SVR ENGINEERING COLLEGE

Experiment No. | | | **Date:** | | | | | |

DEPATMENT OF MECHANICAL ENGINEERING

DT&PI LAB (19A99303P)

LABORATORY MANUAL

Prepared by

DEPATMENT OF MECHANICAL ENGINEERING SVR ENGINEERING COLLEGE AYYALURIMETTA, NANDYAL-518501

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Experiment No. **Date:**

GENERAL INSTRUCTIONS

1. Students should wear the uniform and closed foot wear. Students inappropriately dressed for lab, at the instructor's discretion, are denied access.
2. Eating, drinking and smoking are prohibited in the laboratory at all times.
3. Never work in the laboratory without proper supervision by an instructor.
4. Never carry out unauthorized experiments. Come to the laboratory prepared. If you are unsure about what to do, please ask the instructor.
5. Except the scientific calculator, any other electronic devices are not permitted to use inside the Laboratory.
6. Any damage to any of the equipment/instrument/machine caused due to carelessness, the cost will be fully recovered from the individual (or) group of students.

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List of Experiments:

EXPT NO.	DATE	TOPIC	PAGE NO
I		To develop a CAD model and simulate in CAE environment.	
2.		To develop tooling and make a physical prototype	
3.		To design a device for measurement of Temperature/ pressure.	
4.		To design a device for measurement of Humidity.	
5.		To design a device for Water Level Indicator.	
6.		To design a Smart Lighting system.	
7		To design Automatic Car Wiper/ safety issues in Automobiles.	
8.		Design of simple pneumatic and hydraulic circuits using basic components.	
9.		Design of pneumatic circuit for speed control of double acting cylinders.	
10.		Design a hydraulic circuit by using Flow Control Valves for simple application.	
11.		Design and Simulation of a Hydraulic Shaper.	
I2		Design and Simulation of a Hydro Electric Circuit for simple application.	

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INTRODUCTION

Computer Aided Design (CAD) is the use of computer software to design a product or an object. Computer Aided Manufacturing (CAM) is the use of computer software and hardware to plan, manage and control the operations of a manufacturing plant. Computer Aided Engineering is the use of computer software to solve engineering problems and analyze products created using CAD.

CATIA is an acronym for Computer Aided Three-dimensional Interactive Application. It is one of the leading 3D software used by organizations in multiple industries ranging from aerospace, automobile to consumer products.

CATIA is a multi platform 3D software suite developed by Dassault Systems, encompassing CAD, CAM as well as CAE. Dassault is a French engineering giant active in the field of aviation, 3D design, 3D digital mock-ups, and product lifecycle management (PLM) software. CATIA is a solid modelling tool that unites the 3D parametric features with 2D tools and also addresses every design-to-manufacturing process. In addition to creating solid models and assemblies, CATIA also provides generating orthographic, section, auxiliary, isometric or detailed 2D drawing views. It is also possible to generate model dimensions and create reference dimensions in the drawing views. The bi-directionally associative property of CATIA ensures that the modifications made in the model are reflected in the drawing views and vice-versa.

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Experiment No. | | | **Date:** | | | | | |

Exp: 1

To develop a Slider Crank Mechanism and simulate in CATIA

Aim: To prepare a Slider crank parts and assemble and simulating in CATIA **Equipment:**

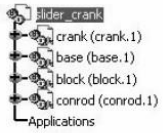
Catia V5 Software with PC

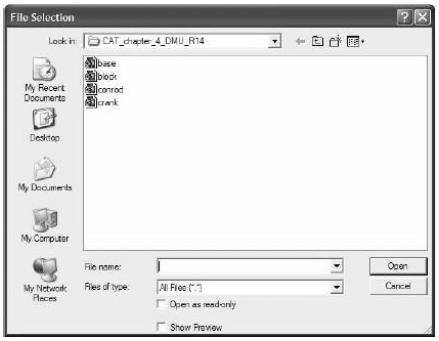
Procedure: Step: 1 Draw the Individual parts according to given dimensions Step: 2

Assembly

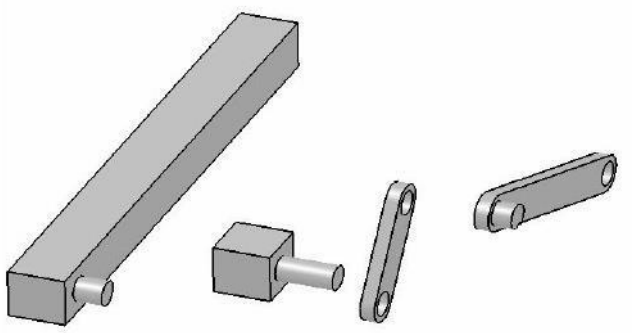
File > New> select Product-1> rename with slider crank.

The next step is to insert the existing parts in the assembly just created. From the standard windows toolbar, select Insert > Existing Component. From the File Selection pop up box choose all four parts





You may have to use the **Manipulation** icon in the Move toolbar to rearrange them as desired.



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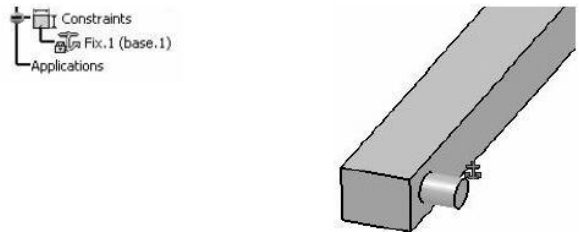
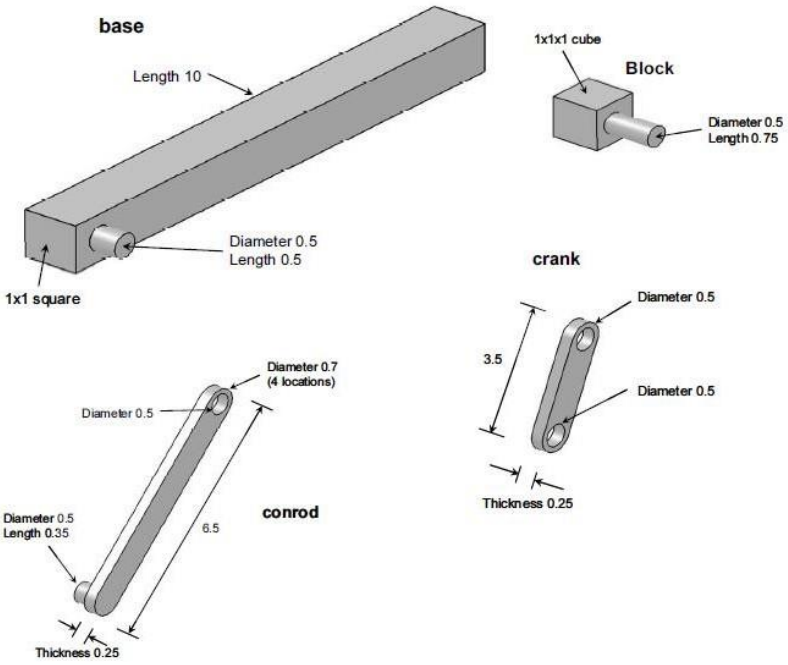
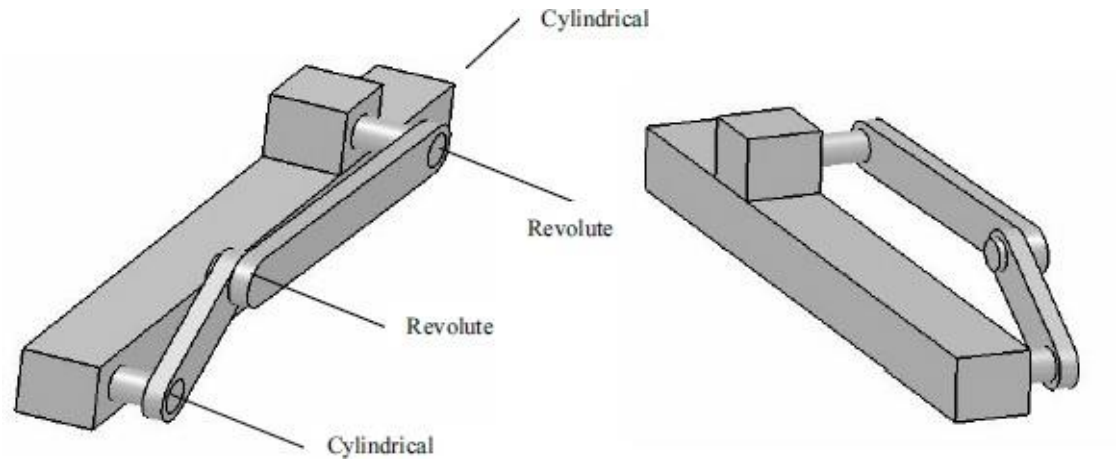
Pick the **Anchor** icon from the Constraints toolbar and select the base from the tree or from the screen. This removes all six degrees of freedom for the base.







Coincidence icon from the Constraints toolbar. Select the two edges of the base and the block as shown below. This constraint is reflected in the appropriate branch of the tree

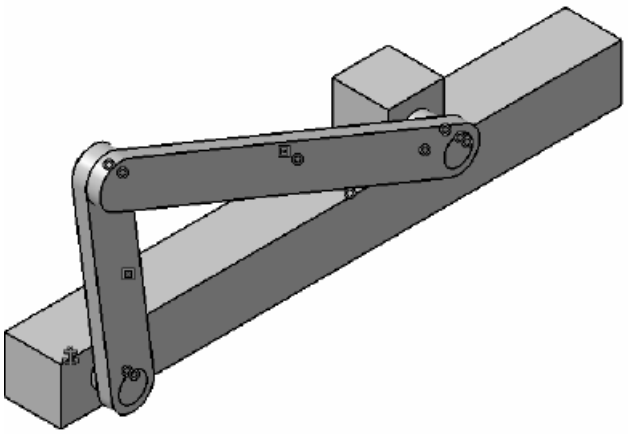
Use **Update** icon to partially position the two parts as shown.

Note that the **Update** icon no longer appears on the constraints branches.

You can always use the Manipulation icon to position it where desired followed by Update if necessary

If your parts are originally oriented similar to what is shown, you will need to choose **same** for the **Orientation** in the **Constraints Definition** box so that the conrod will flip to the desired orientation upon an update. The tree is modified to reflect this constraint.

To create the constraint, Pick the **Contact** icon from **Constraints** toolbar and select the surfaces. The tree is modified to reflect this constraint.

