**Oil Hydraulics and Pneumatics**
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**Introduction to Oil Hydraulics and Pneumatics**
**Lecture – 03**
**Part 3: Brief History, Application Areas, Major Divisions of Fluid Power System**

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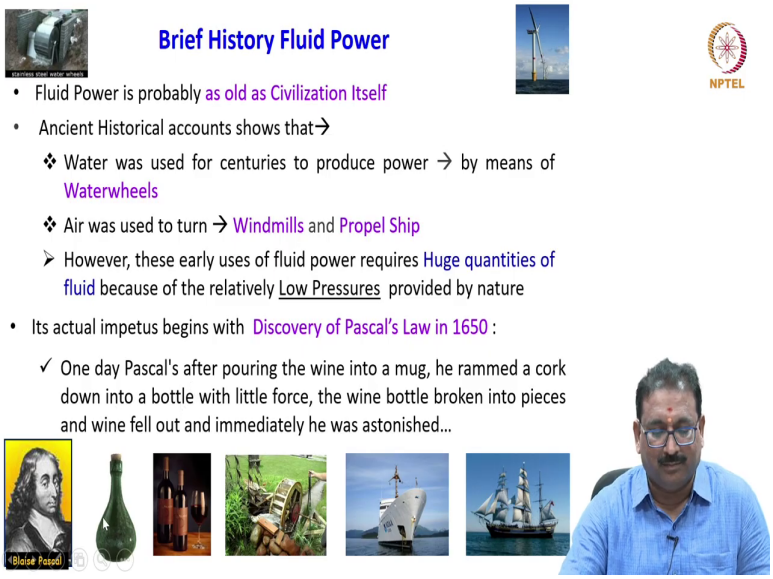


My name is Somashekhar, course faculty for this course. After knowing these merits and demerits of the fluid power system, let us we will move on to the brief history of fluid power. How it is developed? Whether it is a new technology or whether is a old technology? Let us we will discuss brief history of fluid power now.

The fluid power is probably as old as civilization itself. Ancient historical account shows that water was used for centuries to produce the power by means of waterwheels. Air was used to turn windmills and propel ship. However, these early uses of fluid power requires huge quantities of fluid because of the relatively low pressure provided by the nature. That is why in the fluid power we are concentrate more on the confined fluids rather than the open fluids.

Its actual impetus begin with the Discovery of Pascal's Law in 1650. How he discovered this law just you will see friends. One day Pascal's after pouring the wine into a mug, he rammed

a cork down into the bottle with a little force, the wine bottle broken into pieces and wine fell out and immediately he was astonished.

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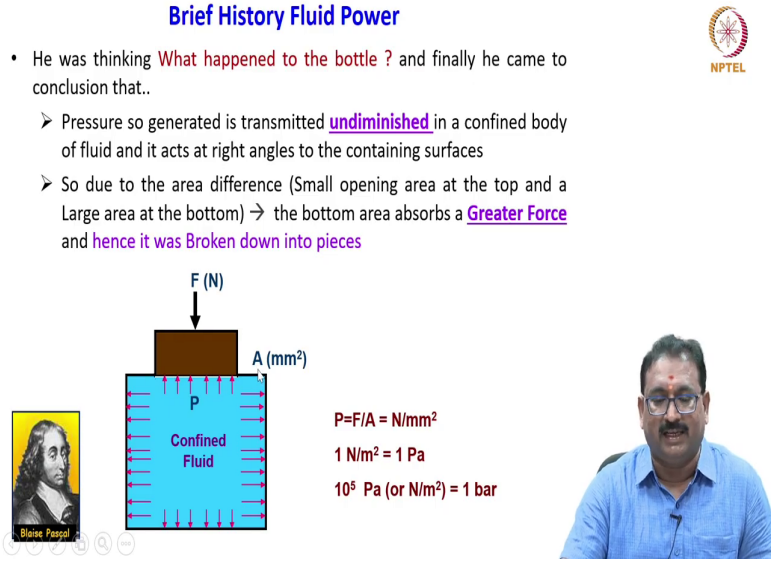


He was thinking what happened to my bottle because I applied only small force on the cork. And finally, he came to conclusion that pressure so generated is transmitted undiminished in a confined body of fluid and it acts at right angles to the containing surfaces. So, due to the area difference because the small opening area at the top and a large area at the bottom, the bottom area absorbs a greater force and hence it was broken down into the pieces.

