I

Name_____

Roll No._____Year20__20_____

Exam Seat No._____

MECHANICAL GROUP| SEMISTER VI | DIPLOMA IN ENGINEERING AND TECHNOLOGY

A LABORATORY MANUAL

FOR

Industrial Hydraulics And Pneumatics (22655)

(ME)

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI

(Autonomous) (ISO 9001 : 2015) (ISO / IEC 27001 : 2013)

A Laboratory Manual for

Industrial Hydraulics and Pneumatics

(22655)

Semester – VI

(Diploma in Mechanical Engineering)

Maharashtra State
Board of Technical Education, Mumbai
(Autonomous) (ISO-9001-2008) (ISO/IEC 27001:2013)

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4th Floor, Government Polytechnic Building, 49, Kherwadi,
Bandra (East), Mumbai -400051.

(Printed on November 2019)

Maharashtra State
Board of Technical Education

Certificate

This is to certify that Mr. / Ms …….

Roll No…….of Sixth Semester of Diploma in

…….of Institute

……..

has completed the term work satisfactorily in **Industrial Hydraulics and Pneumatics(22655)** for the academic year 20…….to 20…..... as prescribed in the curriculum.

Place …… Enrollment No……

Date:…..... Exam Seat No. …….....

Course Teacher **Head of the Department** **Principal**

Seal of the Institute

Preface

The primary focus of any engineering laboratory/ field work in the technical education system is to develop the much needed industry relevant competencies and skills. With this in view, MSBTE embarked on this innovative 'I' Scheme curricula for engineering diploma programmes with outcome-base education as the focus and accordingly, relatively large amount of time is allotted for the practical work. This displays the great importance of laboratory work making each teacher; instructor and student to realize that every minute of the laboratory time need to be effectively utilized to develop these outcomes, rather than doing other mundane activities. Therefore, for the successful implementation of this outcome-based curriculum, every practical has been designed to serve as a ***'vehicle'*** to develop this industry identified competency in every student. The practical skills are difficult to develop through 'chalk and duster' activity in the classroom situation. Accordingly, the 'I' scheme laboratory manual development team designed the practical to ***focus*** on the ***outcomes***, rather than the traditional age old practice of conducting practical to 'verify the theory' (which may become a byproduct along the way).

This laboratory manual is designed to help all stakeholders, especially the students, teachers and instructors to develop in the student the pre-determined outcomes. It is expected from each student that at least a day in advance, they have to thoroughly read through the concerned practical procedure that they will do the next day and understand the minimum theoretical background associated with the practical. Every practical in this manual begins by identifying the competency, industry relevant skills, course outcomes and practical outcomes which serve as a key focal point for doing the practical. The students will then become aware about the skills they will achieve through procedure shown there and necessary precautions to be taken, which will help them to apply in solving real-world problems in their professional life.

This manual also provides guidelines to teachers and instructors to effectively facilitate student-centered lab activities through each practical exercise by arranging and managing necessary resources in order that the students follow the procedures and precautions systematically ensuring the achievement of outcomes in the students.

Hydraulic and pneumatic operated machines and equipment are widely used in various industries due to its versatility and adaptability to automation. Mechanical engineering technologists are required to maintain such systems in different segments of industries. This competency needs the knowledge of construction and working of different components of hydraulic and pneumatic systems. This course will give the students, the basic skills and knowledge to use and maintain different types of hydraulic systems and pneumatic systems

The Practical manual development team wishes to thank MSBTE who took initiative in the development of curriculum re-design project and implementation and also acknowledge the contribution of individual course experts who have been involved in laboratory manual as well as curriculum development (I scheme) directly or indirectly. The National Institute of Technical Teachers' Training and Research, Bhopal deserves our sincere appreciation for the guidance provided.

Although all care has been taken to check for mistakes in this laboratory manual, yet it is impossible to claim perfection especially as this is the first edition. Any such errors and suggestions for improvement can be brought to our notice and are highly welcome.

Programme Outcomes (POs) to be achieved through Practical of this Course

Following POs and PSO are expected to be achieved through the practicals of the (Industrial Hydraulics and Pneumatics) course.