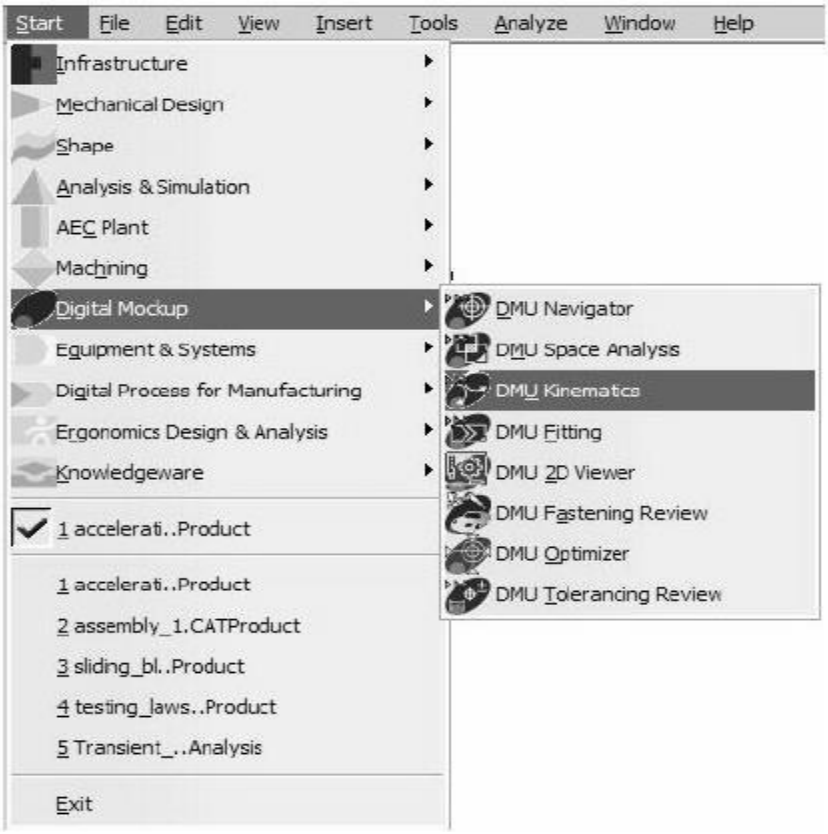


The assembly is complete and we can proceed to the **Digital Mockup** workbench. As you proceed in the tutorial, keep in mind that we have created the assembly constraints with attention to the relative degrees of freedom between the parts in a manner consistent with having a

cylindrical joint between the base and the crank, a revolute joint between the crank and the lower end of the conrod, a revolute joint between the upper end of the conrod and the block, and a cylindrical joint between the block and the base.

4 Creating Joints in the Digital Mockup Workbench

The Digital Mockup workbench is quite extensive but we will only deal with the **DMU Kinematics module.** To get there you can use the Windows standard toolbar as shown below. **Start > Digital Mockup > DMU Kinematics.**



Select the **Assembly Constraints Conversion** icon  from the **DMU Kinematics** toolbar 

. This icon allows you to create most common joints automatically from the existing assembly constraints.
The pop up box below appears.

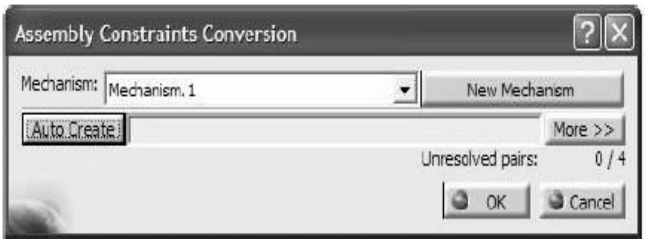
Select the New Mechanism button 

.
This leads to another pop up box which allows you to name your mechanism.
The default name is **Mechanism.1**. Accept the default name by pressing **OK**.

Note that the box indicates **Unresolved pairs: 4/4**

Select the **Auto Create** button 

. Then if the **Unresolved pairs** becomes **0/4**, things are moving in the right direction.



The DOF is 1 (if you have dof other than 1, revisit your assembly constraints to make sure they are consistent with those herein, delete your mechanism, then begin this chapter again). This remaining dof can be thought of as the position of the block along the base, or the rotation of the crank about the base. Since we want to drive the crank at constant angular speed, the latter interpretation is appropriate.

Note that because we were careful in creating our assembly constraints consistent with the desired kinematic joints, the desired joints were created based on the assembly

constraints created earlier and the **Assembly Constraints Conversion** icon. 

All of these joints could also be created directly using the icons in the **Kinematics Joints** toolbar

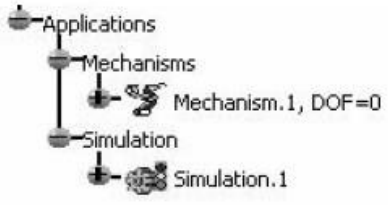
In order to animate the mechanism, you need to remove the one degree of freedom present. This will be achieved by turning **Cylindrical.2** (the joint between the base and the crank) into an **Angle driven** joint.

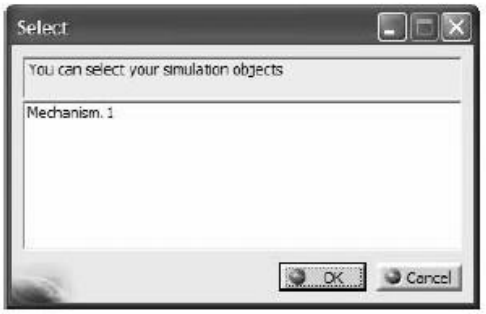
Note that naming the instances of parts to be the same as the part name makes it easy to identify the joint between any two parts.
Double click on **Cylindrical.2** in the tree. The pop up box appears.

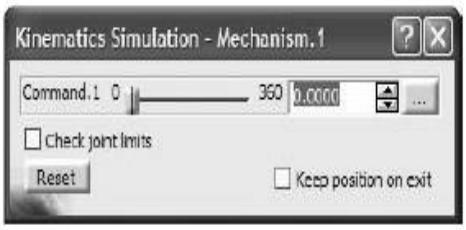
We will now simulate the motion without regard to time based angular velocity. Select the **Simulation** icon  from the **DMU Generic Animation** toolbar

. This enables you to choose the mechanism to be animated if there are several present. In this case, select **Mechanism.1** and close the window.

As soon as the window is closed, a Simulation branch is added to the tree.







As you scroll the bar in this toolbar from left to right, the crank begins to turn and makes a full 360 degree revolution. Notice that the zero position is simply the initial position of the assembly when the joint was created. Thus, if a particular zero position had been desired, a temporary assembly constraint could have been created earlier to locate the mechanism to the desired zero position. This temporary constraint would need to be deleted before conversion to mechanism joints.

When the scroll bar in the **Kinematics Simulation** pop up box reaches the right extreme end, select the **Insert** button 

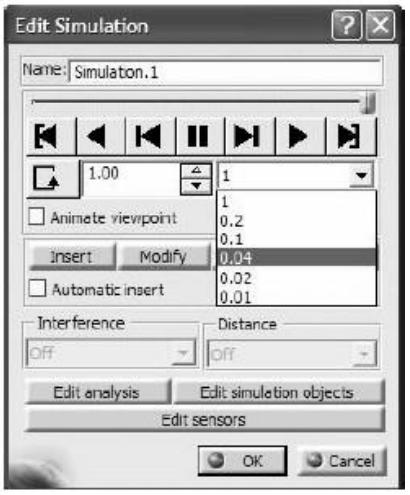
in the **Edit Simulation** pop up box shown above. This activates the video player buttons shown

Return the block to its original position by picking the **Jump to Start** button  .

Note that the **Change Loop Mode** button  is also active now.

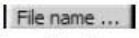
Upon selecting the **Play Forward** button  , the crank makes fast jump completing its revolution.

In order to slow down the motion of the crank, select a different **interpolation step**, such as 0.04.

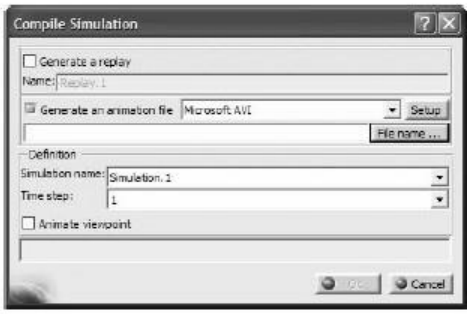


Upon changing the interpolation step to 0 0.04, return the crank to its original position by picking the **Jump to Start** button  . Apply **Play Forward** button  and observe the slow and smooth rotation of the crank. It is likely that your slider will proceed beyond the end of the block; the entities involved in the joints are treated as infinite. If you wish, you may alter your block dimensions so the slider remains on the block.

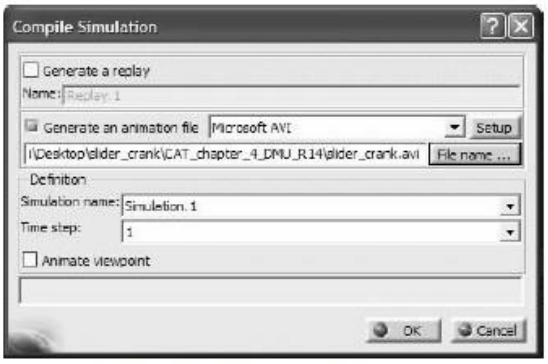
Select the **Compile Simulation** icon  from the **Generic Animation** toolbar

and activate the option **Generate an animation file**. Now, pressing the **File name** button 

allows you to set the location and name of the animation file to be generated as displayed below.
Select a suitable path and file name and change the **Time step** to be 0.04 to produce a slow moving rotation in an AVI file.

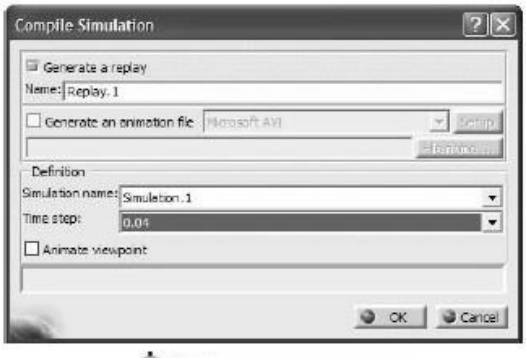


The completed pop up box is displayed for your reference.



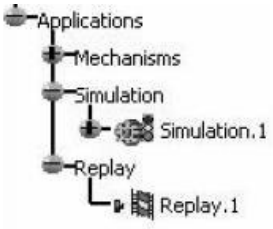
As the file is being generated, the crank slowly rotates. The resulting AVI file can be viewed with the Windows Media Player.

In the event that an AVI file is not needed, but one wishes to play the animation, repeatedly, a **Replay** need be generated. Therefore, in the **Compile Simulation** box, check the **Generate a replay** button.



Note that in this case most of the previously available options are dimmed out.

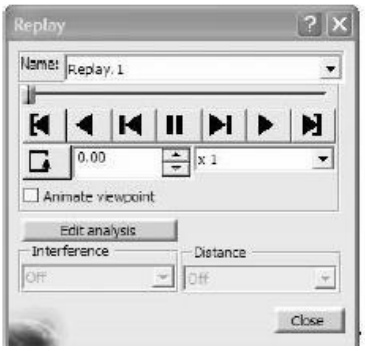
A **Replay.1** branch has also been added to the tree.



Select the **Replay** icon  from the **Generic Animation** toolbar 

Double clock on **Replay.1** in the tree and the **Replay** pop up box appears.
Experiment with the different choices of the **Change Loop Mode** buttons  .
The block can be returned to the original position by picking the **Jump to Start** button  .

The **skip ratio** (which is chosen to be x1 in the right box) controls the speed of the **Replay**.