This is a simple case in which the confined fluid is there in the cylinder fitted with one plunger, area is a, we are applying the force, small force F. Then we know that the pressure generated in the contacting surface, what is that? P equal to pressure P equal to force by an

area. Force is a newton area is mm square. Then the pressure is generated, is transmitted undiminished and perpendicular to the wall surfaces.

Please note friends, 1 Newton per meter square is equal to 1 Pascal, 10 to the power of 5 Pascal is equal to 1 bar.

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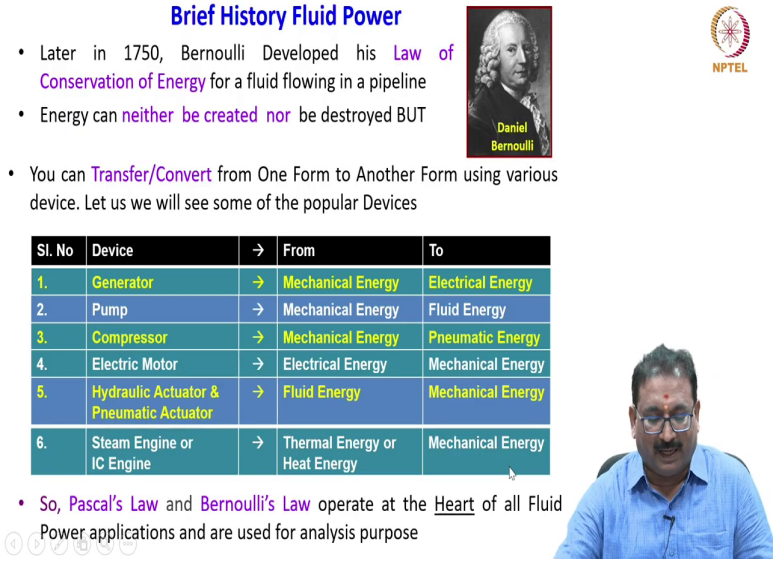


Later in 1750, Bernoulli developed his law of conservation of energy for a fluid flowing in a pipeline. What is this? Energy can neither be created nor destroyed, but you can transfer or convert from one form to another form using various device. Let us we will see some of the popular devices used for this energy conversion.

Generator, which will convert the mechanical energy to electrical energy. Pump, converts the mechanical energy to fluid energy. Compressor, converts mechanical energy into pneumatic

energy. Then, electric motor electrical energy into mechanical energy. Hydraulic actuators and pneumatic actuators, whatever it may be they will convert the fluid energy into mechanical energy. Then steam engine or IC engine, convert thermal energy or heat energy into mechanical energy.

So, the Pascal's law and Bernoulli's law operate at the heart of all the fluid power applications and are used for many analysis purpose.

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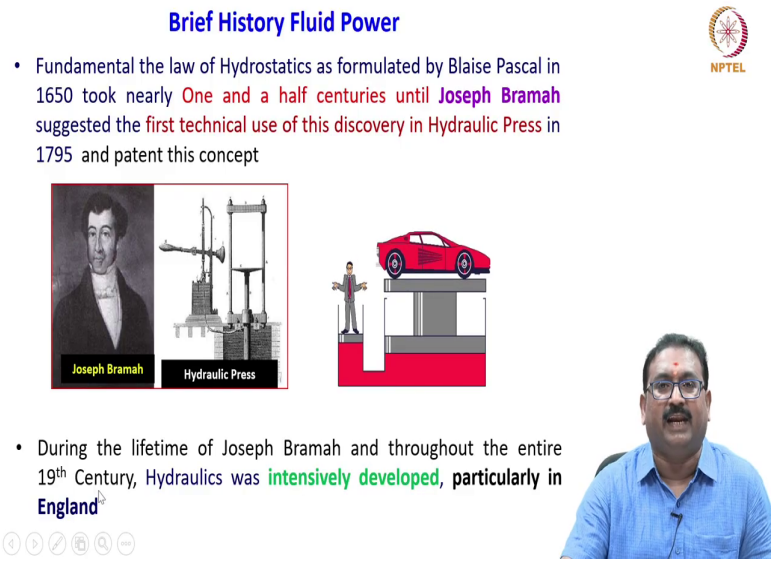


Fundamental the law of hydrostatic as formulated by Blaise Pascal in 1650 took nearly 1 and a half centuries until Joseph Bramah suggested the first technical use of this discovery in Hydraulic Press in 1795 and patent this concept. Please note friends, during the lifetime of the Joseph Bramah and throughout the entire 19th centuries, hydraulics was intensively developed particularly in England.

