Automation in Manufacturing
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Week - 03
Selection and fabrication
Lecture-1
Section of electrical and electronics components for mechatronics based automated systems

In this week, we will be studying various aspects related to selection and fabrication of the components, which are required to build an automated system. We will be looking at the selection criteria which is therefore, the electrical and electronics components that are required to develop a mechatronic based automated system.

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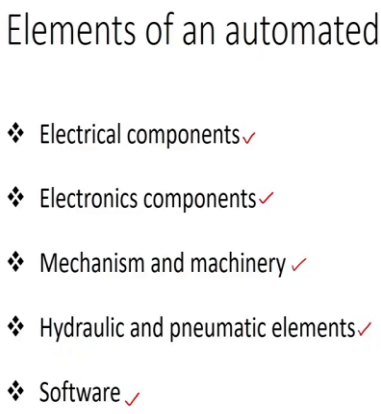

To build an automated system or to build an equipment, which is based on mechatronics based system, it requires variety of components. And, these components are electrical components, electronics components, mechanisms and machinery that are the mechanical components, hydraulics and pneumatic elements and the computer programming that is the software elements.

To build a system all these components need to be assembled together, but before that, we have to select the appropriate or suitable component available in the market. For that purpose there are certain selection criteria and procedures that need to be followed.

Some of the components such as the mechanical components or mechanisms have to be built in house; at the shop floor. So, how to manufacture them at our shop floor will be discussed in the next lectures.

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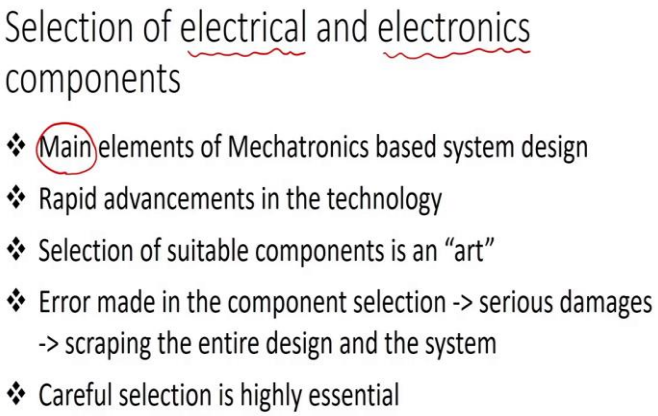

Electrical and electronics components are the main components of a typical mechatronics based system that we have seen already in the disciplines of mechatronics. Various drives, various electrical drives, the microprocessor signal conditioning devices sensors, are the major constitutes of a mechatronics based system design. There is rapid advancements in the development of these components.

If suppose we are getting integrated chip or a microprocessor, we may get a better quality or an advanced technology in that microprocessor within 6 months.

Being the designer, being the engineer who is working on mechatronics based system, we should be in touch with the technological advancements of the variety of these components as well. The proper selection of these components is a challenging task. If a sudden error is made in the component selection, it may be very dangerous to the entire design of the system.

The improper selection or inappropriate component of the assembly of the automated system, may lead to the scrapping of the entire design. The entire design or the product

or the system have to be scrapped. Therefore, we must be very careful in selection of these elements.

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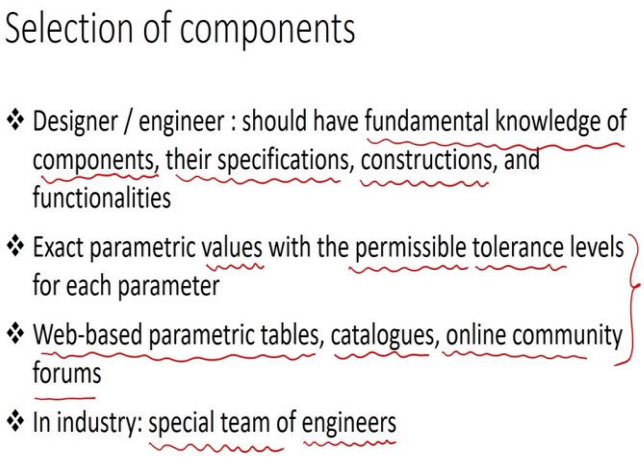

Being the designer, we should have the fundamental knowledge of these components. , The designer must know the specifications of these components, the construction and the functionalities or working of these components. In this course we will be learning the variety of components which are required to build such a system. After getting the fundamental knowledge of the components the designers must come up with the exact parametric values, of that element or the component. In addition to the exact parametric value, that is required to purchase or to select a component, the designer also need to give the permissible tolerance levels, the designer is designing the element or component and comes up with a certain value.