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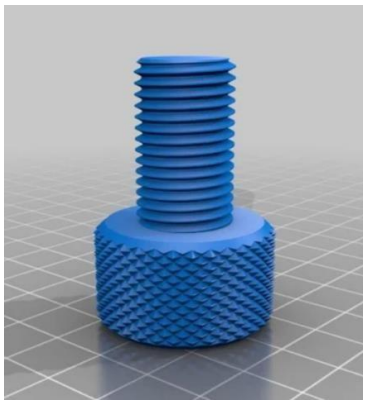
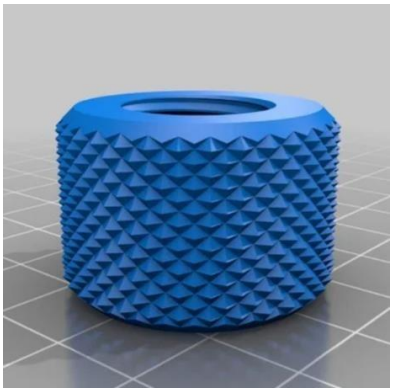
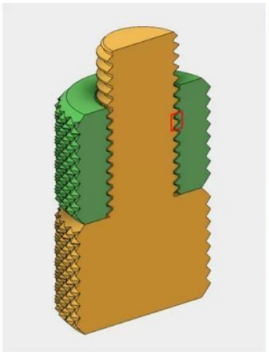
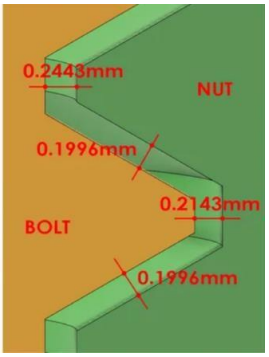
MODELING & 3D PRINTING - KNURLING NUT & BOLT

AIM: To develop a 3d model and making into prototype (Knurling Nut and Bolt)









APPARATUS:

- Minimum criteria of the PC to run the slicing and 3d modeling software are as follows, RAM - 8 GB or higher
- Graphics card - 2 GB or higher (Nvidia Graphics card)
  Processor - Intel i5 7th generation or higher
- Hard disk – 1TB HDD / 256 SSD+512 GB HDD
- Operating system – Windows 10 Slicing

  Software 3D PRINT/ CURA PLA

  Material

- Fusion 360 Software / CATIA / TINKER CAD / SOLIDWORKS

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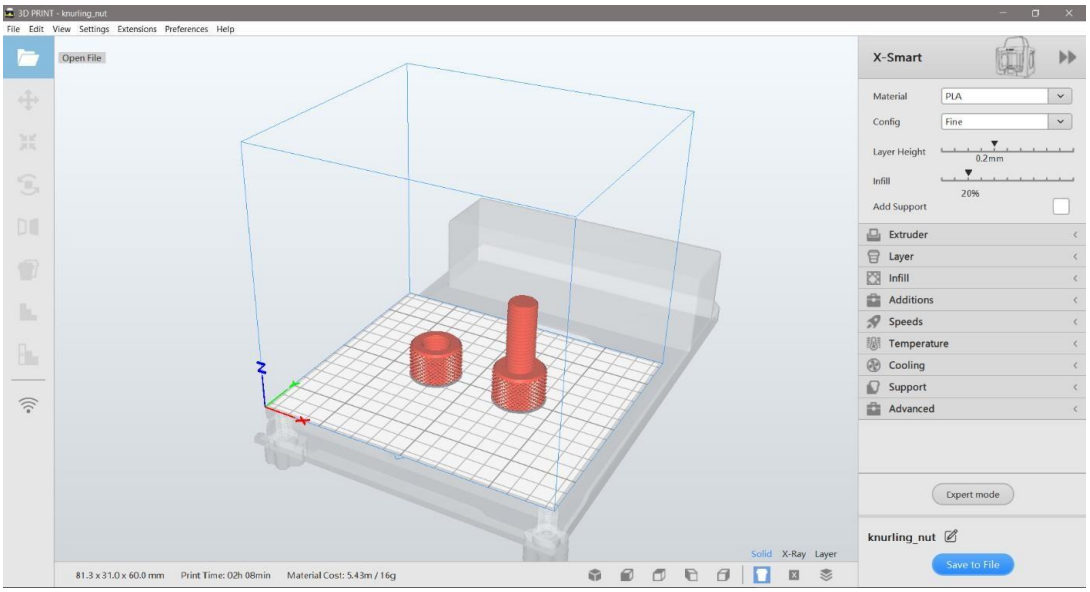
Experiment No. | | | **Date:** | | | | | |

Procedure:

1. Design the 3d model according to given dimensions in any CAD software.
2. Save the file in .stl format- Mesh high quality
3. Open the saved file in slicing software X-Smart



4. Select the material on the top right side on 3D Print slicing software. Here we are using PLA – Poly lactic acid material for the prototype.
5. Now, give the input details like
    a. Layer height – 0.2mm
    b. Infill – 20%
    c. Material temperature – 205℃ & 50℃
    d. Speed – 60mm/s
    e. Supports – Needed or not (based on the orientation)
    f. Additions – Skirt/ Brim/Raft
6. Just click on the prepare model, so that using the input values the slicing software generates the G-Code.
7. Save the G-code file in the removal disk with file name of your product
8. Place the removal disk in 3D printer.
9. Now turn on the 3d printer and go to print option on the screen and select the saved gcode.
10. Then print the model

Result: Estimate time to print according to given dimensions with fine print

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Experiment No. | | | **Date:** | | | | | |

MODELING & 3D PRINTING - Spanner

Aim: To develop a 3d model and making into prototype (Spanner)

OPEN BEARING

Apparatus:

- Minimum criteria of the PC to run the slicing and 3d modeling software are as follows, RAM - 8 GB or higher
- Graphics card - 2 GB or higher (Nvidia Graphics card)
  Processor - Intel i5 7th generation or higher
- Hard disk – 1TB HDD / 256 SSD+512 GB HDD
- Operating system – Windows 10 Slicing

  Software – 3D PRINT/ CURA PLA

  Material

- Fusion 360 Software / CATIA / TINKER CAD / SOLIDWORKS

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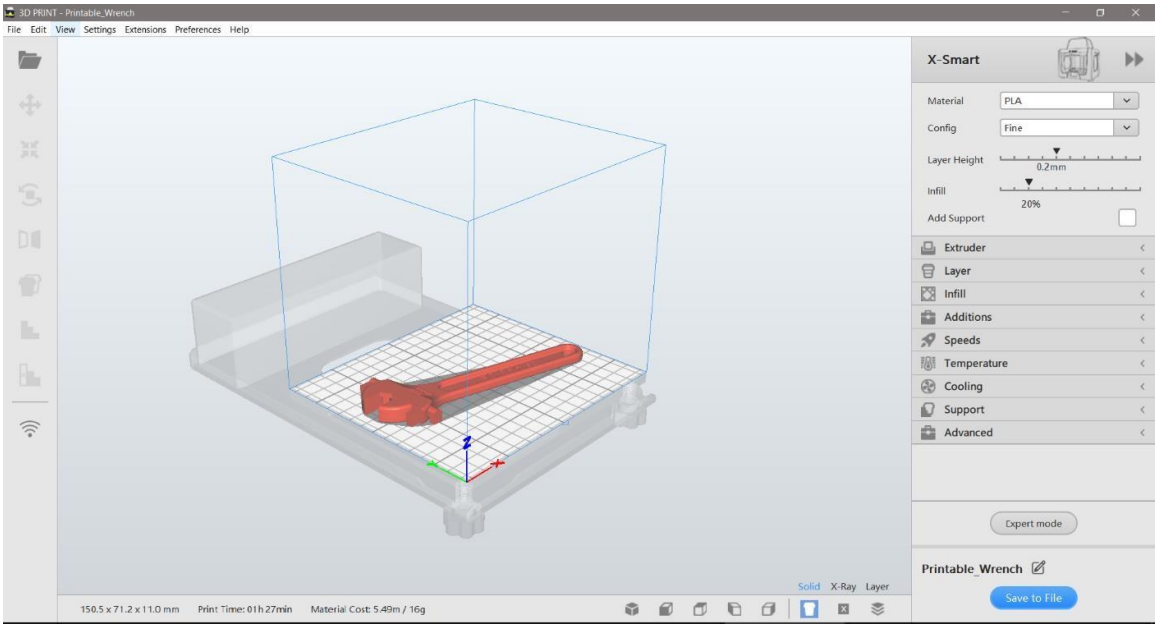
Experiment No. **Date:**

Procedure:

1. Design the 3d model according to given dimensions in any CAD software.
2. Save the file in .stl format- Mesh high quality
3. Open the saved file in slicing software X-Smart



4. Select the material on the top right side on 3D Print slicing software. Here we are using PLA – Poly lactic acid material for the prototype.
5. Now, give the input details like
    a. Layer height – 0.2mm
    b. Infill – 20%
    c. Material temperature – 205°C & 50°C
    d. Speed – 60mm/s
    e. Supports – Needed or not (based on the orientation)
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8. Place the removal disk in 3D printer.
9. Now turn on the 3d printer and go to print option on the screen and select the saved gcode.
10. Then print the model

Result: Estimate time to print according to given dimensions with fine print

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Experiment No. | | | **Date:** | | | | | |

To design a device for measurement of Temperature/ pressure

Aim: - To design a device for measurement of Temperature/ pressure

Introduction:-Temperature and pressure measuring system. we will use a pressure sensor model BMP180 to detect temperature and pressure, Arduino device and 16 X 2 characters LCD to display temperature and pressure.

Apparatus:-

Hardware requirements

- Arduino UNO board
- USB cable connector for Arduino device Pressure Sensor BMP180
- 16 X 2 Character LCD Display Project Board
- Jumper wires (male to female, male to male)

Software requirement

Arduino software IDE

Introduction:-

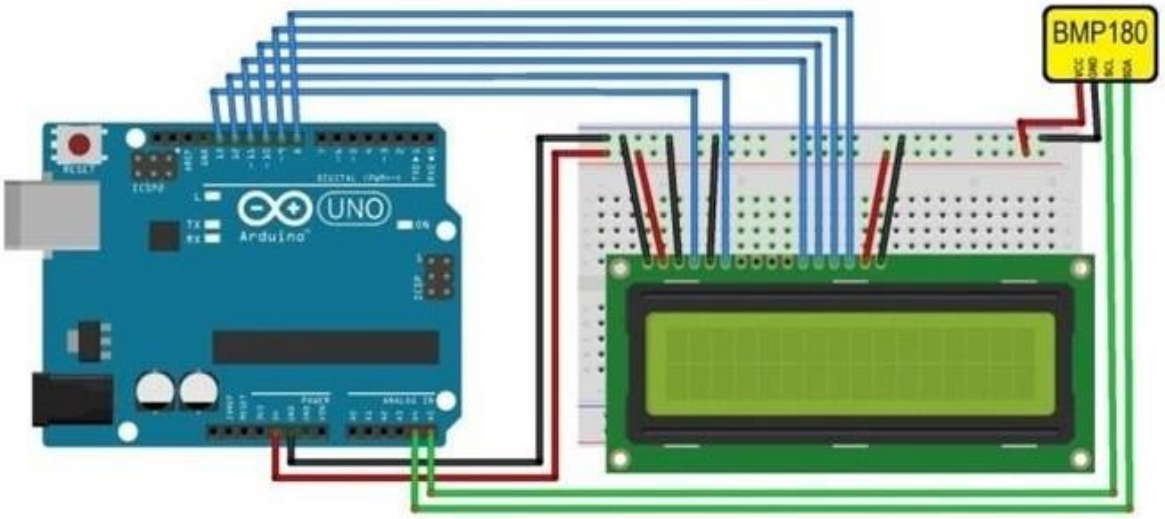
Temperature measurement in today's industrial environment encompasses a wide variety of needs and applications. To meet this wide array of needs the process controls industry has developed a large number of sensors and devices to handle this demand. In this experiment you will have an opportunity to understand the concepts and uses of many of the common transducers, and actually run an experiment using a selection of these devices. Temperature is a very critical and widely measured variable for most mechanical engineers. Many processes must have either a monitored or controlled temperature. This can range from the simple monitoring of the water temperature of an engine or load device, or as complex as the temperature of a weld in a laser welding application. More difficult measurements such as the temperature of smoke stack gas from a power generating station or blast furnace or the exhaust gas of a rocket may be need to be monitored. Much more common are the temperatures of fluids in processes or process support applications, or the temperature of solid objects such as metal plates, bearings and shafts in a piece of machinery.