PO 1. **Basic knowledge :** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based mechanical engineering problems
PO 2. **Discipline knowledge:** Apply mechanical engineering knowledge to solve broad-based mechanical engineering related problems.
PO 3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based mechanical engineering problems.
PO 4. **Engineering tools:** Apply relevant mechanical technologies and tools with an understanding of the limitations
PO 5. **The engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in field of mechanical engineering.
PO 6. **Environment and sustainability:** Apply mechanical engineering solutions also for sustainable development practices in societal and environmental contexts.
PO 7. **Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of mechanical engineering
PO 8. **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.
PO 9. **Communication:** Communicate effectively in oral and written form.
PO 10. **Life-long learning:** Engage in independent and life-long learning activities in the context of technological changes also in the mechanical engineering and allied industry.

Program Specific Outcomes (PSOs)

PSO 1: Modern Software Usage: Use latest mechanical related software for simple design, drafting, manufacturing, maintenance and documentation of mechanical components and processes.

PSO 2: Maintenance and selection of machines, equipment, instruments: Maintain and select appropriate machine, equipment and instrument in field of Mechanical Engineering.

PSO 3: Manage Mechanical Process: Manage the mechanical process by selection and scheduling right type of machinery, equipment, substrates, quality control techniques, operational parameters and software for a particular mechanical process or job for economy of operations.

List of Industry Relevant Skills-

The following industry relevant skills of the competency '**Use different types of hydraulic and pneumatic systems for engineering applications**' are expected to be developed in you by undertaking the practical of this laboratory manual.

1. Identify various components of hydraulic & pneumatic systems.
2. Use pump and actuators for fluid operated systems.
3. Use control valves for fluid operated systems.
4. Use compressor and accessories for fluid operated systems.
5. Prepare different hydraulic and pneumatic circuits for simple applications.

****

Practical- Course Outcome matrix

	Course Outcomes (COs) **1.** Identify various components of hydraulic & pneumatic systems. **2.** Select pump and actuators for fluid operated systems. **3.** Select control valves for fluid operated systems. **4.** Select compressor and accessories for fluid operated systems. **5.** Develop different hydraulic circuits for simple applications. **6.** Develop different pneumatic circuits for simple applications						
S. No.	**Practical Outcome**	**CO a.**	**CO b.**	**CO c.**	**CO d.**	**CO e.**	**CO f.**
1.	Identify the components and Draw ISO symbols used in hydraulic and pneumatic system.	√	-	-	-	-	-
2.	Analyze the performance of Pump and Actuators mounted on hydraulic trainer.	-	√	-	-	-	-
3.	Analyze the performance of control valves used in hydraulics and pneumatics.	-		√	-	-	-
4.	Analyze the performance of compressor, FRL unit, special valves and accessories of pneumatics.	-		-	√	-	-
5.	Construct and actuate hydraulic circuit for SAC, DAC and Hydro motor for the given purpose.	-	-		-	√	-
6.	Construct and actuate Meter-in, Meter out Hydraulic circuit for the given purpose.	-	-		-	√	-
7.	Construct and actuate hydraulic circuit for the given sequencing of operations.	-	-		-	√	-
8.	Develop circuit for simple machine tool applications such as milling machine, shaper machine, grinding machine	-	-	-		√	-
9.	Maintain simple parts of mobile hydraulic system such as in earth moving equipment.	-	-	-		√	-
10.	Maintain simple parts of any one stationary hydraulic system such as in any machine tool.	-	-	-	-	√	-
11.	Maintain simple parts of any one stationary Pneumatic system such as in any machine tool.	-	-	-	-		√
12.	Construct and actuate Pneumatic circuit for SAC, DAC and Air motor for the given purpose.	-	-	-	-		√
13.	Construct and actuate speed control Pneumatic circuits for the given purpose.	-	-	-	-		√
14.	Construct and actuate indirect (pilot) control Pneumatic circuit for the given purpose.	-	-	-	-		√
15.	Construct and actuate Pneumatic circuit for the given sequencing of operations.	-	-	-	-	-	√
16.	Construct and actuate Pneumatic circuit for the given Logic functions (AND/OR/TIME DELAY)	-	-	-	-	-	√