But, for that exact value the component may not be available in the market. For that purpose the designer should have some tolerance that are specified on the exact parametric value of the component that is to be selected. The purchase engineer or the selection engineer, will go to the market and search for the component which is giving the value in the permissible limits that is the tolerances.

Nowadays the web based technologies are being used, and a lot of web based parametric tables are available. We should go through these parametric table's available online catalogs. The catalogs are having the required information, 3D visualization of the

components; videos of the performance of the components. All these relevant information are available on the internet.

Being the designer it is our duty to extensively go through the literature available of the concerned components, catalogs and then select the appropriate one. In addition to these web based parametric tables and catalogs, there are a lot of community forums which are available online. , The volunteers or the expert people will give their opinions and answer the queries, which are asked by the community members.

To carry out the selection process or to carry out the selection of the variety of components, a special team will be created in industry. And, the special team will have the experienced engineers who will look at the web based parametric tables catalogs. And they will interact with the online community forums or they may even go to the market and try to get the components.

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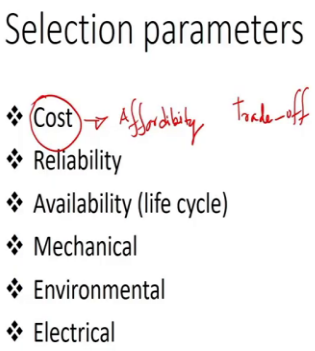

Now, what are the various parametersthat we need to consider during the selection of these items?The first parameter is the affordability, the cost. The cost is directly affecting on the economics of the product design and development, so we should have the components which are affordable to us. It does not mean that we should go for very low quality and less expensive components.

There should be a tradeoff between the cost and the quality. There should be the optimization of the cost with the quality of the product. That is why it is called as an art. We should have the balanced decision. With minimum possible cost we should get a good quality component because, the cost of the component is directly affecting the cost of the product or automated system.

The next point is the reliability.

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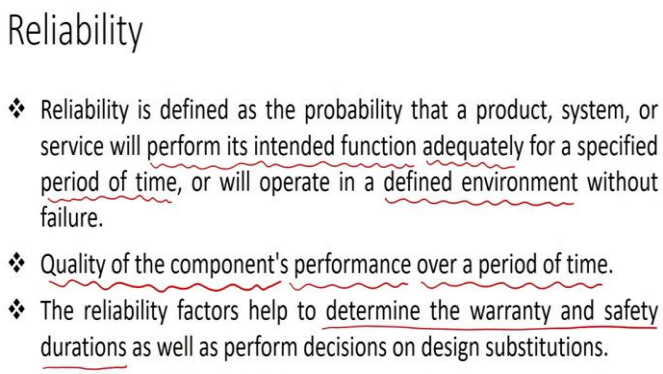

Reliability is defined as the probability that a product or system or service will perform its intended function adequately for a specified period of time, or will operate in defined environment without failure. Reliability of a product is nothing but, its performance for the intended function.

How the product is performingits intended function adequately for specified period of time? When we are purchasing certain component, some product or commodity, it is mentioned that for how long the product would be working in its normal condition.

Moreover, the product should work in the defined environment without failure. If suppose we are taking a product for certain condition, say the shop floor where the conditions are very harsh, there would be noise, dust. If the sensor or if the component is not able to work under these kinds of harsh conditions, which are specified, then it is not advisable to go for purchase of such products.

Or in short, the quality of components performance for a period of time is reliability. The reliability factors are helping us to determine the warranty and safety durations, as well as they are helping us to perform the decisions on design substitutions.

The final automated system constitutes a variety of elements. And, the warranty of service of the final equipment that will be developed and selling into the market, its success is dependent upon its constituent elements.

And, we are outsourcing these elements we are purchasing from the market. If the elements or the components are reliable; then only the product will be reliable. Moreover, the product safety is also dependent upon the proper functioning of these elements. If one of the elements will malfunction, it will definitely affect the safety aspects of the product.