Working:

The pressure sensor BMP180 consists of a piezo-resistive sensor, an analog and digital converter, control unit with E2PROM and a serial I2C interface. It delivers the contributed values of temperature and pressure. The microcontroller of the sensor device sends the start sequence to measure temperature and pressure. The temperature and pressure can be read over 16 X 2 characters LCD.

The calculated temperature and pressure are measured in 0C, and hPa (hector Pascal) respectively.

In this case, the rate of measuring temperature and pressure is once per second



Result

We measure the pressure and temperature of Delhi in the winter season.

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Experiment No. | | | **Date:** | | | | | |

To design a device for measurement of Humidity

Aim: - To design a device for measurement of Humidity

Introduction:

Humidity measurement is an important tool for predicting the climate outdoors as well as controlling the climate indoors. Humidity control is especially important in living, storage, and manufacturing sites.

Relative humidity **(RH)** is the percentage of the amount of water that the air can hold at a given temperature. The following equation calculates the percent relative humidity.

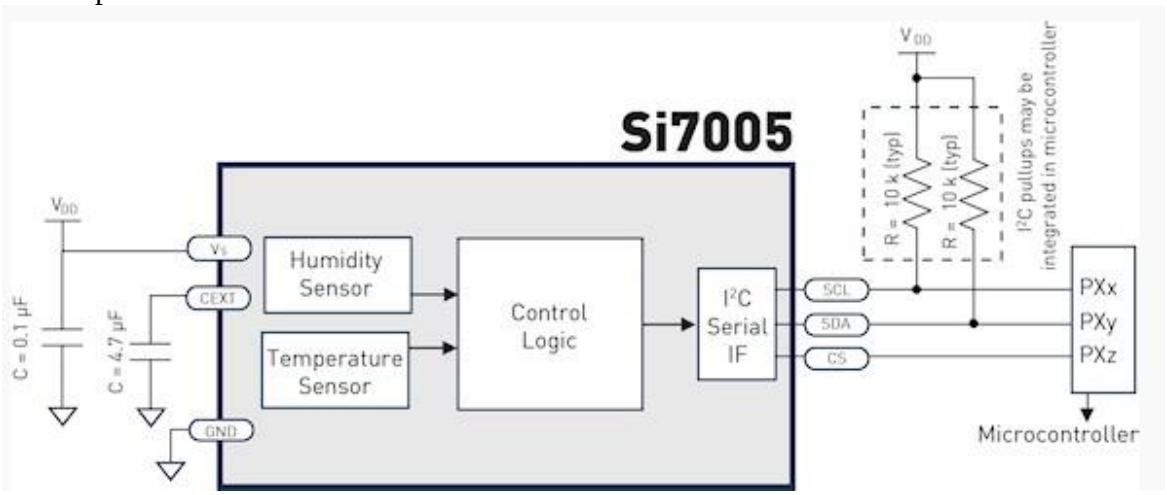
$$\%RH = \frac{P_a}{P_s} \text{ x } 100$$

Where:

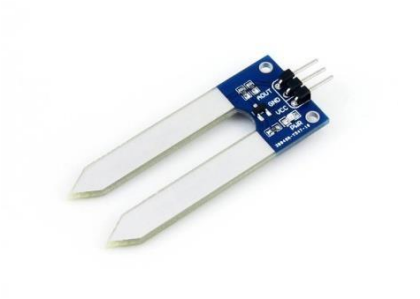
Pa = actual pressure

Ps = saturated pressure

Humidity can be quantified in a number of ways, but the most important measurement for maintaining atmospheric quality is relative humidity (RH). This is the ratio of the actual water vapor present in air to the amount of water vapor present in saturated air, which cannot absorb any more moisture. Absolute humidity is defined as the mass of water vapor dissolved in a total volume of moist air at a given temperature and pressure.



A humidity sensor (or hygrometer) senses, measures and reports both moisture and air temperature. The ratio of moisture in the air to the highest amount of moisture at a particular air temperature is called relative humidity. Relative humidity becomes an important factor when looking for comfort.



Humidity sensors work by detecting changes that alter electrical currents or temperature in the air. There are three basic types of humidity sensors:

- Capacitive
- Resistive
- Thermal

Capacitive

A capacitive humidity sensor measures relative humidity by placing a thin strip of metal oxide between two electrodes. The metal oxide's electrical capacity changes with the atmosphere's relative humidity. Weather, commercial and industries are the major application areas.

Resistive

Resistive humidity sensors utilize ions in salts to measure the electrical impedance of atoms. As humidity changes, so do the resistance of the electrodes on either side of the salt medium.

Thermal

Two thermal sensors conduct electricity based upon the humidity of the surrounding air. One sensor is encased in dry nitrogen while the other measures ambient air. The difference between the two measures the humidity.

Some parameters for judgement

So once you know what it is, and how it works, the next step probably would be to check its working. And how do you do that? By working through some of the below-mentioned parameters.

Accuracy

Every sensor has its own calibration curve, based on a 9 point system. It basically pitches the pros against the cons of the particular sensor.

Linearity

It indicates the voltage deviation from the BFSL value and the measured output voltage value, converted to relative humidity.

Reliability

The measurements often cause the sensor to fall out of sync. However for a sensor to be useful, it has to provide reliable measurements.

Repeatability

The measurements from a sensor, have to be so that they don't drift apart. Repeatability is the measurement of drift among measurements of a single quantity.

Response time

Typically, the time is taken by a sensor to rise to 66% (rise time) or fall to 33% (fall time) of maximum output voltage, is known as the response time.

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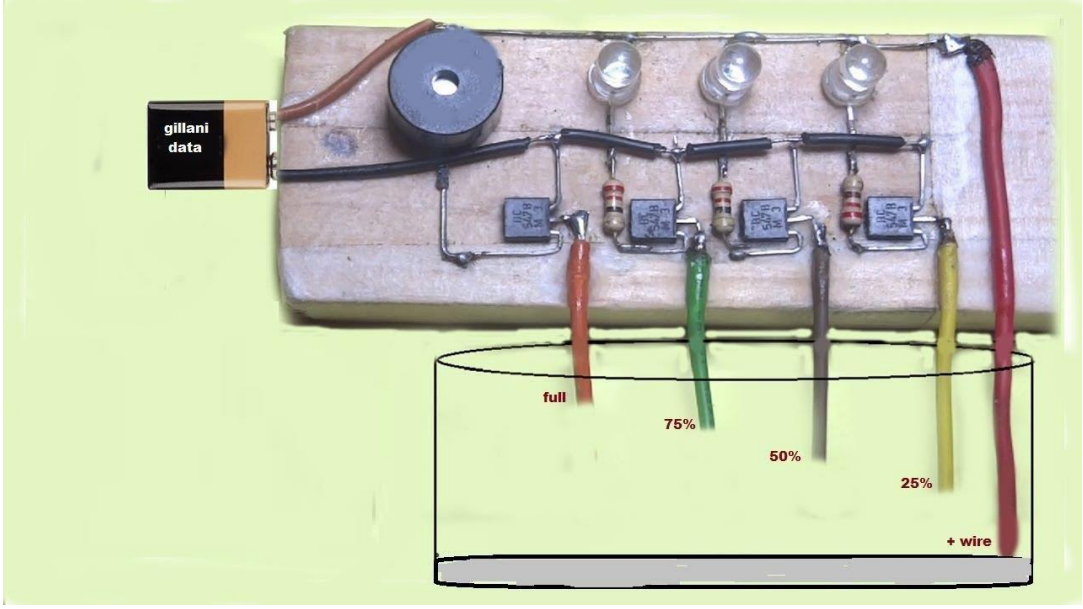
Experiment No. | | | **Date:** | | | | | | |

To design a device for Water Level Indicator

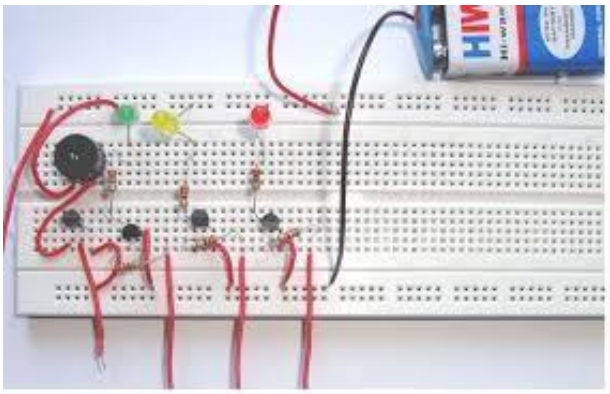
Aim: - To design a device for Water Level Indicator.

Apparatus:- Battery, Switch, Led Bulbs, Wires, Connectors, Capacitor, Relay,Diodes, Sensor, Buzzer, Transistor, Resister, breadboard/PCB, Transformer/Adapter, Voltmeter, microcontroller, motor, Soldering



Introduction:

Water level controller is equipment used to control the water level in a field. The level of the water is controlled by using a microcontroller. Main components are PIC microcontroller, sensor, motor etc. The sensors sense the presence of water and give indication to the microcontroller. The micro-controller produces the control signals to drive the motor. If there is no water then microcontroller gives control signal to start the motor and if there is sufficient water in the field then the microcontroller give control signal to stop the motor. And also the microcontroller when the motor is off. Hence the level of water in a field can be automatically controlled. The main components used in this equipment are PIC microcontroller, sensor and motor.



Microcontroller:

The main heart of this project is AT89C51 microcontroller. The water level probes are connected to the P3.0, P3.1, P3.2, and P3.3 through the transistors. Port P2 connected to the data pins of LCD and control pins RS, RW and EN of LCD are connected to the P1.0, P1.1, and P1.2 respectively. Initially when tank is empty, LCD will display the message EMPTY and motor runs automatically. When water level reaches to quarter level, now LCD displays QUARTER and still motor runs. For further levels, LCD displays the messages HALF and ¾ FULL. When tank is full, LCD displays FULL and motor automatically stops. Again motor runs when tank is empty.

Motor:

Motor is controlled by the microcontroller the microcontroller switching the power supply to motor by relay mechanism. The motor employed is DC motor which has high starting torque and constant speed DC motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. opposite (North and South) polarities attract, while like polarities(North and North, South and South) repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.

COLOUR Led: Used for the signal of level of water.

BUZZER: It is used to produce alarm when water is full in the tank. 9V Battery &Battery Clips used to supply power to microprocessor and sensor.

