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| **PART II Sensors (II) (30H)** |

***1-Objectives:***

This course is an introduction of the sensors. It treats the optical and temperature devices which are used in the power systems as command circuits.

At the end of this course, the student will be able to:

•Define the sensors.

•State the types of sensors and the difference between them.

•Define static and active sensitivity.

•Show the fundamental properties of the optical and temperature sensors.

•Describe the operation of the following optical and temperature sensors: Photoelectric cell, Photo-resistance, Photo-voltaic cell, Photo-diode, Photo-transistor, Photo-thyristor, light emitting diode, thermistors (NTC) and (PTC).

•Identify the structures and characteristics of the optical and temperature sensors.

•Explain and analyze the operation of the command circuits which using optical and temperature sensors.

**2- *Teaching method*:**

The Analog electronics I course is a prerequisite for the power electronics and sensors course.

After a brief review of the basic concepts of semiconductors the instructor explains the course of power electronics and sensors in such a way as to bring about coherence and continuity between the various parts, as follows:

1. Give the objective of the sensor, and explain the difference between the types of sensors.
2. Give the fundamental properties of the optical sensors.
3. Explain the principle of the photo-emission, photoconductivity, photovoltaic effect and

Light emitting.

1. Show The composition of the following optical sensors: The Photoelectric cell, Photo-resistance, Photo-voltaic cell, Photo-diode, Photo-transistor, Photo-thyristor, light emitting diode, and present their principle of operation and characteristic curves I = f (V) under the effect of the intensity of the light.
2. Explain and analyze application circuits using optical sensors.
3. Give the fundamental properties of the temperature sensors.
4. Explain the principal of the thermistors NTC and PTC.
5. Show the composition of the thermistors NTC and PTC, and present their principle of operation, characteristic curves I = f (V) under the effect of the temperature.
6. Explain and analyze application circuits using the temperature sensors.

**3- *Teaching means***

* Overhead projector or power point on white board or active board with accessories.
* A notebook.
* A technical manual.
* A multi-media computer (if possible).
* Technical information documentaries (movies).
* Library access (guided if possible).

**4**- ***Contents***

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***Skills:***

At the end of this section, the student will be able to:

1. Describe the operation principle of the optical sensor devices.
2. Describe the operation principle of the temperature sensors devices.

3-Knowledge the command methods through optical and temperature sensor devices.

4- Describe the application circuits using the optical and temperature sensors devices.

***Evaluation***

1. Define and give the symbol and the construction of the optical and temperature sensor devices
2. Represent the characteristic curves of the optical and temperature sensor devices.
3. Analyze the command circuit using the optical and temperature sensor devices.
4. Analyze the applications circuits using the optical and temperature sensors devices

***Chapter1: Introduction about sensors* (3h)**

1.1- Definition of a sensor.

1.2- Types of sensors.

1.3- Difference between types of sensors.

1.4- Physical characteristics of the sensors types.

1.5- Static and dynamic sensitivities of sensors.

***Chapter 2: Introduction about optical sensors* (3h)**

2.1- Fundamental properties of the light.

2.2- Definition of the photo-elements.

2.3- Classification of the photo-elements.

2.4- Notions of photometry.

2.5- Photo-electric components: Photo-emission, Photo-conductivity, Photo-voltaic effect and light

emitting.

***Chapter 3:*** ***The Photo-electric cell* (3h)**

3.1- Role, Composition and Symbol.

3.2- Circuit, Biasing, Principle of operation.

3.3- Applications.

***Chapter 4:*** ***The Photo-resistor* (3h)**

4.1- Role, Composition and symbol.

4.2- Principle of operation.

4.3- Characteristic curves current-voltage I= f (V) in both cases obscurity and lighting.

4.4- Characteristic curves resistance-lighting.

4.5- Application circuits: Voltage divider, Command of lighting systems, Alarm system, Power regulator with thyristor and UJT controlled by photo-resistor.

***Chapter 5: The photovoltaic cell* (3h)**

5.1- Role, Composition and symbol.

5.2- Principle of operation.

5.3- Characteristic curves current-voltage I= f (V) in both cases darkness and lighting.

5.4- Parameters which characterize the battery's photo.

***Chapter 6: The photo-diode* (3h)**

6.1- Role, Composition and symbol.

6.2- Principle of operation.

6.2- Characteristic curves current-voltage I= f (V) in both cases darkness and lighting.

6.3- Application circuits: Command of lighting systems, Passage detector.

***Chapter 7: The photo-transistor* (3h)**

7.1- Role, Composition, equivalent circuit and symbol.

7.2- Principle of operation.

7.3- Characteristic curves current-voltage IC = f (VCE) in both cases darkness and lighting.

7.4- Application circuits: Command of relay with timing. Counter or alarm systems.

***Chapter 8:* *The photo-thyristor* (3h)**

8.1- Role, Composition, equivalent circuit and symbol.

8.2- Principle of operation: Firing by luminous beam.

8.3- Applications: Detection circuits, Command circuits, logic circuits.

***Chapter 9:* *The******Light emitting diode*** ***(LED)*** **(3h)**

9.1- Role, Composition, equivalent circuit and symbol.

9.2- Principle of operation

9.3- Application circuits: Luminous display, optoelectronic coupling.

9.4***-*** The Photo-couplers:

9.4.1- Role, Composition, equivalent circuit and symbol.

9.4.2- Principle of operation

9.4.3- Application circuits.

***Chapter10:* *The temperature sensors* (3h)**

10.1- Role of the temperature sensors.

10.2- Fundamental properties of the temperature sensors.

10.3- NTC and PTC thermistors.

10.3.1- Role, Composition, Symbol.

10.3.2- Principle of operation.

10.3.3- Characteristic curves resistance-temperature R= f (t).

10.4- Application circuits.