Guidelines to Teachers

1. ***Teacher need to ensure that a dated log book*** for the whole semester, apart from the laboratory manual is maintained by every student which s/he has to ***submit for assessment to the teacher*** in the next practical session.
2. There will be two sheets of blank pages after every practical for the student to report other matters (if any), which is not mentioned in the printed practicals.
3. For difficult practicals if required, teacher could provide the demonstration of the practical emphasizing of the skills which the student should achieve.
4. Teachers should give opportunity to students for hands-on after the demonstration.
5. Assess the skill achievement of the students and COs of each unit.
6. One or two questions ought to be added in each practical for different batches. For this teachers can maintain various practical related question banks for each course.
7. If some repetitive information like data sheet, use of software tools etc. has to be provided for effective attainment of practical outcomes, they can be incorporated in Appendix.
8. For effective implementation and attainment of practical outcomes, teacher ought to ensure that in the beginning itself of each practical, students must read through the complete write-up of that practical sheet.
9. During practical, ensure that each student gets chance and takes active part in taking observations/ readings and performing practical.
10. Teacher ought to assess the performance of students continuously according to the MSBTE guidelines

Instructions for Students

1. For incidental writing on the day of each practical session every student should maintain a ***dated log book*** for the whole semester, apart from this laboratory manual which s/he has to ***submit for assessment to the teacher*** in the next practical session.
2. For effective implementation and attainment of practical outcomes, in the beginning itself of each practical, students need to read through the complete write-up including the practical related questions and assessment scheme of that practical sheet.
3. Student ought to refer the data books, IS codes, Safety norms, Electricity act/rules, technical manuals, etc.
4. Student should not hesitate to ask any difficulties they face during the conduct of practical.

Content Page

List of Practical and Progressive Assessment Sheet

12.	Construct and actuate Pneumatic circuit for SAC, DAC and Air motor for the given purpose.	81					
13.	Construct and actuate speed control Pneumatic circuits for the given purpose.	83					
14.	Construct and actuate indirect (pilot) control Pneumatic circuit for the given purpose.	95					
15.	Construct and actuate Pneumatic circuit for the given sequencing of operations.	102					
16.	Construct and actuate Pneumatic circuit for the given Logic functions (AND/OR/TIME DELAY)	108					
Total							

Note: To be transferred to Proforma of CIAAN-2017.

A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.

Practical No. 1 : Identify the components and Draw its ISO symbols used in hydraulic and pneumatic system

I Practical Significance

The various hydraulic and pneumatic components are arranged systematically in a general layout of hydraulic as well as pneumatic system. The hydraulic/ pneumatic trainer is a bench mounted system in which various components are mounted for performance of practical. They are designed for the practical purposes of exercising the proportional technology uses in hydraulics/Pneumatics. These allow the students to take an in-depth knowledge of working of hydraulics/Pneumatics. The trainers have the good frame design that separates them from other models.

II Relevant Program Outcomes (POs)

PO1 - **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic Engineering to solve the broad-based Mechanical Engineering problems.
PO3 - **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Mechanical Engineering problems.
PO4 -**Engineering tools:** Apply relevant mechanical technologies and tools with an understanding of the limitations.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency '**Use different types of hydraulic and pneumatic systems for engineering applications'*:***

1. Identify and draw ISO symbol of given hydraulic/pneumatic components

IV Relevant Course Outcome(s)

- Identify various components of hydraulic & pneumatic systems.

V Practical Outcome

Identify the components and Draw its ISO symbols used in hydraulic and pneumatic system

VI Relative Affective Domain-

- Practice good housekeeping.
- Practice energy conservation.
- Demonstrate working as a leader/a team member.

VII Minimum Theoretical Background

1. **General layout of hydraulic system**

The hydraulic systems consists a number of parts for its proper functioning. These include storage tank, filter, hydraulic pump, pressure regulator, control valve, hydraulic cylinder, piston and leak proof fluid flow pipelines. The schematic of a simple hydraulic system is shown in figure.