Result

A water-level indicator with an alarm that will allow reduction in wastage of water is made. A Water level ndicator and controller using microcontroller is a low-cost controller that is capable of managing water levels n different systems like water tanks, boilers and swimming pools, etc

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Experiment No. | | | **Date:** | | | | | |

To design a Smart Lighting system

Aim: To design a Smart Lighting system

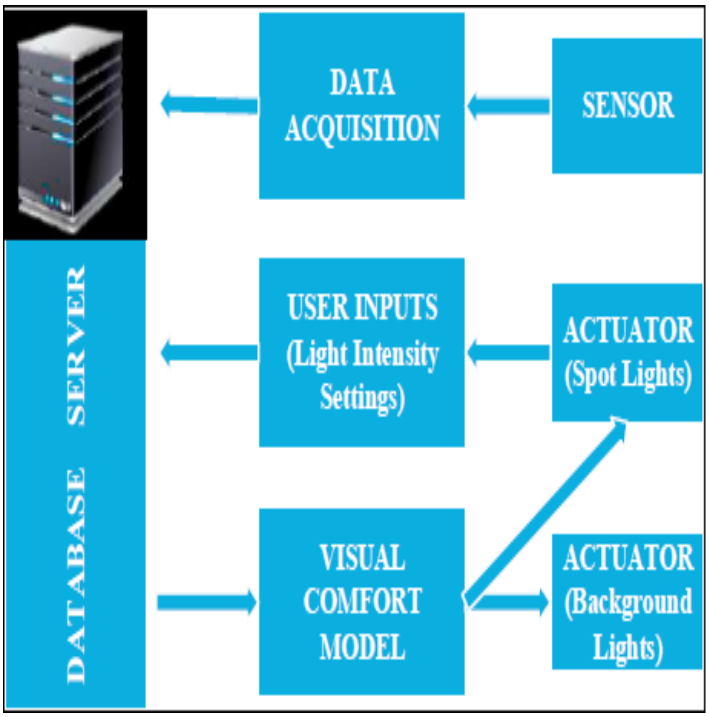
Introduction:

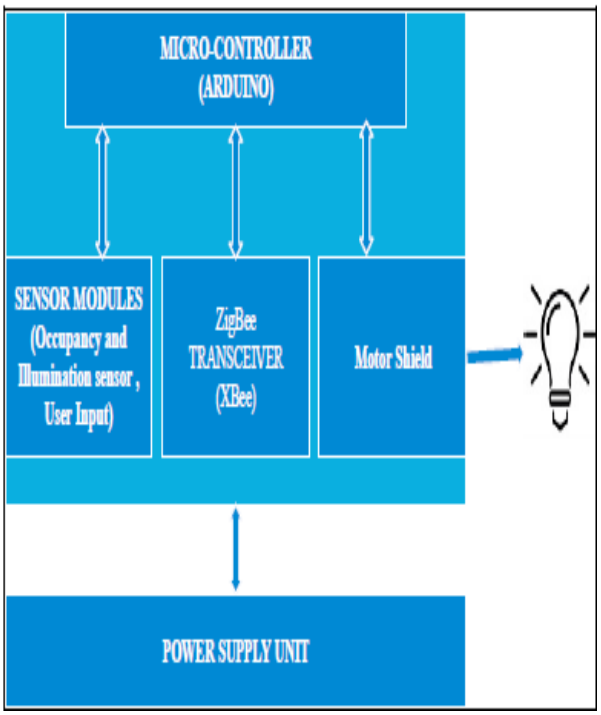
The energy-efficient smart LED lighting systems provide a better visual comfort-working environment at a reduced energy consumption compared to existing lighting systems. Present day lighting systems are able to regulate the light intensities via communication technologies utilizing smart sensors. This paper presents implementation of a smart LED lighting system utilizing different energy-efficient techniques without compromising the visual comfort of occupants. The proposed lighting system uses ZigBee and Wi-Fi communication protocols to control the lights of commercial/residential buildings according to natural daylight, occupancy or as per the requirements of the inhabitants of the building. The lighting system can be operated in three different modes: Manual, Auto, and Hybrid to account for various applications. A wireless sensor and actuator network (WSAN) is used to collect available data, regarding the usage of personalised smart LED lights by occupants in the building. A complete design and implementation of the smart lighting system are presented in the paper. The paper also presents the detailed test-bed implementation of the proposed smart lighting technique and data management system to illustrate the impact of the proposed lighting system on energy consumption and occupants' visual satisfaction. The proposed lighting system aims to reduce energy consumption by 60-70% compared to the existing lighting system while satisfying the visual comfort of the occupants. The proposed work also suggests the guidelines to incorporate intelligence into the system such that it can automatically predict the occupant preferences in a decentralized framework for better visual comfort and improved energy utilization in existing buildings.

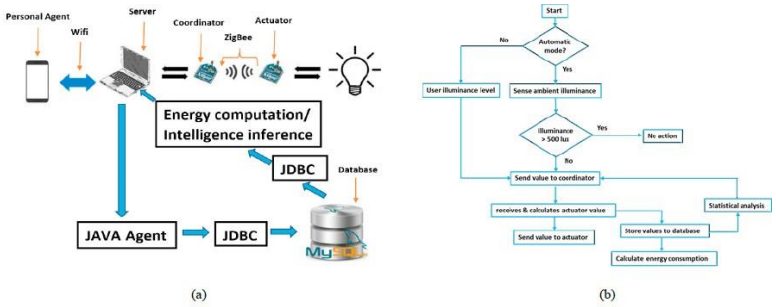
Smart Lighting System

The proposed framework enables changing the brightness of lights to provide satisfactory visual comfort to the users at a lesser energy cost. In addition, the framework provides the methodology to integrate visual comfort devices with WSAN in the built environment. A schematic of the proposed WSAN framework is shown in Fig. 1 (a). To account for different types of experiments (both with personal control and centralized control), the framework is designed to operate in three different modes; Manual Mode - the users can interact with the lights according to their preference. Auto Mode - the lights are actuated according to a model-based or data-driven control based on the sensor measurements. Hybrid Mode - the lights can be actuated automatically

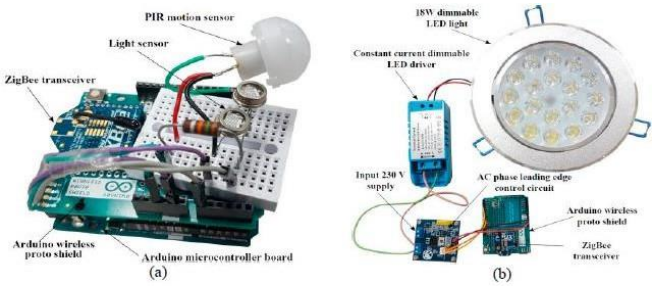
but the users can interact with the device in case they feel discomfort. Modern bidirectional communication networks can control sensor activities and put them into SLEEP state after receiving data from them. Therefore, the smart lighting system is designed using the WSAN. The WSAN is widely used in many applications to analyze physical and environmental parameters. The structure of the WSAN comprises of nodes where each node represents an autonomous entity in the network. The sensor network in this system comprises of sensor nodes, which transmit measured sensor values to the coordinator. A Gateway node facilitates connectivity of the WSAN with the other nodes involved within it. Actuation nodes work based on the instructions from the coordinator. The lighting system implements the proposed actions







(a) overview of database connectivity of smart lighting system; (b) flow diagram of the smart lighting system.



(a) Components of sensor node (b) components of actuator node

Result:-

The Implementation of Smart LED Lighting and Efficient Data Management System for Smart Buildings without compromising the visual comfort of occupants. The proposed lighting system used Zig Bee and Wi-Fi communication to control the lights of commercial/residential buildings according to natural available daylight, occupancy or as per the requirements of the inhabitants of the building.

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Experiment No. | | | **Date:** | | | | | |

To design Automatic Car Wiper/ safety issues in Automobiles

Aim: - To design Automatic Car Wiper/ safety issues in Automobiles

INTRODUCTION

A windscreen wiper or windshield wiper is a device used to remove rain and debris from a windscreen. Almost all motor vehicle, including trains, aircraft and watercraft, are equipped with such wipers, which are usually an essential requirement. A wiper generally consists of an arm, pivoting at one end and with a long rubber blade attached to the other. The blade is swung back and forth over the glass, pushing water from its surface. The speed is normally adjustable, with several continuous speeds and often one or more "intermittent" settings. Most automobiles use two synchronized radial type arms. It takes a lot of force to accelerate the wiper blades back and forth across the windshield so quickly. In order to generate this type of force, a worm gear is used on the output of a small electric motor

Automatic Wiper system

Vehicles are now available with driver-programmable intelligent (automatic) windscreen wipers that detect the presence and amount of rain using a rain sensor. The sensor automatically adjusts the speed of the blades according to the amount of rain detected. Rain-sensing windscreen wipers appeared on various models in the late 20th century, one of the first being Nissan's 200SX/Silvia. As of early 2006, rain-sensing wipers are optional or standard on all Cadillac and most Volkswagen, and are available on many other main-stream manufacturers.

Why Automatic Wiper

In the present automobiles the number of facilities is much higher. The driver has to concentrate on road while driving, and with increased traffic, things get frustrating. The features in the car like GPRS to trace the route, music system, air condition system etc may drive away the attention of the driver. Thus an effort has been made to reduce the effort put by driver in controlling the speed of the wiper and put more concentration on his driving. Since this system is put into use in many higher end cars and has been successfully working, an effort was made to reduce the cost of the system so that this system can be implemented in common economic cars where a common man can also enjoy the benefits.

Factors Affecting the Rain Sensing Wiper System

The factors that could possibly affect automatic rain sensing car wiper system are:

- **Comfort**

To operate the wiper with response to changing rainfall and driving conditions, thus keeping the driver‘s windshield clear.

- **Installation**

The system is easy to install. In the installation process we add one sensor system on the front glass. When sensor detect water droplet then wiper system is operating. If the installation is not done properly it may not work accurately as its designed purpose

- **Failsafe Function**

It is assured that the wiper operates at 6-second intervals when the drop detection function is disabled because the sensor is completely blocked by dust, snow, or other matter stuck to the se

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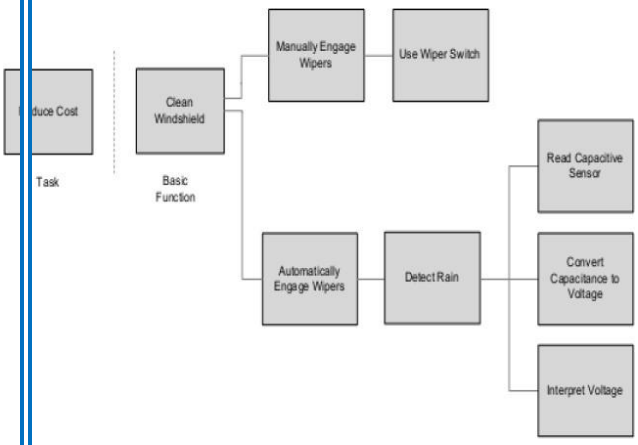
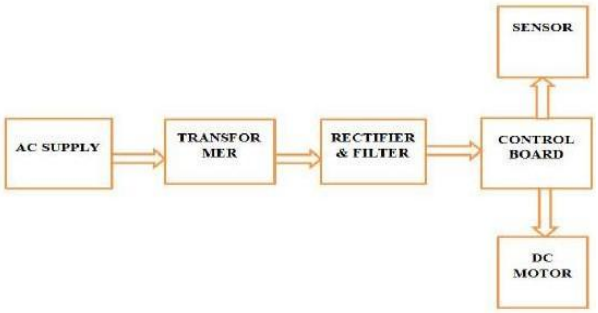
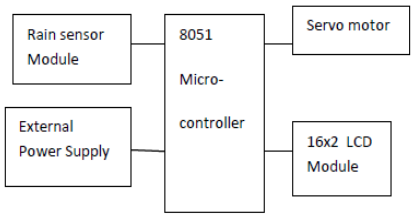