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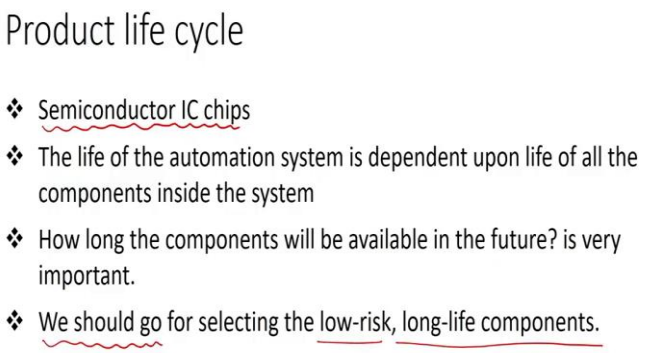

The next parameter is product life cycle. We have seen the concept of product life cycle in our previous lectures. The product life cycle is defined as the time duration between the start of the development of the product till its decline of sales in the market. The components which are purchased from the market, are also having a life cycle. They are also having a stipulated time to survive in the market. because of the technological advancements or the change in choices of the customers. Simple example is the semiconductor IC chips. With technological advancements we are getting the higher or the better versions of the IC chips. When we look for the mass production of our product,

we should consider the life cycle of the selected IC chip. For how long this components will be available in the future? That is a fundamental question

If the IC chips availability is not there, then the product cannot be manufactured. The design of our product have to be changed. That is time consuming. In view of this, the life cycle of the product that we are selecting or purchasing from the market must be taken into consideration.. Therefore, we should go for a low risk and long-life components. When long-life components are purchased , naturally the risk of failure or the risk of losing the time of development of the product will be low.

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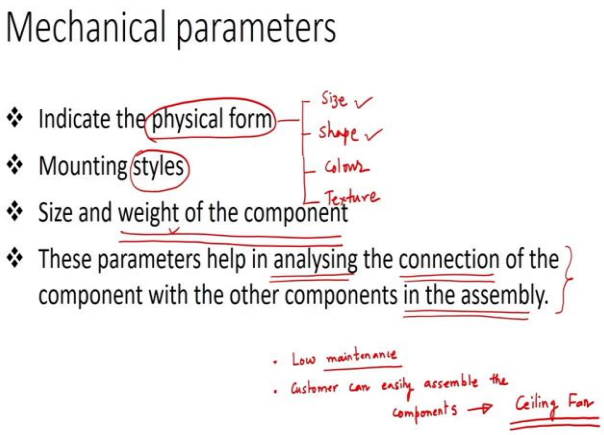

The next set of parameters is mechanical parameters. The mechanical parameters suggest or indicate, the physical form of that element or the component. The physical form designates the size, shape, color, texture of that component or the element. Next point of mechanical parameter is mounting styles. How the component is getting mounted? What is the mounting style of the available product in the market?

Is it mounted on a certain fixture or whether the component need a fixture to fix it in the assembly, whether the component is hanging, how many fasteners are required, whether the mounting is robust. All these aspects are coming into the mechanical parameters. The next mechanical parameter is the weight of the component. We need to have a component with low weight, the component should be light. Otherwise, weight of our product would be very high, which is not advisable.

But, it should have the sufficient inertia, the size, shape, weight and mounting style are helping in proper analysis of the connection of these elements in the assembly. We should consider the mounting style, the size, shape and weight in a proper wayso that the assembly would be easy and the product construction would be simple. It will have low maintenance as the number of components are less, the assembly is less complicated and it would be easily assembled.

The customer can easily assemble the components.The ceiling fan is a simple example. We can easily assemble the ceiling fan and we can easily mount it, wherever required for the domestic applications. If we look at its various parts or the mountings mechanical elements, they are very simple and a layman can easily assemble it.

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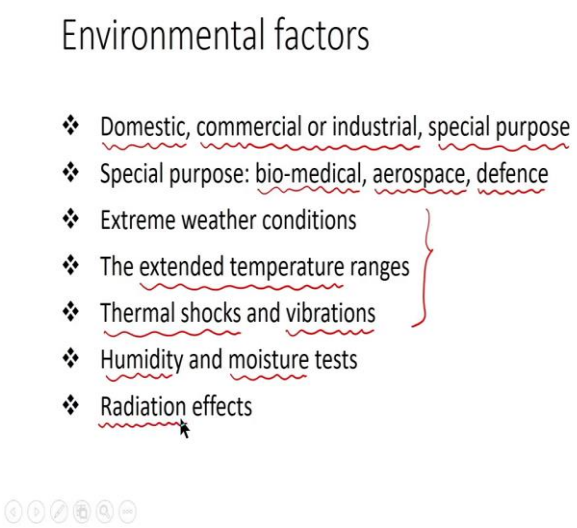

The next set of factors or the parameters is the environmental factors. The intended automated system maybe utilized for a variety of purposes and applications, such as domestic application or industry or a special purpose product. What is the meaning of special purpose product? The product may be utilized in biomedical instrumentation; or for aerospace applications. Say it may be a part of a satellite, or it will be utilized for defense applications.