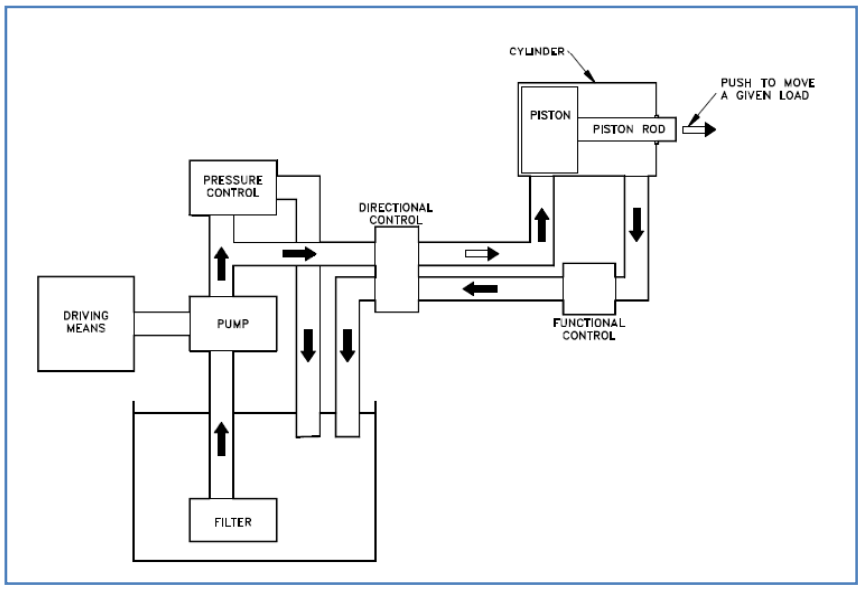

Figure 1 General Layout

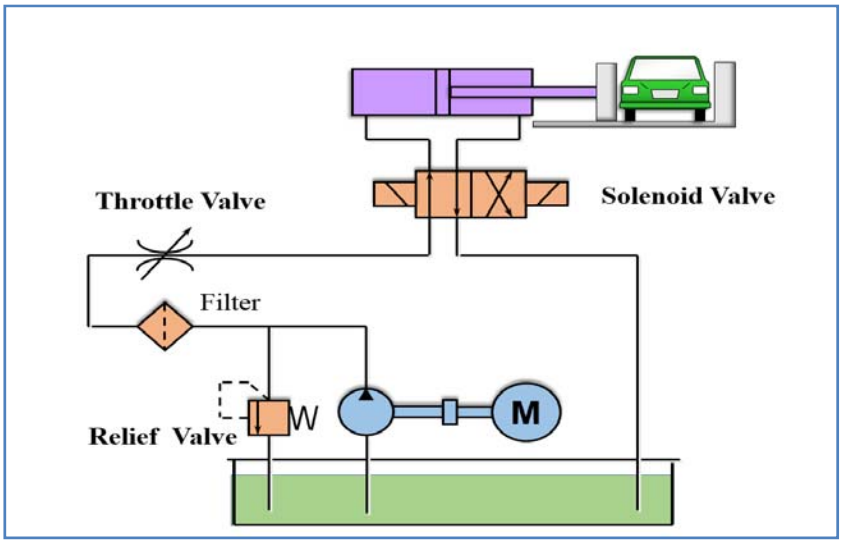

Figure 2. Symbolic layout

2. **General layout of Pneumatic system**

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.

The pneumatic systems consists of compressor unit, air receiver, filter, Air dryer, air servicing unit which includes Filter, Regulator and lubricator, Actuators, Muffler leak proof fluid flow pipelines. The schematic of a simple pneumatic system is shown in figure.