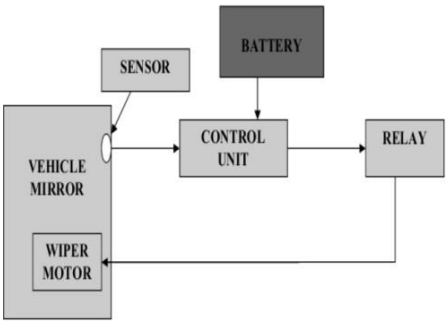


Block Diagram of an Automatic Wiper

BLOCK DIAGRAM



Block Diagram of Rain Sensing Automatic Car Wiper system



Result: Our Automatic multispeed rain operated wiper system works well with conductive sensor. An intelligent car/vehicle wiper system which can sense rain and start itself. The wiper adjusts speed itself based on the intensity of rainfall

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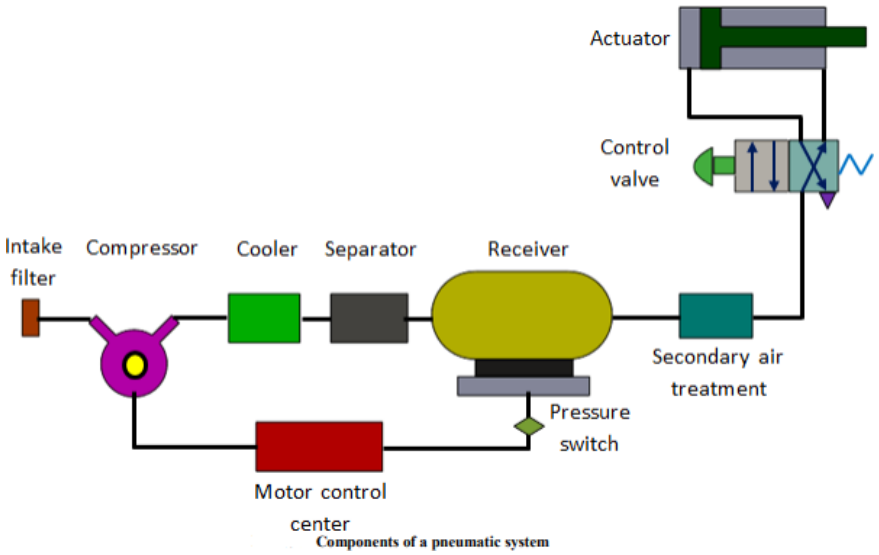
Experiment No. | | | **Date:** | | | | | |

Design of simple pneumatic and hydraulic circuits using basic components

Aim:- Design of simple pneumatic and hydraulic circuits using basic components.

Pneumatic technology deals with the study of behavior and applications of compressed air in our daily life in general and manufacturing automation in particular. Pneumatic systems use air as the medium which is abundantly available and can be exhausted into the atmosphere after completion of the assigned task.

Basic Components of Pneumatic System:



Components of a pneumatic system

Important components of a pneumatic system

a) Air filters: These are used to filter out the contaminants from the air.

b) Compressor: Compressed air is generated by using air compressors. Air compressors are either diesel or electrically operated. Based on the requirement of compressed air, suitable capacity compressors may be used.

c)Air cooler: During compression operation, air temperature increases. Therefore coolers are

a) Dryer: The water vapor or moisture in the air is separated from the air by using a dryer.

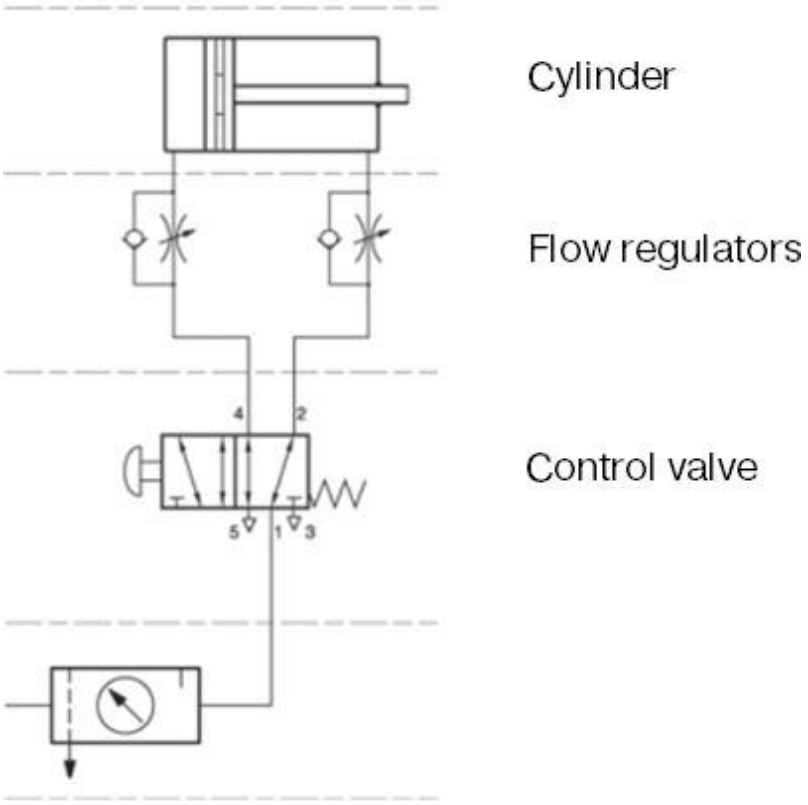
b) Control Valves: Control valves are used to regulate, control and monitor for control of direction flow, pressure etc.

c) Air Actuator: Air cylinders and motors are used to obtain the required movements of mechanical elements of pneumatic system.

d) Electric Motor: Transforms electrical energy into mechanical energy. It is used to drive the compressor.

e) Receiver tank: The compressed air coming from the compressor is stored in the air receiver

Experiment No. **Date:**



(Right click the Front plane>insert sketch and draw the 2D sketch).

A hydraulic circuit is a group of components arranged in such a way that they will perform a Useful task.

- The elements of hydraulic circuit are pumps, actuators, control valves, pipe & pipe fittings, reservoir, accumulator, filter and strainer
- These components are arranged in various ways to obtain a desired output from the circuit

Functions of the components are as follows:

1. The hydraulic actuator is a device used to convert fluid power into mechanical power to do useful work. The actuator may be of the linear type (cylinder) or rotary type (motor) to provide linear or rotary motion.
2. The hydraulic pump is used to force the fluid from the reservoir to rest of the hydraulic circuit by converting mechanical energy into hydraulic energy.
3. Valves are used to control the direction, pressure and flow rate of a fluid flowing through the circuit.
4. External power supply (motor) is required to drive the pump.
5. Reservoir is used to hold the hydraulic oil.
6. Piping system carries the hydraulic oil from one place to another.
7. Filters are used to remove any foreign particles so as keep the fluid system clean and efficient, as well as avoid damage to the actuator and valves.
8. Pressure regulator regulates the required level of pressure in the hydraulic fluid

1. Reservoir / Oil Tank
They are used to hold the hydraulic oil.

2. Hydraulic Pump
They are used to pressurized the hydraulic fluid and force the fluid through the system. There are three types of hydraulic pump:
a) Fixed Displacement Pump,
b) Variable Displacement Pump,
c) Hand /Manual Hydraulic pump

3. Hydraulic Motor
A hydraulic motor is a mechanical hydraulic actuator that converts hydraulic energy or hydraulic pressure into torque and angular displacement / rotation.

4. Hydraulic Cylinder
Hydraulic cylinder is a mechanical hydraulic actuator that converts hydraulic energy or hydraulic pressure into linear displacement. It consists of cylindrical barrel, piston and piston rod.

5. Pressure Control Valve
Pressure control valves limit the system pressure to protect the system components. There are four types of pressure control valve
a) Pressure Relief Valve
b) Pressure Reducing Valve
c) Sequence Valve
d) Counterbalance Valve

6. Flow Control Valve
A flow control valve is used for adjusting the flow rate of a fluid in a pipeline. The valve contains a flow passage or a port whose area can be varied.

7. Directional control valve
Types of directional control valve.

I. Check Valve – check valve or non return valve are simplest type of directional control valve used to allow free flow of fluid in only one direction.

II. Spool Type Directional Control Valve – These valve are used to control the direction of fluid flow.

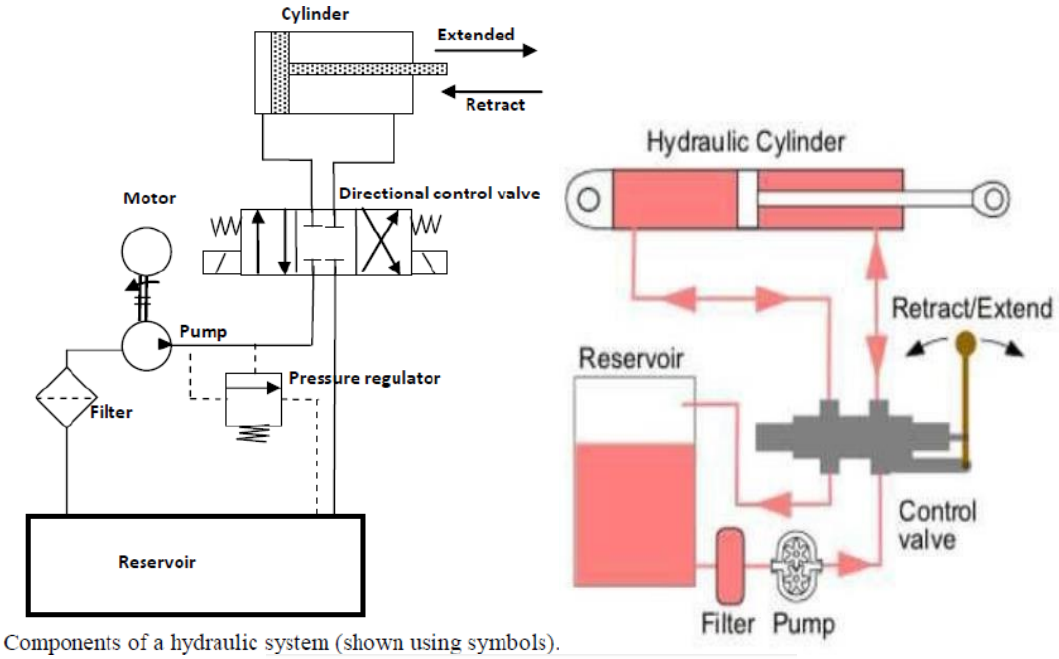
III.

8. Proportional Valve
They are used in a hydraulic system that needs to vary either flow or pressure to reduce lunge and shock.

