Pearson BTEC Levels 4 Higher Nationals in Engineering (RQF)

Unit 6: Mechatronics

Unit Workbook 1

in a series of 4 for this unit

Learning Outcome 1

Mechatronic Systems

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In this Unit we will examine the design and operational characteristics of a mechatronic system.

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System Characteristics:

Design of systems in an integrated way.

Sensor and transducer types used.

Consideration of component compatibility.

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Control device requirements and examples of application.

Origins and Evolution

What is Mechatronics?

Mechatronics is a field of engineering which involves integration of software, mechanical and electronic engineering. Mechatronics is modern design engineering as technology is constantly evolving and becoming more intelligent. To be a Mechatronics Engineer means to have knowledge of software, mechanical and electronic engineering, but to also have the knowledge of how the elements in a mechatronic system interact and affect one another. ***Figure 1*** depicts how the elements relate.

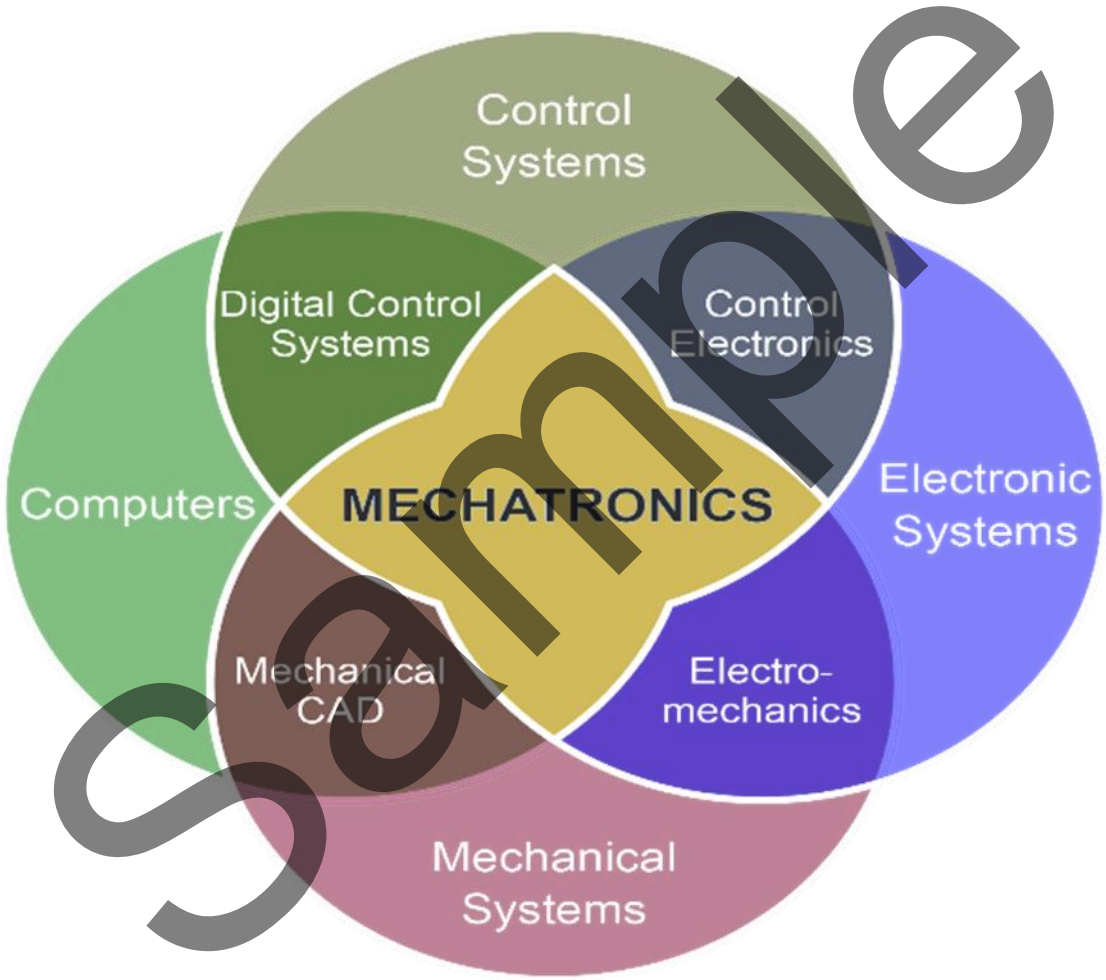

Figure 1 – *Disciplines which make up the field of Mechatronics Engineering*

Early Automation

Before there was automation, processes where done manually. An example of early automation of systems appeared in Greece from 300 to 1 B.C when the development of float regulator mechanisms occurred. [1]

This is a purely mechanical device that maintains a constant level of fluid (see ***figure 2).***

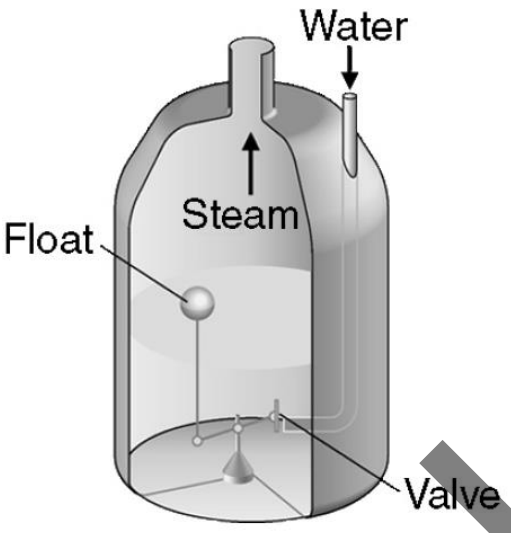

Figure 2 – *Water level float regulator*

From the 17th to the 19th century many significant automated devices were invented. One of the earliest feedback systems was utilised in the temperature regulator that was designed by a Dutch inventor Cornelis Drebbel (1572 -1633).

