INTRODUCTION

MECE 104

Fundamentals of Mechatronics Engineering

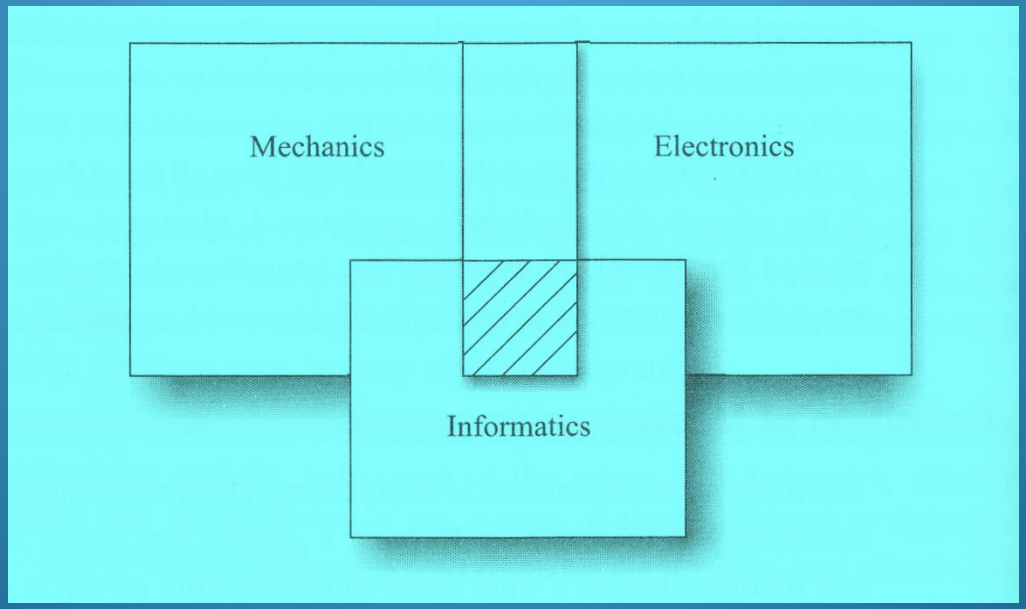
Definition of mechatronics

The integration of mechanical engineering, electronics engineering and computer technology is increasingly forming a crucial part in the design, manufacture and maintenance of a wide range of engineering products and processes. As a consequence of the synergy of systems in industry, it is becoming increasingly important for engineers and technicians to adopt an interdisciplinary and integrated approach towards engineering problems.

The term 'mechatronics' is used to describe this integrated approach. In the design of cars, robots, machine tools, washing machines, cameras, microwave ovens, and many other machines, an integrated and interdisciplinary approach to engineering design is increasingly being adopted.

Definition of mechatronics

The term 'mechatronics' was first coined by the Japanese scientist Yoshikaza in 1969. The trademark was accepted in 1972. Mechatronics is a subject which includes mechanics, electronics, and informatics