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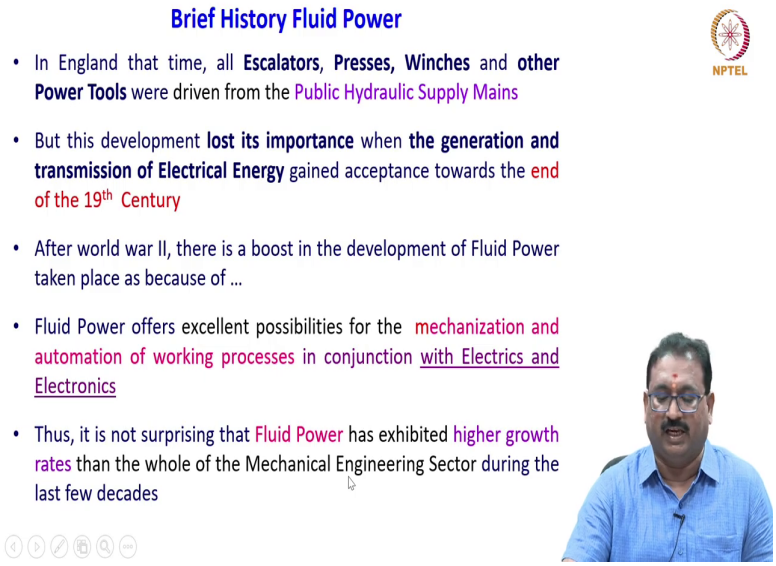


Also please note, in England that time, all escalators, presses, winches and other power tools were driven from the public hydraulic supply mains. But this development lost its importance when the generation and transmission of electric energy gained acceptance towards the end of the 19th century.

After the World War II, there is a boost in the development of fluid power taken place as because of fluid power offers excellent possibilities for the mechanization and automation of working processes in conjunction with electrics and electronics. Thus, it is not surprising that fluid power has exhibited a higher growth rates than the whole of the mechanical engineering sector during the last few decades.

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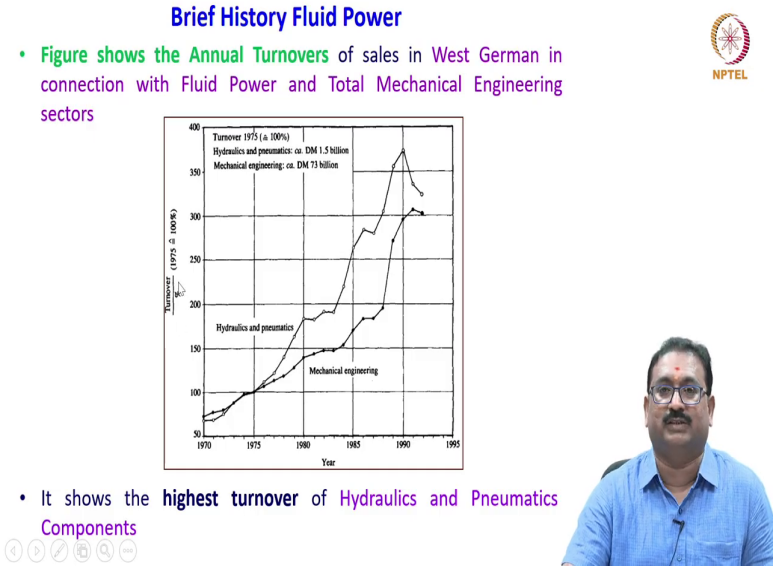


This figure shows the annual turnovers of sales in West Germany in connection with fluid power and total mechanical engineering sectors. See here friends, it shows the highest turnover of hydraulic and pneumatic components compared to total mechanical engineering in terms of turnovers.

