Module Information Summary in Master of Sustainable Energy Programme

MODULE NAME	MODULE PURPOSE
Sustainable Energy Technologies (M6SET19) Core-compulsory Module	This core-compulsory module will be offered by the Department of Mechanical Engineering Science. The aim of this module is to provide a survey of new and established renewable energy technologies and their integration into existing energy infrastructure for heat, power and transport fuel uses, for students in the first semester so that they can obtain a broad overview of the technology options for producing sustainable energy.
Energy Efficiency and Green Buildings (M6MGB19) Core-compulsory Module	This core-compulsory module will be offered by the Department of Mechanical Engineering Science. The aim of this module is to introduce the concept of energy efficiency and how it may be applied for carrying out all types of energy-dependent activities, such as manufacturing products, heating/cooling buildings and transport of people and freight.
Sustainable Energy Systems Modelling (M6MSM19) Core-compulsory Module	This core-compulsory module will be offered by the Department of Mechanical Engineering Science. The aim of this module is to acquaint participants with tools for solving problems in the world of energy planning and analysis. Students will be presented with the framework for energy modelling and analysis, including the various modelling approaches for assisting decision-makers and policy makers with energy planning
Energy Economics (ENS8X03) *,A Elective Module	This elective module will be offered by the Faculty of Science. The aim of this module is to strengthen the overall level of knowledge of students in the steps involved in renewable energy development, increasing their effectiveness when engaging on renewable energy related analytical work, technical assistance, and investment operations. The course covers the application of planning, costing, cost control, managing risk and quality, and designing the organisation structure for renewable energy projects.
Energy and Development (EAD8X01) *,A	This elective module will be offered by the Faculty of Humanities. The aim of this module is to address the possible positive and negative effects that various forms of renewable energy have on developing countries. Students will gain a critical understanding of the key concepts of renewable energy, the tools and techniques for assessing impacts of renewable energy schemes. In particular, they will be able to assess the challenges facing development and deployment of large renewable

Elective Module	energy schemes and the uncertainties related to their environmental impact. The module will reflect the current research and advances in the field.
Energy Policy Formulation (ENS8X01) *,B Elective Module	This elective module will be offered by the Faculty of Science. The aim of this module is to provide background knowledge of policy and regulations governing renewable energy and sustainability.
International, Geographical and Political Aspects of Energy (ENS8X02) *,B Elective Module	This elective module will be offered by the Faculty of Science. The aim of this module is to consider the politics and geography of global energy resources, the producing and consuming countries, transport structures, and international physical and political constraints, protocols and general issues that influence global energy trade.
Minor Dissertation (M6SED19, Research: 0.25) & (M6SED29, Research: 0.25) Core-compulsory Module	This core-compulsory module will be offered by the Department of Mechanical Engineering Science. The aim of this module is to focus on a minor research project aimed at preparing students to conduct research in relation to sustainable energy.

Instructions for course selection:

- The total credits should add up to 200.
- Three core courses and the minor dissertation are compulsory (orange block).
- On top of those core-compulsory modules, each student must select one elective module from Group *A (blue block), and one elective module from Group *B (green block).

Detailed Module information

Purpose statements, outcomes and course outline for the modules in Master of Sustainable Energy

MODULE NAME	NOF level	CREDITS	MODULE PURPOSE	MODULE OUTCOME	**Course outline**
Sustainable Energy Technologies **(M6SET19)** Core-compulsory Module	9	30	The purpose of this Sustainable Energy Technologies module is to provide a survey of new and established renewable energy technologies and their integration into existing energy infrastructure for heat, power and transport fuel uses, for students in the first semester so that the can obtain a broad overview of the technology options for producing sustainable energy.	• Apply a comprehensive understanding of and ability to interpret, apply and resolve the scientific concepts and principles underpinning renewable energy technologies • Analyse and apply a wide knowledge and comprehensive understanding of design processes and methodologies for renewable energy systems and the ability to apply them to new situations • Discuss current practice and its limitations as well as likely new and advanced developments at the forefront of renewable energy technology	1. Sources and availability of renewable energy. 2. Advanced Solar Theory: • Sources and availability of solar energy; terrestrial irradiance and illuminance. • The terrestrial solar spectrum and atmospheric extinction. • Ground solar spectrum, irradiance and illuminance. • Effects of altitude • The Equation of Time. • Atmospheric Global, direct and diffuse solar irradiance and illuminance. • Properties of glass as a function of

					angle of incidence and wavelength. • Health considerations of non-full spectrum illuminance. • Effects of cloud cover. • Application of commercial software for insolation prediction. 3. Scientific and technological background to energy available from as well as engineering design of: • Photovoltaic cells. • Solar thermal (water, air, drying). • Wind energy systems • Sea (wave and tidal) energy systems • Hydroelectric storage and single discharge. • Biomass (conversion processes) energy systems. • Solar illuminance systems and day lighting.
Energy Efficiency and Green Buildings (M6MGB19)	9	30	This module will introduce the concept of energy efficiency and how it may be applied for carrying out all types of energy-dependent activities, such as manufacturing products,	• To be able to define energy efficiency in all sectors of the economy; • To analyse the energy supply-demand chain	1. Various methods of quantifying energy efficiency