When the special purpose products are to be developed then, the extreme weather conditions have to be considered under which these products are being utilized. For example, the aerospace products are working at entirely different working conditions, the

gravity will not be there, the temperatures or the pressures are entirely different. All these factors need to be considered during the development of the product.

Same case with the biomedical applications. When we select the components for biomedical applications, we should consider the sensitivity of the elements, the humidity level or the temperature, under which these equipments are being utilized. In defense level applications as well. The weather conditions may be very harsh, even at the shop floor, when the vibrations are very high or if we consider a typical example of forging, when the noise levels and temperatures are very high.

All these parameters are needed to be considered, when the constituents of the automated system are selected. These special purpose automated systems may be utilized in extreme weather conditions. The temperature ranges maybe extended, there may be thermal shocks and extreme vibrations. When it is known that the products may lead to such kind of extreme weather conditions, its constituting elements should also be able to withstand these extreme weather conditions.

In addition to thermal shocks and vibration, the humidity and the moisture also affect the performance of the automated system. Thus, these are to be considered. Then, some of the products may have the exposure to radiation in case of the nuclear applications, this equipment may be utilized for carrying out some of the operations, where the chances of radiation maybe there. The components should able to withstand these effects as well.

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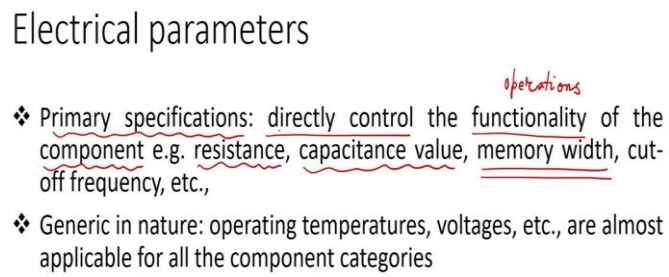

The next set of parameter is the electrical parameters. Electrical parameters can be grouped together into the primary specifications. The primary specifications are nothing but the parameters, which are directly controlling the functionality of the component. The resistance value, the capacitance value, memory width and cutoff frequency are some of the examples of these primary specifications.

However, there are certain specifications which are generic in nature. For example, the operating temperatures or the voltages, which are almost applicable for all sort of component categories. The constituent elements of a mechatronic based systems, may require the electrical energy to get operated.

There may be certain generic parameters associated with them and these are the temperature and the voltage. The temperature range in which the component is able to work. And, what are the voltage requirements to operate that element or the component? The designer should have the proper knowledge about the primary specifications as well as the generic specifications of these constituting elements.

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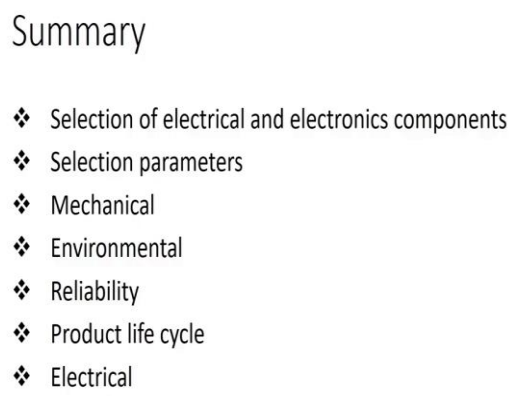

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Let us summarize, in this lecture we have seen, how to select the electrical and electronics components. What are the various selection parameters? Such as the mechanical, environmental, reliability related parameters product life cycle and the electrical parameters. These are the parameters that need to be considered when selecting

the components for the intended purpose that is design and development of an automated system.

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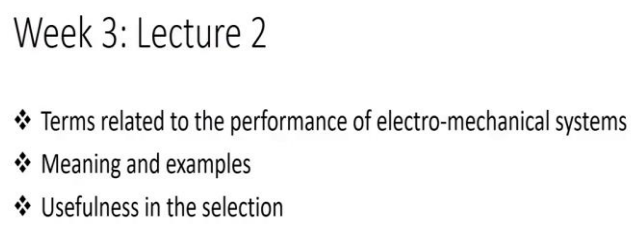

In the next lecture we will be looking at the technical aspects of the electromechanical systems. There are various terms related to the performance of these electromechanical systems. We will study them, we will understand the meaning of these terms; we will see a variety of examples to understand these terms in a better way. These terms are very much useful in the proper selection of the constituting elements for a better automated system design.