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This is the history of fluid power, how it was used from olden days and currently how it is employed in the mechanization and automation of the processes.

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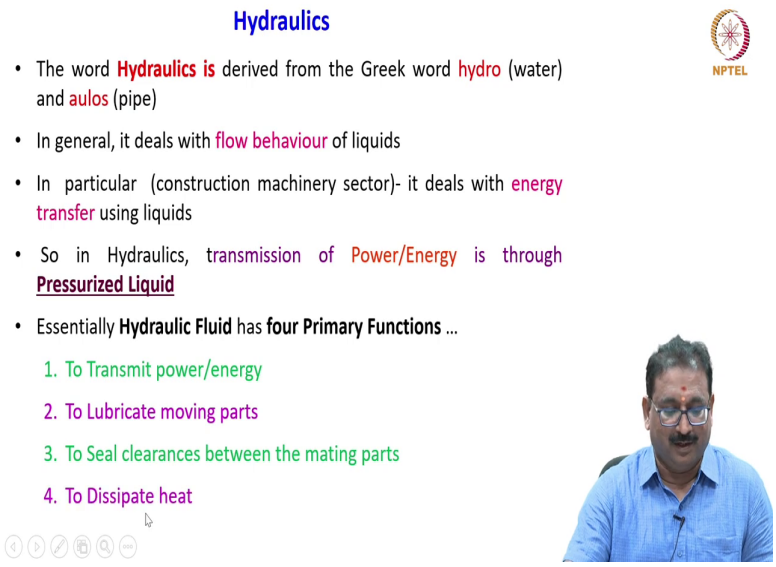


Now, let us we will move on to the major divisions in fluid power system. What are those? As we know there are the two major divisions, one is hydraulics also known as oil hydraulics and second one is in pneumatics. Let us we will see some of the aspects in the hydraulics.

The word hydraulics is derived from the Greek word hydro mean water and aulos meaning pipe. Meaning what we are doing here? In general, it deals with the flow behaviour of the liquids. In particular for example, in the construction machinery sector, it deals with the energy transfer using the liquids.

So, in hydraulics that transmission of power is through the pressurized liquid, pressurized liquid very important, confined fluid is very important. Essentially hydraulic fluid has four primary functions.

What are those? First one is to transmit a power as I have told you. Second to lubricate the moving parts, no need to have separate lubrication system in the hydraulics, the oil itself lubricate the moving parts. To seal the clearance between the mating parts, to dissipate the heat.

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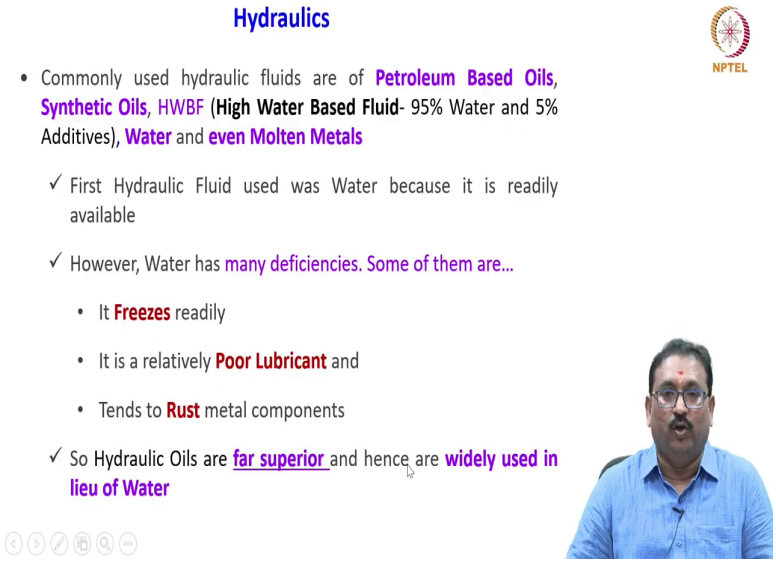


So, please note commonly used hydraulic fluids are of petroleum based oils, synthetic oils, HWBF fluids meaning High Water Based Fluids in which 95 percent of the water and 5 percent of the additives, like a rust inhibitors, lubricators, some of the elements are added in the water and water itself is used as a fluid.