Core-compulsory Module			heating/cooling buildings and transport of people and freight.	• To apply the means of increasing energy efficiency throughout the supply chain and at the level of the energy consumer who is undertaking a specified activity • To appreciate the range of approaches and technologies available • Present the outcomes of the assessment to the general public • To analyse the typical barriers to achieving higher energy efficiency	2. Building types (residential, office, retail centres, hospitals, schools, theatres) 3. Insulation and R (thermal resistance) and U (thermal conductivity) values. 4. Heat transfer in buildings. 5. Building materials and methods of construction. 6. Shading, solar, internal, external, glass performance). 7. Solar hot water generation, collector types, storage, phase change materials. 8. Energy efficiency systems; chillers, heat recovery systems. 9. Solar lighting and day lighting.
Sustainable Energy Systems Modelling **(M6MSM19)** Core-compulsory Module	9	30	The aim of this module is to acquaint participants with tools for solving problems in the world of energy planning and analysis. Students will be presented with the framework for energy modelling and analysis,	• Critically engage with contemporary academic and policy debates on energy policy and development • Apply a systematic understanding of the tensions and complementarities between energy policy and sustainable	1. Introduction to modelling 2. Energy balance modelling 3. Fluid dynamics, heat and mass transfer

			including the various modelling approaches for assisting decision-makers and policy makers with energy planning	development in a developing-country context • Analyse the roles of technology and innovation in energy for development • Critique the advantages and disadvantages of orthodox and alternative approaches to energy policy in developing countries	4. Computational fluid dynamics, heat and mass transfer 5. Solar radiation modelling 6. ASME fair weather conditions model 7. Life Cycle Assessment
Energy Economics **(ENS8X03)** **Elective Module*, A**	8	30	This module will to strengthen the overall level of knowledge of students in the steps involved in renewable energy development, increasing their effectiveness when engaging on renewable energy related analytical work, technical assistance, and investment operations. The course covers the application of planning, costing, cost control, managing risk and quality, and designing the organisation structure for renewable energy projects.	• Critically assess available economic environmental information • Assess the potential economic impact of each of renewable energy source • Evaluate and critique the economic restrictions on renewable energy schemes • Present the outcomes of the assessment to the general public	1. Energy economics as it relates to power producers as well as past and future investment decisions 2. Demand and supply side economics in the global energy sector 3. Calculation and analysis of capacity factors, overnight and levelised costs 4. Energy Returned on Energy Invested and Peak Oil 5. Corporate Finance, Economic Regulation, Pricing, and Funding of Capital Investment
Energy and Development **(EAD8X01)** **Elective Module*, A**	8	30	This module will address the possible positive and negative effects that various forms of renewable energy have on developing countries. Students will gain a critical understanding of the key concepts of renewable energy, the tools and techniques for assessing impacts of renewable energy schemes. In particular, they will be able to assess	• Analyse the impact of renewable energy projects on developing countries • Critically evaluate the challenges in development that may hinder projects. • Evaluate renewable energy solutions that may benefit the development agenda	Humanities (To Be Defined)

			the challenges facing development and deployment of large renewable energy schemes and the uncertainties related to their environmental impact. The module will reflect the current research and advances in the field.		
Sustainable Energy Policy and Regulation (Name to be changed to Energy Policy Formulation so that it is aligned with the FoS module) **(ENS8X01)** **Elective Module*, B**	8	20	The purpose of this module is to provide background knowledge of policy and regulations governing renewable energy and sustainability.	• Have knowledge of different energy (related) policies in South Africa • Understand the process of policy design and formulation • The extant nexus between policy development and politics • Be familiar with stakeholders in policy formulation • Understand policy adoption implementation • Be able to undertake policy assessment and review Module resources	1. Energy policy mechanisms 2. Energy Policy formulation 3. Energy policy analysis 4. Energy policy monitoring and improvement Complexity, Sustainability Transition, and A Just Transition
International Geographical (and Political) Aspects of Energy **(ENS8X02)** **Elective Module*, B**	8	20	This advanced module considers the politics and geography of global energy resources, the producing and consuming countries, transport structures, and international physical and political constraints, protocols and general issues that influence global energy trade.	Demonstrate through explanation an understanding of the knowledge and subject matter associated with international aspects of the energy industry. Discuss and analyse the physical and geo-political factors affecting current and future internationally traded energy.	1. Pros and cons of the conventional sources of electricity and renewable energy industry 2. Politics on Climate change and Sustainable development goals 3. Just Energy Transition 4. Politics on the regulation/deregulation of the energy sector 5. Energy poverty (accessibility and affordability)
Minor Dissertation	9	60	This module focusses on a minor research project aimed at preparing	• Plan and conduct applicable level of investigation, research and /or experiments	

(M6SED19 & M6SED29) Core-compulsory Module			students to conduct research in relation to renewable energy.	by applying appropriate theories and methodologies and perform data analysis, interpretation and discussion. • Communicate effectively, both orally and in writing, with relevant professionals and particularly with research audiences and communities at large in so far as they are affected by the research, using appropriate structure, style and graphical support • Use and assess appropriate planning, development and management methods, skills, tools, technology and information technology effectively and critically in sustainable energy research/development practice and show an understanding of and a willingness to accept responsibility for the impact that renewable energy has on society and the environment • Demonstrate cultural and aesthetic sensitivity across a range of social contexts in the execution of renewable research activities, where applicable.	