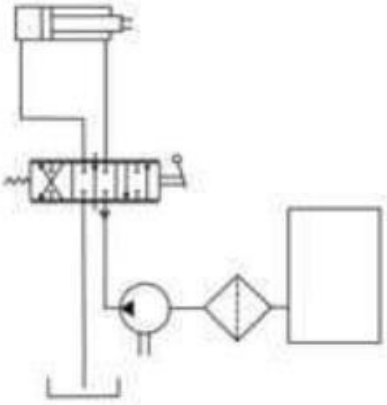
9. Cheque Q Meter
They controls the returning flow in relation to the flow being directed into opposite side of the actuator. It is used in hydraulic system to influence the speed of hydraulic motor and hydraulic cylinder independent to the load (prevent running away)

10. Solenoid Valve

It is a electro mechanically operated valve. The valve is control by electric current through a solenoid. The function of solenoid valve in hydraulic system is to shut off, distribute and release fluid.



Components of a hydraulic system (shown using symbols).



The equivalent circuit schematic

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Experiment No. | | | **Date:** | | | | | |

Design of pneumatic circuit for speed control of double acting cylinders

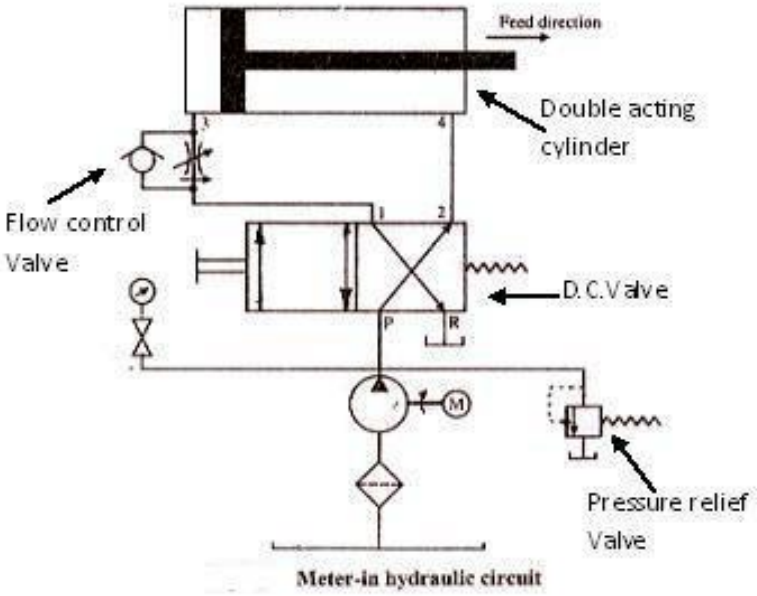
Aim: Design of pneumatic circuit for speed control of double acting cylinders

Flow control circuits

- When a constant delivery pump is used to deliver a constant volume of fluid to the circuit, then the speed or feed control should be provided with metering valves.
- To ensure proper feed and speed of an actuator, the flow control valves may be used in the circuits.
- There are following methods to control flow
  1. Meter-in control circuit
  2. Meter-out control circuit
  3. Bleed-off control circuit

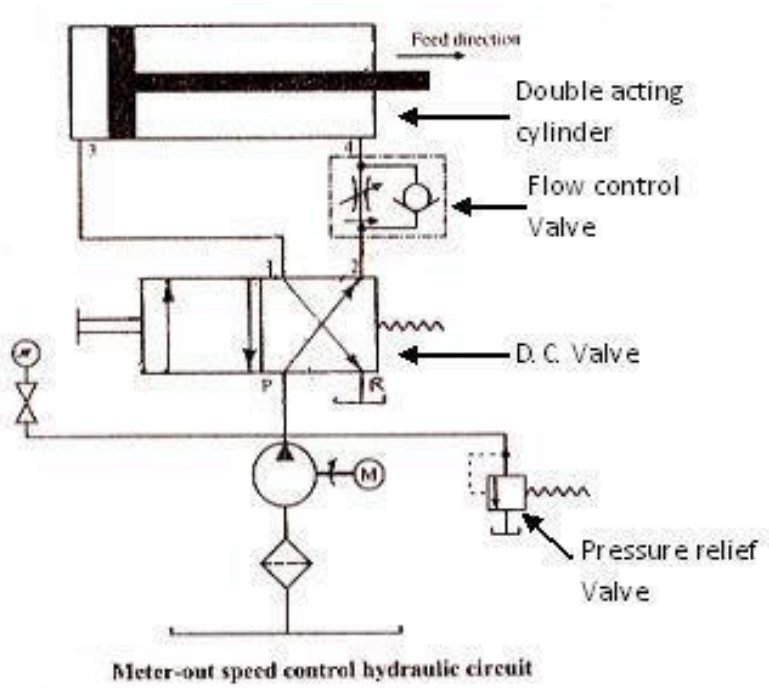
Meter-in control circuit

- In this flow control valve is connected between the D.C valve and blind end of the cylinder.
- Here metered fluid enters the cylinder which controls the speed and feed of the piston.
- When D.C. valve is manually shifted to right side the flow from pump passes through the Compensated flow control valve into blind end of cylinder and the exhaust fluid is directed freely to the reservoir.



Meter-in hydraulic circuit

- When the force on D.C. valve is released, it permits the spool to return due to valve spring and the pump flow is directed to the rod end of the cylinder.
- The fluid from blind end of the cylinder will pass through the integral check valve in the flow control mechanism and the piston can be retracted rapidly to its initial position.
- Flow during retraction is not controlled (i.e. Free flow)
- This method is used when the load characteristics are constant and positive. Hence they are used in surface grinder & milling m/c.
- Also in Shaper planner slotter due to quick return.



Meter-out speed control hydraulic circuit

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Experiment No. | | | **Date:** | | | | | |

Design a hydraulic circuit by using Flow Control Valves for simple application.

Aim: - Design a hydraulic circuit by using Flow Control Valves for simple application.

Introduction

A hydraulic circuit is a group of components such as pumps, actuators, control valves, conductors and fittings arranged to perform useful work. There are three important considerations in designing a hydraulic circuit:

1. Safety of machine and personnel in the event of power failures.
2. Performance of given operation with minimum losses.
3. Cost of the component used in the circuit.

The speed control of a hydraulic motor (Bi -directional motor) is accomplished using a flow control valve to control the fluid flow to the motor.

In the spring-centered position of the tandem four-way valve, the motor is hydraulically locked. When the four-way valve is actuated into the 1st position, the motor rotates in one direction. Its speed can be varied by adjusting the setting of the throttle of the flow control valve. In this way the speed can be infinitely varied as the excess oil goes to the tank through the pressure relief valve. When the four-way valve is deactivated, the motor stops suddenly and becomes locked. When the 2nd position of the four-way valve is in operation, the motor turns in the opposite direction. The pressure relief valve provides overload protection if, for example, the motor experiences an excessive torque load.

Analysis of Extending Speed Control

During the extension stroke, if the flow control valve is fully open, all the flow from the pump goes to the cylinder to produce maximum cylinder speed. As the flow control valve is partially closed its pressure drop increases. This causes an increase in pressure p1. Continued closing of the flow control valve ultimately results in pressure p1 reaching and exceeding the cracking pressure of the pressure relief valve (PRV). The result is a slower cylinder speed since part of the pump flow goes back to the oil tank through the PRV setting and the amount of pump flow that is not desired by the cylinder flows through the PRV. An analysis to determine the extending speed is given as follows:

The flow rate to the cylinder equals pump flow rate minus the flow rate through the PRV.

$$Qcyl = Qpump – QPRV$$

The flow rate through the flow control valve (FCV) is governed by

$Q_{FCV} = C_V \sqrt{\Delta P / S_g} = C_V \sqrt{(p_1 - p_2) / S_g}$

Where ΔP = pressure drop across FCV

C_V = capacity coefficient of FCV

S_g = specific gravity of oil

Pressure $p_1 = p_{PRV}$ = Relief valve pressure setting

Also, pressure $p_3 = 0$ (ignoring small frictional pressure drop in drain line from rod end of cylinder to oil tank).

Pressure p_2 can be obtained by summing forces on the hydraulic cylinder.

$p_2 A_{piston} = F_{load}$ or $p_2 = F_{load} / A_{piston}$ ---(a)

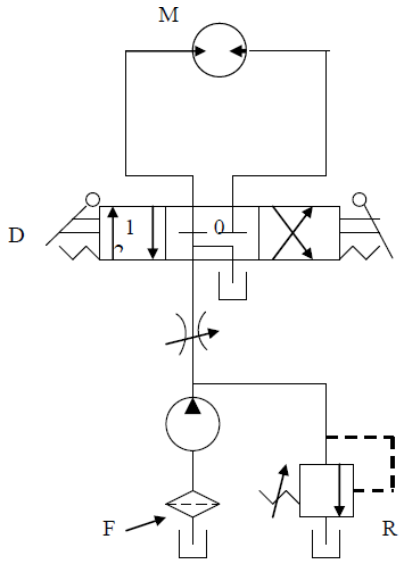
Finally the extending speed of the cylinder is found.

$V_{cyl} = Q_{cyl} / A_{piston} = Q_{FCV} / A_{piston}$ ------ (b)

using Eqs. (a) and (b) yields the final result.

$$V_{cyl} = \frac{C_v}{A_{piston}} \sqrt{\frac{P_{PRV} - F_{load} / A_{piston}}{S_g}} \qquad \text{------ (1)}$$

As can be seen by Eq. 1, by varying the setting of the flow control system, and thus the value of CV, the desired extending speed of the cylinder can be achieved



Speed control of Hydraulic motor using Flow control valve.

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Experiment No. | | | **Date:** | | | | | |

Design and Simulation of a Hydraulic Shaper

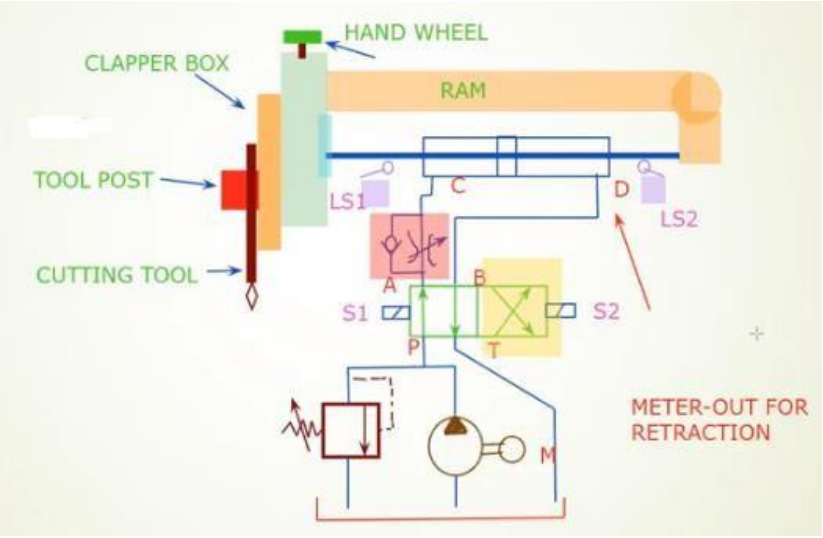
Aim:- Design and Simulation of a Hydraulic Shaper

The shaper is a reciprocating type of machine, basically used to produce flat surfaces and many more

INTRODUCTION

The shaper is a reciprocating type of machine tool intended primarily to produce flat surfaces. These surfaces may be horizontal, vertical, or inclined. In general the shaper can produce any surface compost of straight line element. Modern shaper can generate contoured surface. The metal working shaper was developed in the year 1836 by James Nasmyth an, Englishman.