Now, most of the servo walls are also drive through the water. If you will see the water hydraulics people are used in Japan more to drive with the water itself. And even the molten

metals are also used as a fluids. First hydraulic fluid used was water because it is readily available.

However, water has many deficiencies. Some of them are it freezes readily, correct friends. It is relatively poor lubricants and tends to rust metal parts. So, hydraulic oils petroleum based fluids mineral oils are far superior and hence are widely used in lieu of water.

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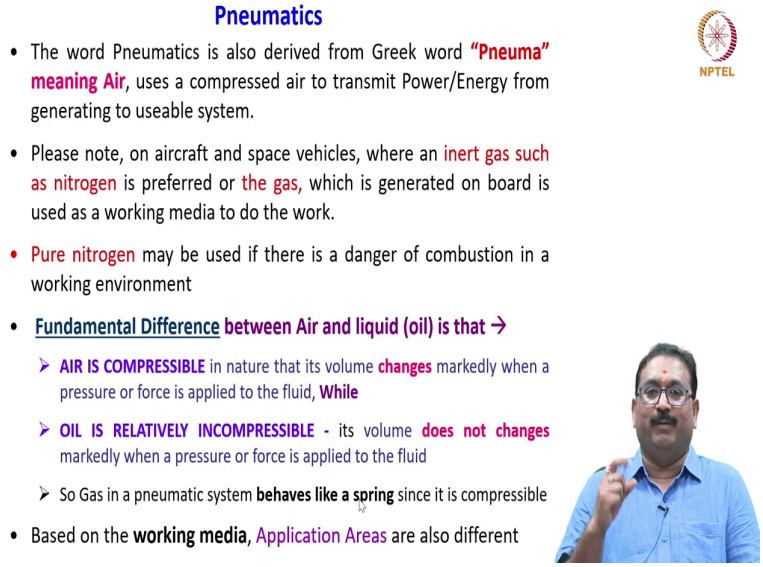


Later we will discuss many things in each part. Now, quickly we will see some of the features in pneumatics. The word pneumatics is also derived from the Greek word pneuma, meaning air uses a compressed air to transmit a power from generating to usable area.

Please note, on aircraft and space vehicle, where an inert gas such as a nitrogen is preferred or the gas, which is generated on board is used as a working media to do the work. Pure nitrogen may be used if there is a danger of combustion in a working environment.

Fundamental difference between the air and liquid meaning pneumatics and hydraulics is that, air is compressible in nature that is its volume changes markedly when a pressure or a force is applied to the fluids. While, the oil is relatively incompressible, its volume does not changes markedly when a pressure or a force is applied to the fluid. So, gas in pneumatic system behaves like a spring since it is a incompressible compressible in nature.

Based on the working media whether you are using the air or a liquid, application areas are different friends please note now. The working media calls for the different application and different power ratings.

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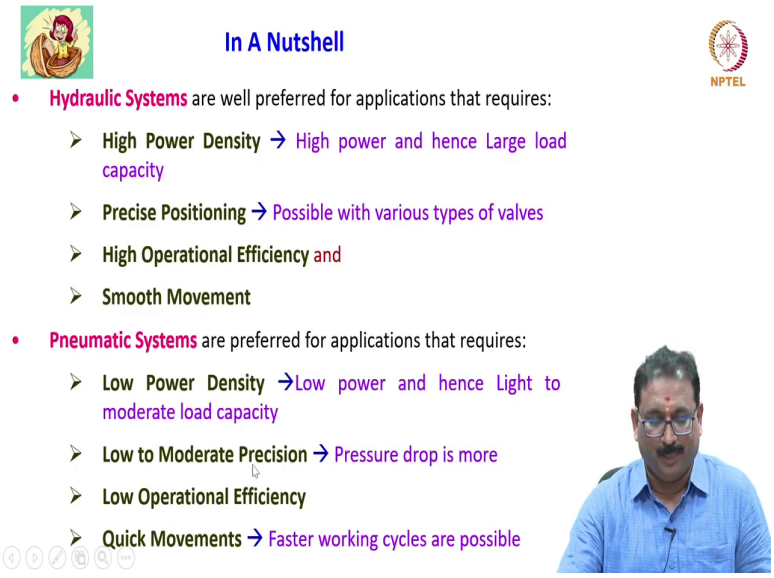


In a nutshell, hydraulic systems are well preferred for application that requires high power density and precise positioning, as I have told you possible with various types of valves. High operational efficiency and a smooth movements.