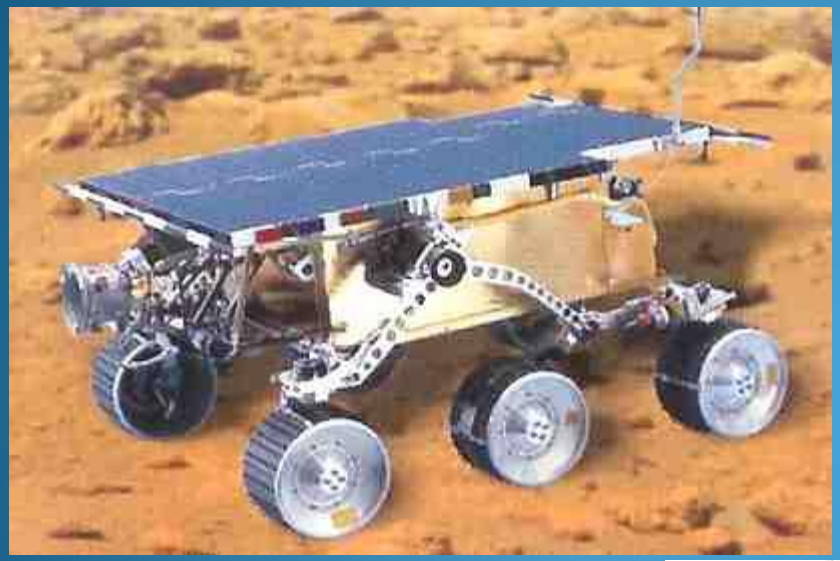


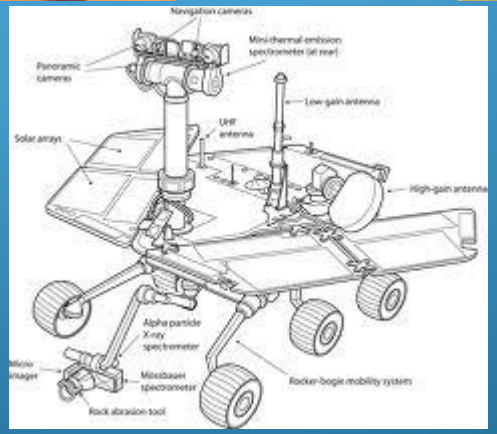
Definition of mechatronics engineer

A mechatronic engineer designs mechanical devices that incorporate electrical, software and mechanical components. The combination of these three key areas has resulted in the development and design of mechatronic or smart products. Examples include a more efficient washing machine, automated robotic assembly lines, cameras, laser printers, photocopiers, stair-climbing wheelchairs, hybrid autos and garage door openers.

Perhaps the most striking example of mechatronics is the development of the Mars rover used by NASA to take samples and photographs of the Martian surface.

Definition of mechatronics engineer





Definition of mechatronics

Mechanics involves knowledge of mechanical engineering subjects, mechanical devices, and engineering mechanics. Basic subjects such as lubricants, heat transfer, vibration, fluid mechanics, and all other subjects studied under mechanical engineering directly or indirectly find application in mechatronic systems. Mechanical devices include simple latches, locks, ratchets, gear drives, and wedge devices to complicated devices such as harmonic and Norton drives, crank mechanisms, and six bar mechanisms used for car bonnets.

Definition of mechatronics

Engineering mechanics discusses the kinematics and dynamics of machine elements. Kinematics determines the position, velocity, and acceleration of machine links. Kinematic analysis helps to find the impact and jerk on a machine element. Change in momentum, causes an *impact,* whereas change in acceleration causes a *jerk.* Dynamic analysis gives the torque and force required for the motion of link in a mechanism. In dynamic analysis, friction and inertia play an important role.

Definition of mechatronics

Electronics involves measurement systems, actuators, power electronics, and microelectronics. Measurement systems, in general, are made of three elements, namely, the sensor, signal conditioner, and display unit. A sensor responds to the quantity being measured, giving an electrical output signal that is related to the input quantity. The signal conditioner takes the signal from the sensor and manipulates it into conditions which is suitable for either display or control any other systems. In a display system, the output from the signal conditioner is displayed. Actuation systems comprise the elements which are responsible for transforming the output from the control system into the controlling action of a machine or device.

Definition of mechatronics

Power electronic devices are important in the control of power-operated devices to actuate through a small gate power of the order milliwatts. The silicon controlled rectifier (thyristor) is an example of a power electronic device which is used to control dc motor drives. The technology of manufacturing microelectronic devices through very large scale integrated (VLSI) circuit designs is also gathering momentum. Microsensors and microactuators are subdomains of the mechatronic system, which are used in many applications.

Definition of mechatronics

Informatics includes automation, software design, and artificial intelligence. The programmable logic controller (PLC) or microcontroller, or even personal computers, are widely used as informatic devices. A completely automated plant reduces the burden on human beings in respect of decision-making and plant maintenance, among other things. Software is used not only for solving complex engineering problems but also in finance systems, communication systems, or virtual modelling.

Definition of mechatronics

Wide area networks, such as internet facilities, have large data storage facilities and the data can be retrieved from anywhere in the world. Informatics systems can make decisions using artificial intelligence. Artificial neural networks, genetic systems, fuzzy logic, hierarchical control systems, and knowledge-base systems are effective tools used in artificial intelligence.

Objectives, Advantages, and Disadvantages of Mechatronics

The objectives of mechatronics are the following:

1. To improve products and processes
2. To develop novel mechanisms
3. To design new products
4. To create new technology using novel concepts

Objectives, Advantages, and Disadvantages of Mechatronics

Earlier the domestic washing machine used cam-operated switches in order to control the washing cycle. Such mechanical switches have now been replaced by microprocessors.

A microprocessor is a collection of logic gates and memory elements whose logical functions are implemented by means of software.

The application of mechatronics has helped to improve many mass-produced products such as the domestic washing machine, dishwasher, microwave oven, cameras, watches, and so on.

Objectives, Advantages, and Disadvantages of Mechatronics

Mechatronic systems are also used in cars for active suspension, antiskid brakes, engine control, speedometers, etc.