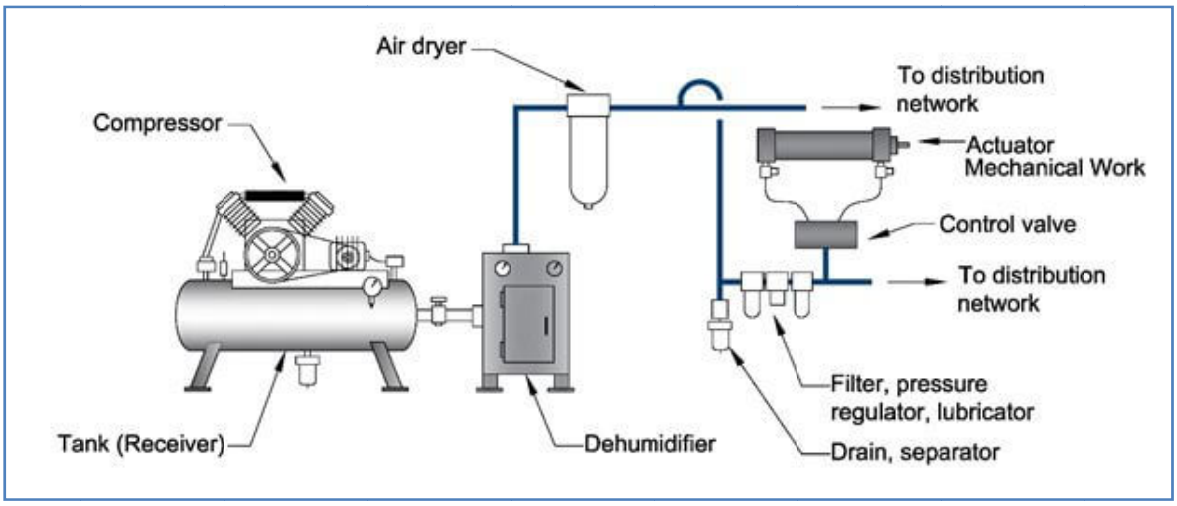

Figure 3 General Layout

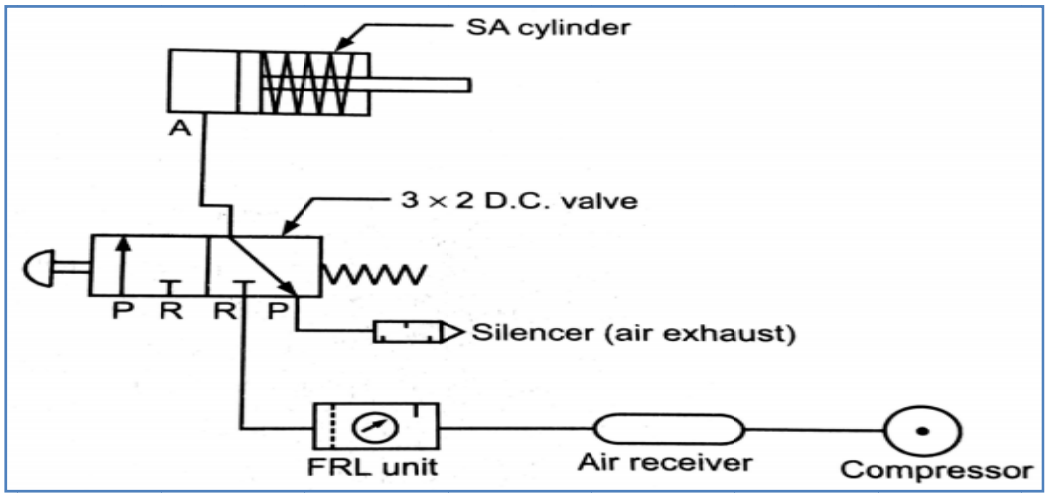

Figure 4 Symbolic layout

3. **ISO symbols of components**:
   The hydraulic and pneumatic elements such as cylinders and valves are connected through pipelines to form a hydraulic or a pneumatic circuit. It is difficult to represent the complex functioning of these elements using sketches. Therefore graphical symbols are used to indicate these elements. The symbols only specify the function of the element without indicating the design of the element. Symbols also indicate the actuation method, direction of flow of air and designation of the ports. Symbols are described in various documents like DIN24300, BS2917, ISO1219 and the new ISO5599, CETOP RP3 and the original American JIC and ANSI symbols. The symbol used to represent an individual element display the following characteristics:

