

A2 LEVEL

FACT FILE

Environmental Technology

For first teaching from September 2014

For first award in Summer 2015

**Emerging Technologies:**  
Smart materials and systems



environmental  
technology



### Specification Content

#### Smart Materials

##### Students should be able to:

- define what is meant by a smart material and explain how smart materials can be used to support environmental management, for example smart glass.

#### Smart Systems

Students should be able to:

- explain what is meant by a smart system;
- describe the range of applications offered by a smart system with reference to engineering, transportation and waste management;
- discuss the potential environmental and economic benefits offered by the use of smart systems.

- **Piezo-electric** material will produce a small voltage when pressure is applied to it and will also work in reverse i.e. if a voltage is applied the material will exert a degree of pressure. This is the basic principle used in strain gauges for many engineering applications. It is used to activate passenger air bags in a car in the event of an accident.



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- **Electrochromic** materials such as polyaniline will change colour when an electric voltage is applied to them. These can be used to control the amount of heat and light passing through windows known as "smart glass". In addition to providing environmental benefits in terms of energy efficiency these also provide a means of improving home privacy.



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### Course Content

**Smart materials** is a term used to refer to a range of materials which have come into common usage in recent years, due to their ability to alter their basic physical properties when an external influence such as temperature, light level, pressure or electricity changes.

Some examples of "smart" materials and their use include:

- **Shape memory alloys** – are materials which if bent out of shape will return to their original shape if heated above a certain level. They are used in the manufacture of certain spectacle frames which if bent out of shape can then be returned to the original shape if heated.



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**Smart Systems** have a wide range of applications and generally involve the use of miniaturised devices that incorporate the following three main control functions;

- Sensing of changes in the environment being controlled and monitored,
- Actuation of devices in response to the changes identified,
- Controlling the situation taking account of the changing variables in the surrounding environment.

The above functions constitute what is known in control engineering as a closed loop feedback system. That is, a sensor 'senses' a change in the environment and informs an actuator to respond appropriately.

Examples of this can be found in the areas of;

- **Health care** – the use of smart systems can lead to improved diagnostic tools and less intrusive operating procedures. They can also assist the older population in our society by allowing them to remain independent in their own homes. Sensors and feedback systems will raise an alarm if there is a concern.
- **Transportation** – there could be an increase in the development of pre-crash systems, more energy efficient devices for mobility e.g. hybrid vehicles and electric traction and the efficient control of traffic movement in our cities.
- **Environmental and waste management** – the use of smart systems could lead to more efficient use and control of energy and facilitate the transition or addition of renewable energy resources into distributed networks such as the National Grid. This would also allow us to control energy use in the home remotely and economically.



## Activity

Produce a "**Concept Map**" of the city of the future showing the variety of ways in which smart systems could be used to provide environmental and economic benefits to its inhabitants.



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