Large-scale mprovements have been made using mechatronic systems in flexible manufacturing engineering systems (FMS) involving computer controlled machines, robots, automatic material conveying and, overall supervisory control.

Objectives, Advantages, and Disadvantages of Mechatronics

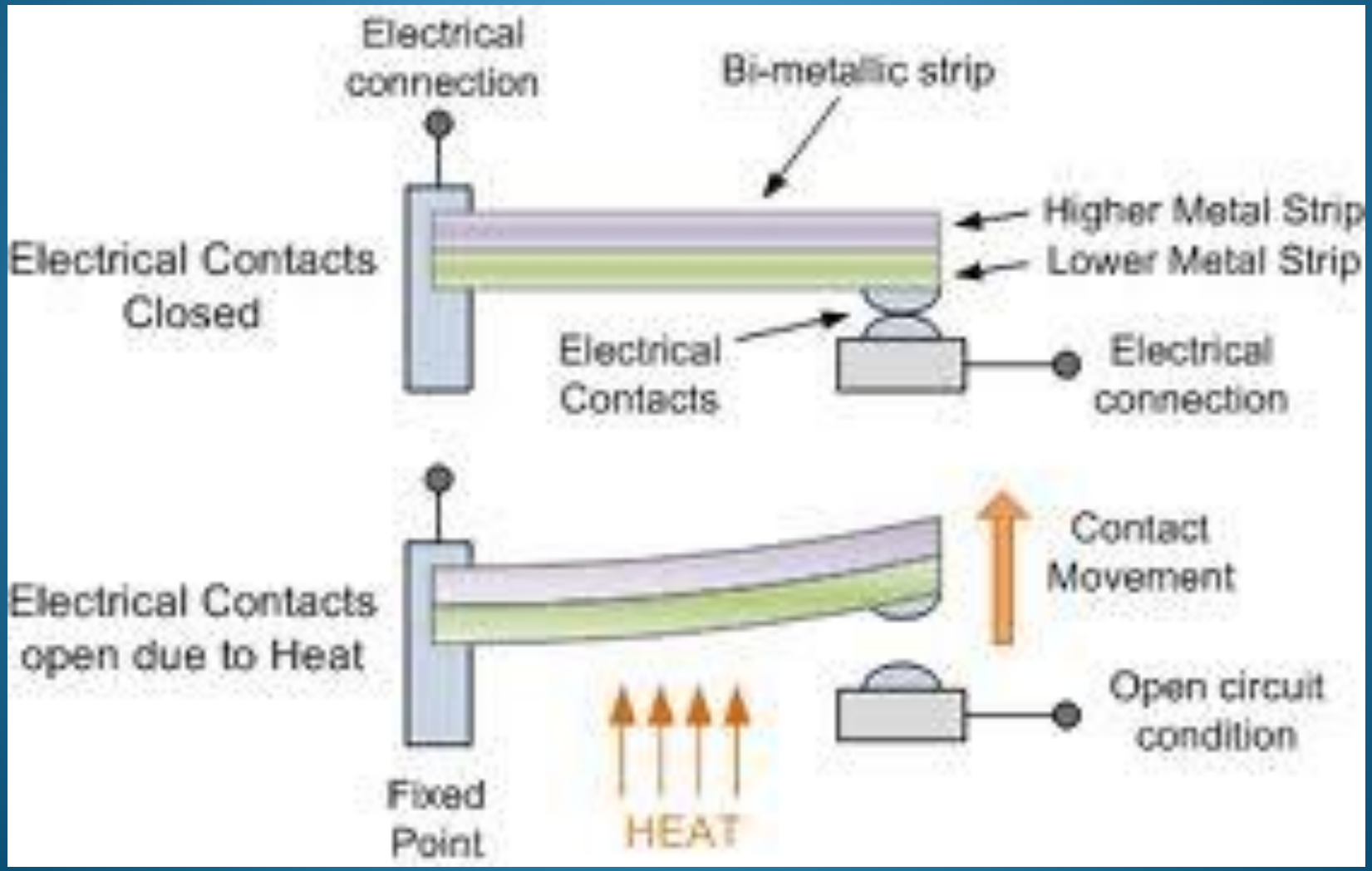
There are many advantages of mechatronic systems. Mechatronic systems have made it very easy to design processes and products. Application of mechatronics facilitates rapid setting up and cost effective operation of manufacturing facilities. Mechatronic systems help in optimizing performance and quality. These can be adopted to changing needs.

Mechatronic systems are not without their disadvantages. One disadvantage is that the field of mechatronics requires a knowledge of different disciplines. Also, the design cannot be finalized and safety issues are complicated in mechatronic systems. Such systems also require more parts than others, and involve a greater risk of component failure.

