wind capacity and off-shore wind technology. Aspects of performance and efficiency. Solar/thermal power plants including solar fields utilising parabolic trough and power tower technologies employed in gas turbine, steam turbine and combined-cycle hybrid power plants. Overall efficiency of plants,		

	heat storage systems and direct steam generation technologies. **Thermodynamics analysis of thermal engines:** Thermodynamic cycles (The Rankine Cycle, The Brayton Cycle, The Otto Cycle, and The Diesel Cycle). Basic processes in gas turbines (atmospheric air characteristics, compression, combustion and expansion). Performance analysis of gas turbines, using simple analysis of an open-circuit gas turbine. Basic processes in boilers/steam generators and steam turbines (combustion, heat transfer, steam production, expansion and condensation). Performance analysis of steam turbines, using simple analysis of superheat steam turbine power plant. Basic processes in the combined-cycle power plants. Performance analysis of a combined-cycle plant, using an open-circuit gas turbine, an interconnecting heat exchanger and a superheat steam turbine. Basic processes in the reciprocating Internal Combustion Engines (Otto and Diesel). Performance analysis of a high power output Diesel engine. **Energy balance analysis and performance characteristics of thermal power plants:** Conservation of mass and energy for control volume. Steady state and transient state analyses of control volumes. Energy balance and calculation of the thermal efficiency of gas turbine, steam turbine and combined-cycle. Pressure drops in the various components of power plants and effects. Improvement of performance via technical and operation modifications and quantify the associated effects on performance. Synthesis of modifications related with heat exchangers, reheat cycles and other developments. **Other aspects of power generation technologies:** Distributed power generation. Energy storage technologies. Environmental pollution, emissions reduction technologies, carbon dioxide capture and storage technologies. Environmental legislation and imposed penalties on pollutant emissions. Economical feasibility of different power generation technologies. **Assignment:** Individual assignment performed following the thermal power plant energy analysis and the various component selections and design, for a combined-cycle power plant of high power output.
Recommended and/or required reading:	Thermodynamics cycles and principles of fluid mechanics
Textbooks:	1. Breeze, P. ***Power Generation Technologies***. Elsevier, 2005. 2. Rolf Kehlhofer, Rolf Bachmann, Henrik Nielsen***. Combined Cycle Gas & Steam Turbine Power Plants***. 2nd edition. Penn Well Publishers, USA,1999. 3. H. I. H. Saravanamuttoo, G. F. C. Rogers, Henry Cohen. ***Gas Turbine Theory***. Prentice Hall, 5th edition, 2001. 4. Poullikkas, A. ***Introduction to power generation technologies***. Nova Science Publications. 2010. 5. Johansson, B. T., Kelly, H., Reddy A. K. N. and Williams, R. H. E. C ***Renewable Energy: Sources for Fuels and Electricity***. London: Earthscan Publications, 1993. 6. Lamarsh, J. R. and Baratta, A. J. ***Introduction to nuclear engineering***. Prentice Hall Publications. Third Edition, 2001. 7. Moran, M. J. and Shapiro, H. W. ***Fundamentals of Engineering Thermodynamics***. 6th Edition, John Wiley and Sons. 2008.
Planned learning activities and teaching methods:	The course is delivered to the students by means of lectures, conducted with the help of computer presentations. Possible visits at local power plants for demonstration of different types of gas turbines, steam turbines, combined-cycle power plants and internal combustion engines. Lecture notes and presentations are available through the web for students to use in combination with the textbooks.
Assessment methods and criteria:	• Assignment 20% • Test 20% • Final Exam 60%
Language of instruction:	English

Work placement(s):	No