Module no. M1 (New)	Low Carbon Power Technology
Module code and mode of delivery	Code MEP55B16 Delivery: Blended Learning through Blackboard VLE/LMS, face-to-face teaching and tutorial discussions as appropriate (see below).
Module ECTS Weighting	10ECTS
Semester of delivery	S1 + S2
Module Contact Hours	44 hours lectures (hybrid synchronous online and face-to-face), 84 hours independent student learning, 22 hours tutorials (face-to-face as appropriate), 50 hours summative assessment and 50 hours continuous assessment in the form of class tests and student assignments which require the design and analytical modelling of energy power plants and combined systems.
Module Coordinator	Prof Stephen Spence
Module teaching staff and academic titles	Prof Stephen Spence
Module description—content	Development and implementation of sustainable electricity generation is a principal requirement for modern society. This requires reliable energy supply with minimal toxic or greenhouse gas emissions. Achieving this requires diversification of energy sources, more efficient energy conversion and large-scale energy storage to smooth daily variations in generation and demand. This course will establish the foundational physical principles that enable the extraction of useful work / energy from various sources (thermal, fluid, chemical, nuclear, solar, tidal etc.), and present the current state of the art in power generation machinery. The important methods of power generation will each by examined, with foundational analysis, in the context of significantly reducing greenhouse gas emissions. The basic chemical and thermal analysis of combustion will be developed, to determine the energy release and carbon release from different fuels. Students will learn to analyse energy cycles for the important configurations of steam plants and gas turbines, including analysis of component performance including pumps, compressors, turbines, heat exchangers and combustors. The students will learn about and analyse advanced natural gas

	turbine power plants including cogeneration plants, trigeneration plants, hybrid GT Fuel cell plants and combined heat and power. Students will learn about technology relevant to waste-to-energy and renewable energies including gasification, anaerobic digestion, pyrolysis, cogeneration gas turbines, biomass combustors. The course will present alternative fuels and different ways of using those in thermal plant, including synthetic fuels, bio-fuels, hydrogen, ammonia and electrolysis. The main types hydraulic turbines and pumps will be presented and analysed in the context of hydroelectric power generation and pumped hydro storage. Other methods of large-scale energy will be presented, including thermal storage, compressed air and gas, batteries and electrolysis. Students will learn the importance of effective storage as part of decarbonising energy and will analyse these systems to determine the overall round-trip efficiency of energy storage to judge their viability. Nuclear energy production will be presented, covering the history of nuclear, underlying physics, basic components, reactor types, neutron moderation, heat transfer and coolant system design. Students will learn to evaluate the different power generation technologies in the context of carbon emissions, reliability, efficiency, cost, flexibility and the impacts of integrating renewable sources along with thermal power plant. [Other important energy technologies, including wind, solar, tidal, fuel cells, smart grids, and distributed power, are addressed in other modules]
Module learning aims/objectives	The key objectives are as follows: • To give students sufficient fundamental understanding of a wide range of low carbon power generation technologies to enable them to undertake energy and carbon analysis of such systems. • To enable students to critically judge the feasibility and. sustainability of power generation systems considering carbon emissions, fuel sources, energy efficiency, flexibility and cost. • To allow students to develop and use their own basic. computational models to analyse and compare energy systems.

	• To enable students to judge the technical, physical, economic impacts of energy systems and present clear arguments with supporting data for choosing appropriate energy systems.
Module learning outcomes	On successful completion of this module, students should be able to: MLO1.1. Articulate the importance of efficient low carbon energy systems for the sustainability of modern society MLO1.2. Evaluate and compare the efficiency, sustainability and carbon impact of various power generation systems MLO1.3. Use fundamental engineering science to analyse and predict the performance of various low carbon energy technologies MLO1.4. Develop a basic computational model and use it to analyse a power generation system MLO1.5. Analyse and compare different energy storage systems and justify their importance for a low carbon energy grid MLO1.6. Demonstrate an understanding of the balance between commercial and environmental sustainability and the time scales of investments and benefits MLO1.7. Quantitatively assess the potential for various renewable energy technologies to complement or replace conventional power generation systems
Module assessment, separate components and their weighting to be mapped into SITS	This module is assessed through 100 % Continuous Assessment (A single SITS component). There will be one assignment to be assessed every 4 weeks in the two semesters (hence 3 assignments per semester for 2 semesters in total). The last assignment consists of a 4-page technical summary of a computational model and its use to evaluate and compare several different energy systems. The students will provide a presentation of the results of their computational assignment to the class.