Practical examples of a mechatronic system

Mechatronics systems are very common, not just found in industrial environments, they can be found in most buildings, such as homes, offices and schools etc.

Most domestic appliances are mechatronic, for example, a washing machine see ***Figure 3.*** The washing machine has an intelligent control system which is responsible for the operation of the machine. This is usually an **embedded system.** The embedded system controls the **electronics** (e.g. timers and heating elements.). It also controls the electromechanical **actuators** of a washing machine such as valves, pumps and motors and the user interface (dials, display and keypads). The embedded system also monitors the sensors which triggers the embedded system to perform operations or to adjust a process via a feedback control loop. There are many **sensors** in a washing machine, these detect the temperature, water level, whether the door/ lid is closed properly and even the speed of the drum. The final part of a mechatronic system is the **mechanical structure**. The enclosure, pulley systems and damper/shock absorber are all mechanical parts of the washing machine.

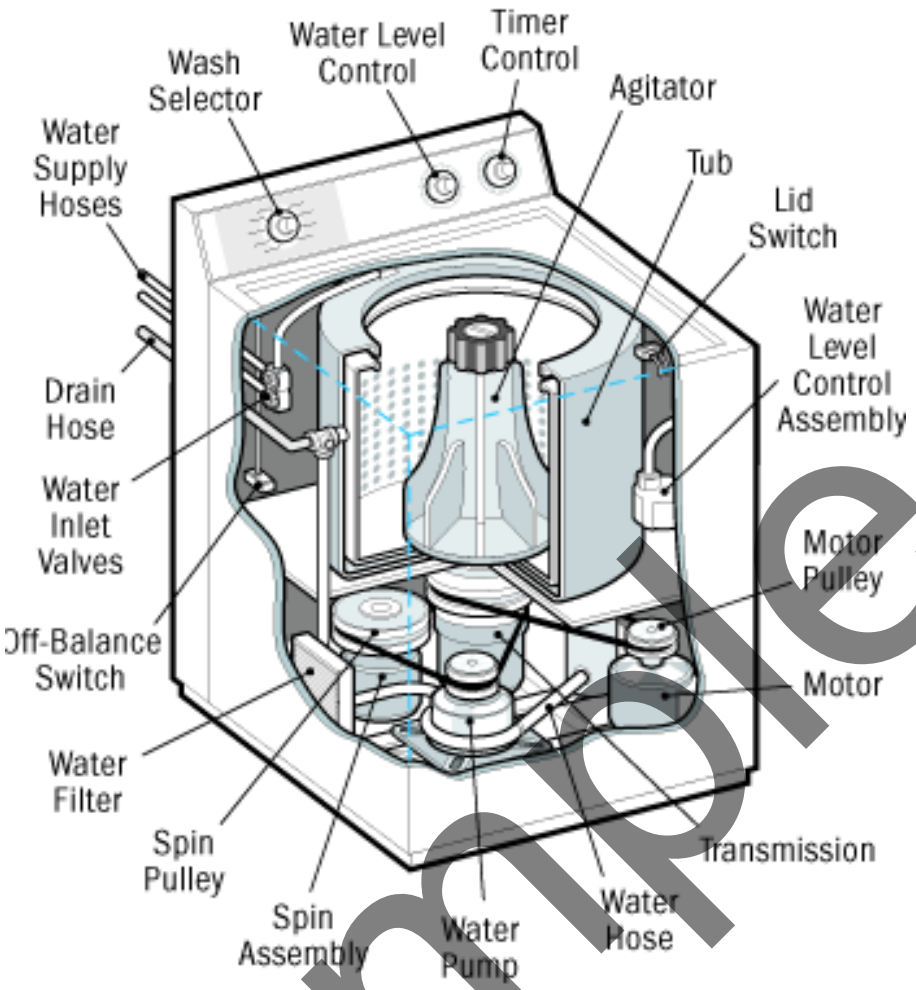

Figure 3 – *Components of a washing machine*

Other examples of mechatronic systems are:

- Auto-focus camera
- Vehicle smart suspension
- Engine control unit
- Anti-locking braking system
- Industrial production line
- Microwave oven
- Elevator
- Escalator
- Robotic arm
- CNC machine
- Aircraft
- Shipping
- Temperature control system
- Heat-seeking missiles

- Satellites
- Planetary orbiters and vehicles

Operational abilities and anticipated improvements

As seen in the previous list of applications, the abilities of mechatronic systems are ever-increasing and pervasive. One further example to add to the list is self-driving cars, which are totally mechatronic, incorporating not only mechanics, hydraulics, pneumatics, electrics, electronics, computing and communications sub-systems, but also ever-evolving AI (artificial intelligence).

It is anticipated that robotics and artificial intelligence will become quite ubiquitous in the workplace and home. Robots will be employed to undertake industrial tasks more and more, plus, tasks in the home.