NANYANG TECHNOLOGICAL UNIVERSITY
AY2015 Special Term II

MA9001 INTRODUCTION TO ENERGY (3 AU)

Learning Objective

This course aims to provide student an overview on the energy technology and present energy scenario. The student will be introduced to various energy sources that will form the basis to pursue, in greater details in other energy courses offered in the Minor.

Content

Overview of energy scenario with respect to demand, availability, environmental concerns, and followed by description of the electricity system. Then each energy source is introduced briefly, covering both conventional and renewable sources. The challenges in energy storage and conversion are discussed. Lastly, efficient energy utilization and energy conservation are discussed.

Course Outline (Lecture hours)

1. Overview of Energy Scenario (2 hrs) Units for measurement of energy and power. Historical energy demand. World energy use by source type. Estimated world energy reserves by type. Detrimental effects of energy utilization to the environment. Carbon emission and global warming.
2. Fossil Fuel Energy (6 hrs) Chemical energy stored in coal, crude oil and natural gas. Similar technology in combustion, boiler, turbine, and electricity generator. Direct use for heat. Combustion products and the environment. The condenser. Thermodynamic limitation and thermal pollution.
3. Electricity System in Society (3 hrs) Overview of electrical energy systems. Generation, transmission and distribution of electricity. Environmental impact of transmission lines. The Singapore scenario.
4. Nuclear Energy (6 hrs) Nuclear fuel. Physics of the nuclear fission reaction. The nuclear reactor as a boiler. Main nuclear reactor types. Environmental and social concerns. Potential for nuclear fusion energy.
5. Wind Energy (2 hrs) Extraction of energy from wind. Wind turbines and wind farms. Wind turbine types. Siting.
6. Geothermal and Ocean Energy (2 hrs) Harnessing energy from geothermal resources. Requirements and existing technology. Harnessing energy from the ocean. Tidal energy. Ocean thermal energy conversion.
7. Hydroelectric Energy (2 hrs) Hydroelectric energy as indirect energy from the sun. Conversion from potential to kinetic energy at dams. Water turbine types. Environmental concerns.
8. Bioenergy (2 hrs) Conversion of biomaterials into fuels. Direct combustion. Biogas from wastes. Biomass production from farms. Vegetable oils. Bioethanol. Biodiesel. Pros and cons.
9. Solar Energy - Part 1 (3 hrs); Part 2 (3 hrs) Part 1. Direct energy from the sun - Applications Part 2. Photovoltaic electricity generation.
10. Energy Storage, Transmission and Conservation (5 hrs) The challenge in energy storage. Mechanical storage. Thermal storage. Charge storage. Fuel cells and the hydrogen economy. Efficient utilization of energy. Energy conservation.

MA9001 *INTRODUCTION TO ENERGY*

Course Schedule (39 hours of classes = 36 lecture hrs + 3 x 1-hour CAs)

Wk. No.	Wk. Date	Teaching Week	Class No.	Weekly Class Sessions	Notes
1	4-8 July	1	1	1st session (2 hrs)	1. Overview of Energy Scenario (2 hrs)
			2	2nd session (2 hrs)	2. Electricity System in Society (4 hrs)
			3	3rd session (2 hrs)	
			4	4th session (3 hrs)	3. Fossil Fuel Energy (5 hrs)
2	11-15 July	1	5	1st session (2 hrs)	
			CA1	CA-1 (1 hr)	CA-1 (30%)
			6	2nd session (2 hrs)	4. Hydroelectric Energy (2 hrs)
			7	3rd session (2 hrs)	5. Nuclear Energy (5 hrs)
			8	4th session (3 hrs)	
3	18-22 July	1	9	1st session (2 hrs)	6. Wind Energy (2 hrs)
			10	2nd session (2 hrs)	7. Geothermal and Ocean Energy (2 hrs)
			11	3rd session (2 hrs)	8. Bioenergy (2 hrs)
			CA2	CA-2 (1 hr)	CA-2 (40%)
			12	4th session (3 hrs)	9.1 Solar Energy - Applications (3 hrs)
4	25-29 July	1	13	1st session (2 hrs)	9.2 Solar Energy - Photovoltaics (4 hrs)
			14	2nd session (2 hrs)	
			15	3rd session (2 hrs)	10. Energy Storage, Transmission and Conservation (5 hrs)
			16	4th session (3 hrs)	
			CA3	CA-3 (1 hr)	CA-3 (30%)

Learning Outcome

Upon successful completion of the course, students should be able to:

- be aware of the energy scenario in the world,
- be aware of the energy scenario in Singapore,
- understand the electricity system in a society,
- understand the concepts and limitations of each energy source,
- be able to critically discuss and compare different energy sources,
- be aware of the importance in energy storage,
- understand the fuel cell and the hydrogen economy, and
- appreciate the importance in efficient energy utilization and energy conservation.

Student Assessment

- Three In-Class Continuous Assessments (CA1: 30% + CA2: 40% + CA3: 30% = 100%)
- No reports, no exams, no final examination

Textbook / References

1. **Twidell J., and Weir, A., *Renewable Energy Resources*, 2nd Edition, Taylor & Francis, New York, 2006.**
2. Godfrey, B., *Renewable Energy: Power for a Sustainable Future*, 2nd Edition, Oxford university Press, 2004.
3. Gevorkian, P., *Sustainable Energy System Engineering*, McGraw-Hill, New York, 2007
4. Tucker, W., *Terrestrial Energy*, Bartleby Press, 2008.

Instructor

Seri LEE	MAE	N3.2-02-44	6790 6940	serilee@ntu.edu.sg