On the other hand, pneumatic systems are preferred for applications that requires low power density, low to moderate precision, low operational efficiency quick movements as because air is compressible in nature, when you will open it air will move (Refer Time 14:07); no control over the air that is why faster working cycles is possible in the pneumatics. But this is not possible in the hydraulics.

Hydraulics is always a smooth and slow based on the opening orifice. But in the pneumatics the faster working cycle because air is compressed when you will open it will expand very quickly that is a main motto in the pneumatics for the faster working cycles.

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Energy imparted to the fluid, using pumps in case of hydraulics or a compressor in case of pneumatics, respectively. Energy so imparted can be utilized depending on the industrial requirements for running a machinery devices like a drills, bore wells, earth moving equipment and many more. And hydraulic rams, moving or compressing the materials.

Hydraulic presses used for drawing, bending, forming materials and many more. Hydraulic elevator, transporting people or freight vertically and many more.

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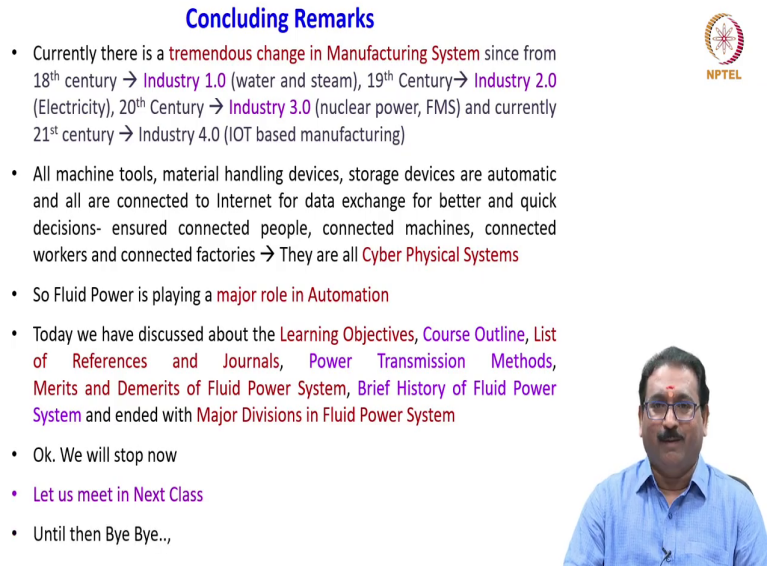


Concluding remarks of the today's lecture; currently there is a tremendous change in manufacturing system since from 18th century, here we have seen the industry 1.0 all the machines are drive through the water and a steam. Next phase is 19th century industry 2.0, where all the machine tools are drive through the electricity.

Next phase is in the 20th century industry 3.0 in which we have seen the nuclear power and flexible manufacturing system, in which all machine tools are automatic connected to the material handling system and storage devices. Only one centralized computer controlling the whole internal machine tools.

And currently we are in the 21st century; the new technology is industry 4.0. This is also known as IOT based manufacturing, or IIOT. Here all the machine tools, material handling devices, storage devices are automatic and all are connected to the internet for data exchange,

for better and quick decisions which ensured connected people, connected machines, and connected workers, and connected factories.

Meaning here all the elements involved in the industry 4.0 are a Cyber Physical System. What are cyber physical systems? All are automatic and able to connect to the internet to the cloud for data exchange. So, the fluid power is playing a major role in current automation technology.

Today, we have discussed about the learning objectives, course outline, list of references and journals, power transmission methods, merits and demerits of fluid power system. Also we have seen the brief history of fluid power system and ended with major divisions of fluid power system as a oil hydraulics and a pneumatic system. Both are based on the media used.

Ok friends, we will stop now. Let us meet in the next class; until then bye-bye.

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Thank you one and all for your kind attention. [FL]