MS4630 – Photovoltaic and Energy Storage

Course Code	MS4630					
Course Title	Photovoltaic and Energy Storage					
Pre-requisites	NIL					
Pre-requisite for	NIL					
No of AUs	3					
Contact Hours	LECTURES	10	Tutorials	3		

Course Aims

The course aims to introduce the concept of energy harnessing and energy storage technology through photovoltaics and batteries.

This course aims to give you a general introduction of materials used in photovoltaic devices and energy storage devices. As a student, you would learn the fundamentals of how such devices operate and how those materials could be prepared. You would also learn the device structures and know the limit of the performance of such devices and understand the possible direction for future improvement.

You would be taught how materials selection and properties, which are strongly influenced by the device design and fabrication processes, affect the efficiency of the PV cell.

You also will learn various energy storage technologies, which are being used in market or under development for the future (energy storage, supercapacitor and batteries concepts, lithium ion battery technology). We will focus more on electrochemical energy storage on various batteries including primary and rechargeable ones. Fundamental principles will be given on illustrate the working mechanism of these devices.

Intended Learning Outcomes (ILO)

By the end of this course, you (as a student) would be able to:

1. Explain the basic principles of photovoltaic devices
2. Evaluate PV device performance using standard performance matrix
3. Describe the different PV technologies including their advantage and disadvantages
4. Describe how PV device are fabricated
5. Perform materials selection for fabricating an efficient PV device
6. Propose improvement on PV device design
7. Identify factors that affect the performance of a PV device from materials selection and device fabrication.
8. Explain the basic concepts behind electrochemical cells

9. Describe the structures, properties and working principles of key energy storage devices such as supercapacitors, primary and secondary batteries (such as lithium ion battery)
10. Identify the potential, risk and limitations of different types of energy storage devices
11. Select materials when designing an energy storage device to meet expected requirements such as higher durability, etc.
12. Evaluate the performance of energy storage devices using standard performance metrics; and
13. Improve their performance by taking into consideration their structures, properties and working principles and the properties of available materials.

Course Content

1. Basics of Photovoltaic devices
2. Electrical Characterizations of PV devices
3. Silicon solar cell
4. Thin film solar cell
5. Third generation solar cell
6. Electrochemical cells,
7. Supercapacitors,
8. Primary battery,
9. Secondary battery,
10. Li ion battery

Reading and References

1. Nelson, J. The Physics of Solar Cells, Imperial College Press, 2003.
2. T. Dittrich, Materials Concepts for Solar Cells, Imperial College Press, 2015
3. Luque, A. (Antonio), Handbook of photovoltaic science and engineering [electronic resource], Wiley,2003.
4. Robert Huggins, “Energy storage : fundamentals, materials and applications”, 2nd Ed., Wiley, 2001

Course Policies and Student Responsibilities

(1) CA

Absentees must be supported by a medical certificate or other valid official documents

(2) Class participation

You are expected to participate in the group discussion during tutorials. No marks will be given if you are absent.

(3) Group assignment

You have to submit the assignment within the given deadline.

There will take home assignments every week. You are expected to search the answers by yourself after the class.

Academic Integrity

Good academic work depends on honesty and ethical behavior. Quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honor Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student of NTU, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at the University. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, and collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.