A shaper is a type of machine tool that uses linear relative motion between the work piece and a single-point cutting tool to machine a linear tool path. Its cut is analogous to that of a lathe, except that it is (archetypal) linear instead of helical. (Adding axes of motion can yield helical tool paths, as also done in helical planning.) A shaper is analogous to a planer, but smaller, and with the cutter riding a ram that moves above a stationary work piece, rather than the entire work piece moving beneath the cutter. The ram is moved back and forth typically by a crank inside the column; actuated shapers also exist.



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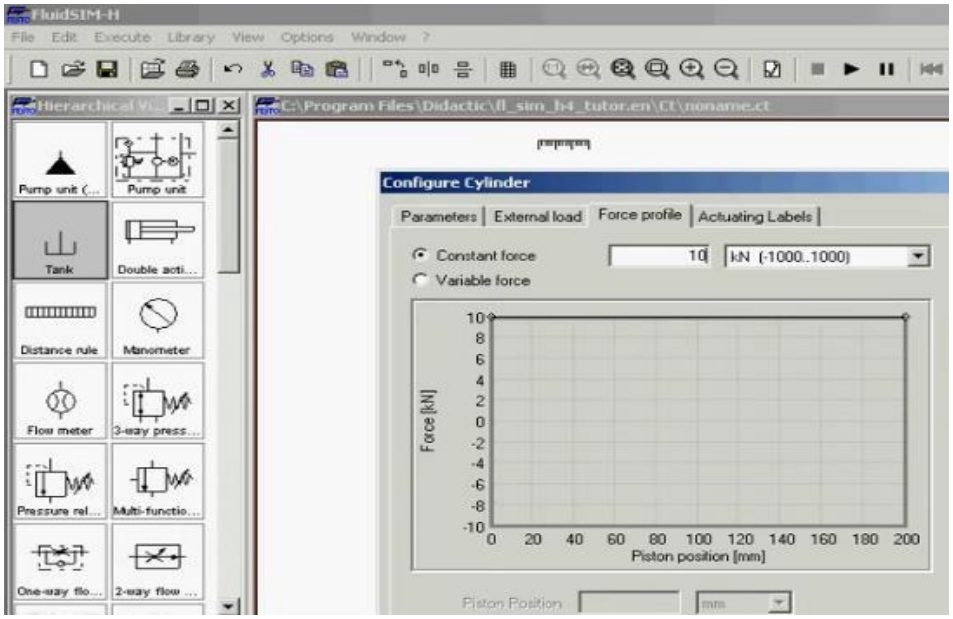

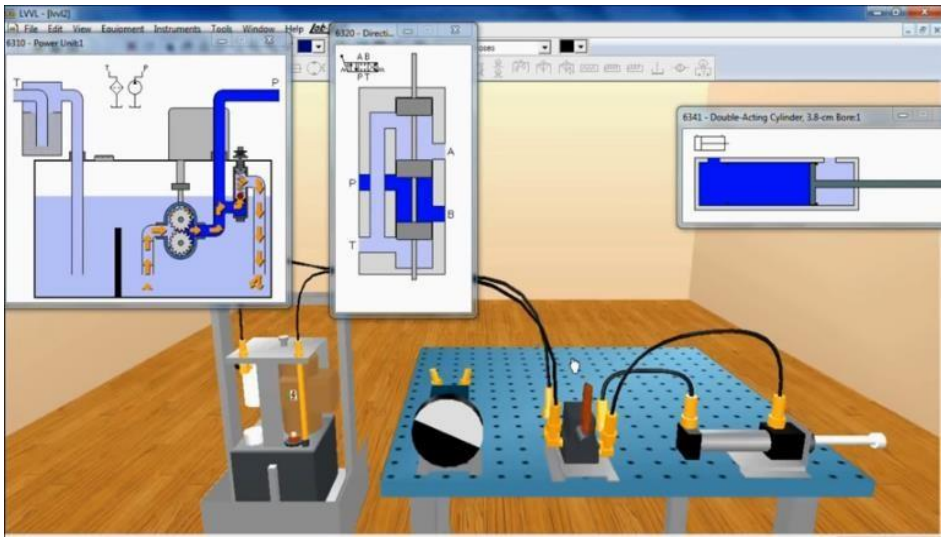

Result: Hence the Design and Simulation of a Hydraulic Shaper has been done by using fluid- sim software

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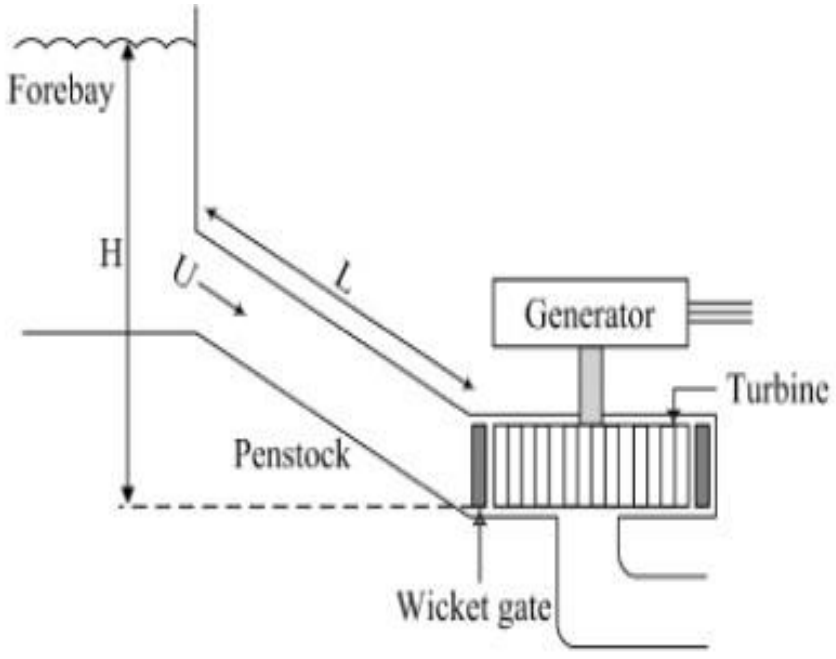
Experiment No. **Date:**

Design and Simulation of a Hydro Electric Circuit for simple application

Aim: - Design and Simulation of a Hydro Electric Circuit for simple application

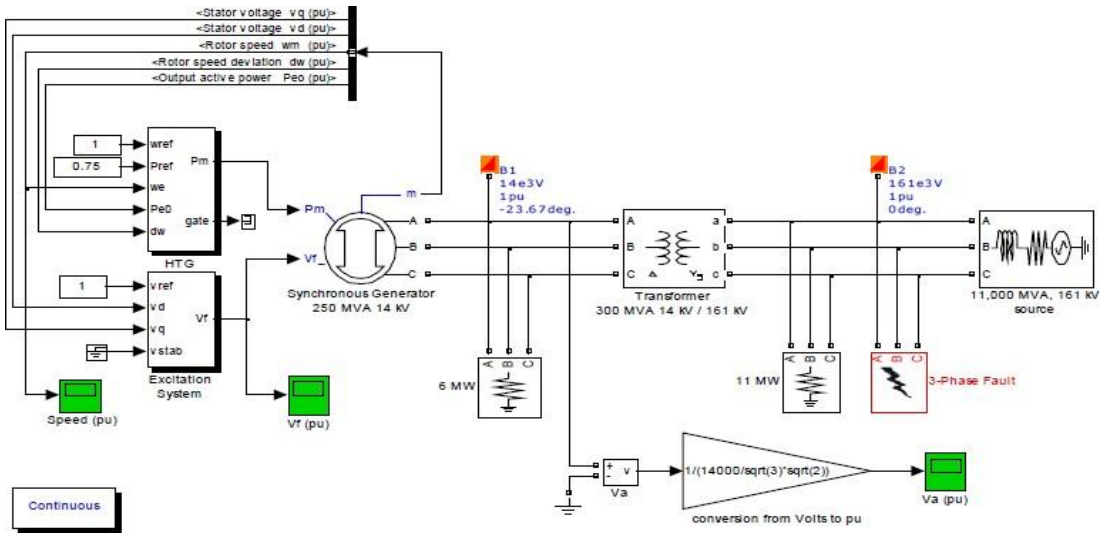
INTRODUCTION

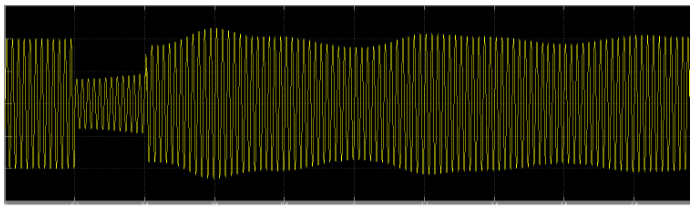
Hydropower plants convert the potential energy of water head to mechanical energy by using a hydraulic turbine. The hydro-turbines are in turn connected to a generator that converts the mechanical energy to electric energy. Later describe the main components of a hydropower plant The hydropower plant is basically made of a generator, a turbine, a penstock and wicket gates. Generally, two types of turbines are used: impulse turbine for instance Pelton Wheel turbine and reaction turbine like Francis and Kaplan turbine. The generator and turbine are mostly connected directly by a vertical shaft. The existence of high head produces fast-flowing water that flows through the penstock and arrives to the turbine. The flow of water into the turbine is controlled by the wicket gates. Wicket gates can be adjusted together with the opening of pivot around the periphery of the turbine to control the quantity of water that flows into the turbine. Servo- actuators, controlled by the governor, help to adjust these gates.



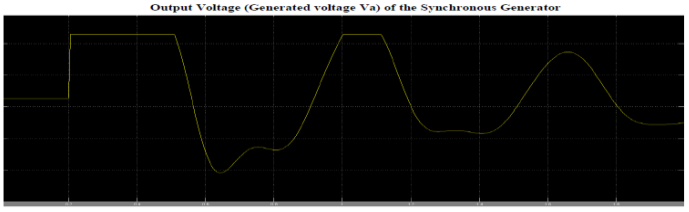
Components of a Hydropower plant

The water drives the turbine-generator set and the rotating generator produces electricity. At the initial stage, the stored water with clear hydraulic head possesses potential energy. As it flows through the penstock it gradually loses potential energy and gain kinetic energy before reaching the turbine. A critical look at the process of energy generation by hydropower plant shows that hydropower plant models are

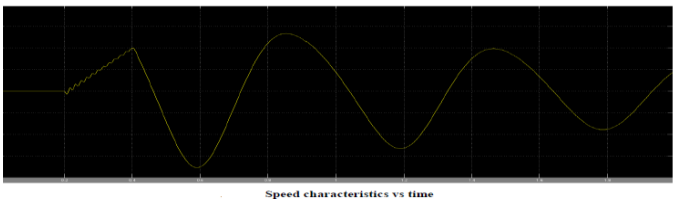




Output Voltage (Generated voltage Va) of the Synchronous Generator



Excitation voltage (Vf)



Speed characteristics vs time

To analyze the simulation results, three graphs have been plotted: the speed characteristic, the output characteristic and the excitation voltage with respect to time. The reliability of the hydropower plant can only be tested by the plant's capacity of overcome fault quickly and effectively. For this matter we introduced a short-circuit fault into the system in order to analyze its response and conclude on the reliability.

Result: Hence the simulation model of Hydro power plant has been done using mat lab and simulink software