Examples

A thermostatically controlled heater or furnace is a mechatronic system. The input to the system is the reference temperature. The output is the actual temperature. When the thermostat detects that the output is less than the input, the furnace provides heat until the temperature of the enclosure becomes equal to the reference temperature. Then the furnace is automatically turned off. Here, the bimetallic strip of the thermostat acts as informatics since it automatically turns the switch on or off. The lever-type switch is mechanical system whereas the heater acts as an electrical system.

Examples

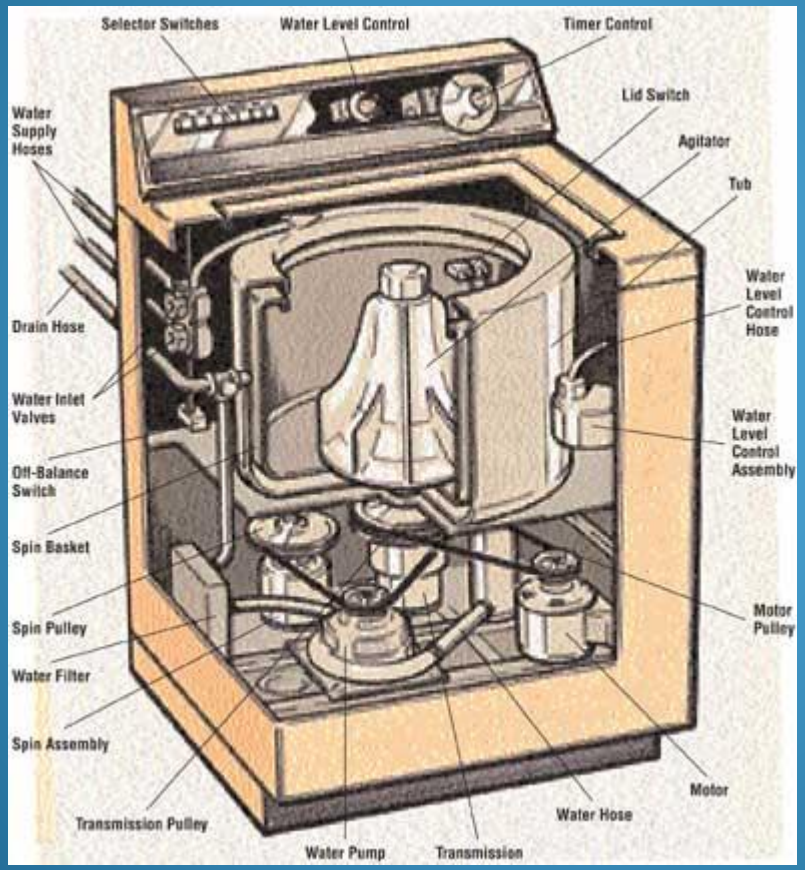

Electrical connection
Bi-metallic strip
Higher Metal Strip
Lower Metal Strip
Electrical Contacts Closed
Electrical Contacts
Electrical connection
Contact Movement
Electrical Contacts open due to Heat
Open circuit condition
Fixed Point
HEAT

Examples

Most washing machines are operated in the following manner. After the clothes to be washed have been put in the machine, the soap, detergent, bleach, and water are put in required amounts. The washing and wringing cycle time is then set on a timer and the washer is energized. When the cycle is completed, the machine switches itself off.

When the required amount of detergent, bleach, water, and appropriate temperature are predetermined and poured automatically by the machine itself, then the machine is a mechatronic system. The microprocessor used for this purpose acts as the informatics system. The electrical motor actuated for wriggling is an electrical system. The agitator and timer are mechanical systems. The washing machine is an ideal example of a mechatronic system.

Examples


Selector Switches
Water Level Control
Timer Control
Lid Switch
Water Supply Hoses
Agitator
Tub
Water Level Control Hose
Drain Hose
Water Inlet Valves
Water Level Control Assembly
Off-Balance Switch
Spin Basket
Motor Pulley
Spin Pulley
Water Filter
Spin Assembly
Motor
Water Hose
Transmission Pulley
Water Pump
Transmission

Examples

The automatic bread toaster is a mechatronic system, in which two heating elements supply the same amount of heat to both sides of the bread. The quality of the toast can be determined by its surface colours. When the bread is toasted, the colour detector sees the desired colours, and the switch automatically opens and a mechanical lever makes the bread pop up. Mechanical, electrical, and informatics systems are involved in the operation of the bread toaster.

Examples