- Function
- Actuation and return actuation methods
- Number of connections
- Number of switching positions
- General operating principle
- Simplified representation of the flow path

VIII Experimental setup

Fig No 5 Hydraulic Trainer

Fig No 6 Pneumatic Trainer

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Hydraulic trainer	Transparent /actual working components.	1
2.	Pneumatic trainer	Transparent/ actual working components.	1
3.	Models of pumps, cylinders, valves, other components	Working / actual	1
4.	Single /Multistage Reciprocating Compressor	pressure 0-10 bar	1

X Precautions to be Followed

1. Avoid improper/loose connections of components.
2. Do not forcefully connect to connectors to avoid the damage.

XI Procedure

1. Identify various components one by one referring general layout of hydraulic system.
2. Connect components as per general layout and run the system.
3. Write specification and function of each component.
4. Draw ISO symbol of identified component.

5. Identify various components one by one referring general layout of Pneumatic system.
6. Connect components as per general layout and run the system.
7. Write specification and function of each component.
8. Draw ISO symbol of identified component.

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

1. Hydraulic Trainer

S N	Component Name	Specification	Function	ISO Symbol
1	Pump	External gear Pump Pressure range: Flow: LPM		
2				
3				
4				

5				
6				
7				
8				

2. Pneumatic Trainer

S N	Component Name	Specification	Function	ISO Symbol
1	Compressor	Make: Pressure range: Drive:		
2				
3				
4				
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8				

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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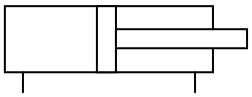
XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questionsso as to ensure the achievement of identified CO.

1. Identify the given symbols and name the components.

Symbol	Name of Component	Symbol	Name of Component
			

2. Identify load application system on UTM available in Strength of Material laboratory.
3. Identify components of hydraulic tractor trolley lifting mechanism.

[Space for Answer]

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XX References / Suggestions for Further Reading

1. https://www.youtube.com/watch?v=WOf9_ZIRFK8
2. https://www.youtube.com/watch?v=kiGR9a5n3RI
3. https://www.youtube.com/watch?v=kzqkPx8F3D8
4. https://www.youtube.com/watch?v=-iwttJ3ahFo

XXI Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the components	20%
2	Drawing of ISO symbols	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. ……..
2. ……..
3. ……..

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total (25)**	

Practical No. 2 : Analyse The Performance Of Pump And Actuators Mounted On Hydraulic Trainer.

I Practical Significance

Pump of hydraulic system is the power source for supplying high pressure oil.Selection of hydraulic pump depends upon pressure generated, flow rate or discharge of oil, speed and efficiency of the pump.The proper selection of a hydraulic actuator requires the consideration of numerous factors influenced by the expected application. Those factors include the amount of force required; cylinder/motor mounting style, stroke length, speed, operating pressure, direction of force, and means of stopping the work load after it is put in motion.

II Relevant Program Outcomes (POs)

PO1 - **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic Engineering to solve the broad-based Mechanical Engineering problems.

PO2 - Discipline knowledge: Apply mechanical engineering knowledge to solve broad-based mechanical engineering related problems.

PO3 - **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Mechanical Engineering problems.

PO8 -**Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency **'Use different types of hydraulic and pneumatic systems for engineering applications'***:*

1. Select hydraulic pump and actuator for given application

IV Relevant Course Outcome(s)

Select pump and actuators for fluid operated systems

V Practical Outcome

Analyse the function of Pump and Actuators mounted on hydraulic trainer

VI Relative Affective Domain-

- Practice energy conservation.
- Demonstrate working as a leader/a team member.

VII Minimum Theoretical Background

Hydraulic pump: The hydraulic pumps are characterized by its flow rate capacity, power consumption, drive speed, pressure delivered at the outlet and efficiency of the pump. The pumps are not 100% efficient. The efficiency of a pump can be specified by volumetric efficiency and power efficiency which is the ratio of output hydraulic

power to the input mechanical/electrical power. The typical efficiency of pumps varies from 90-98%.

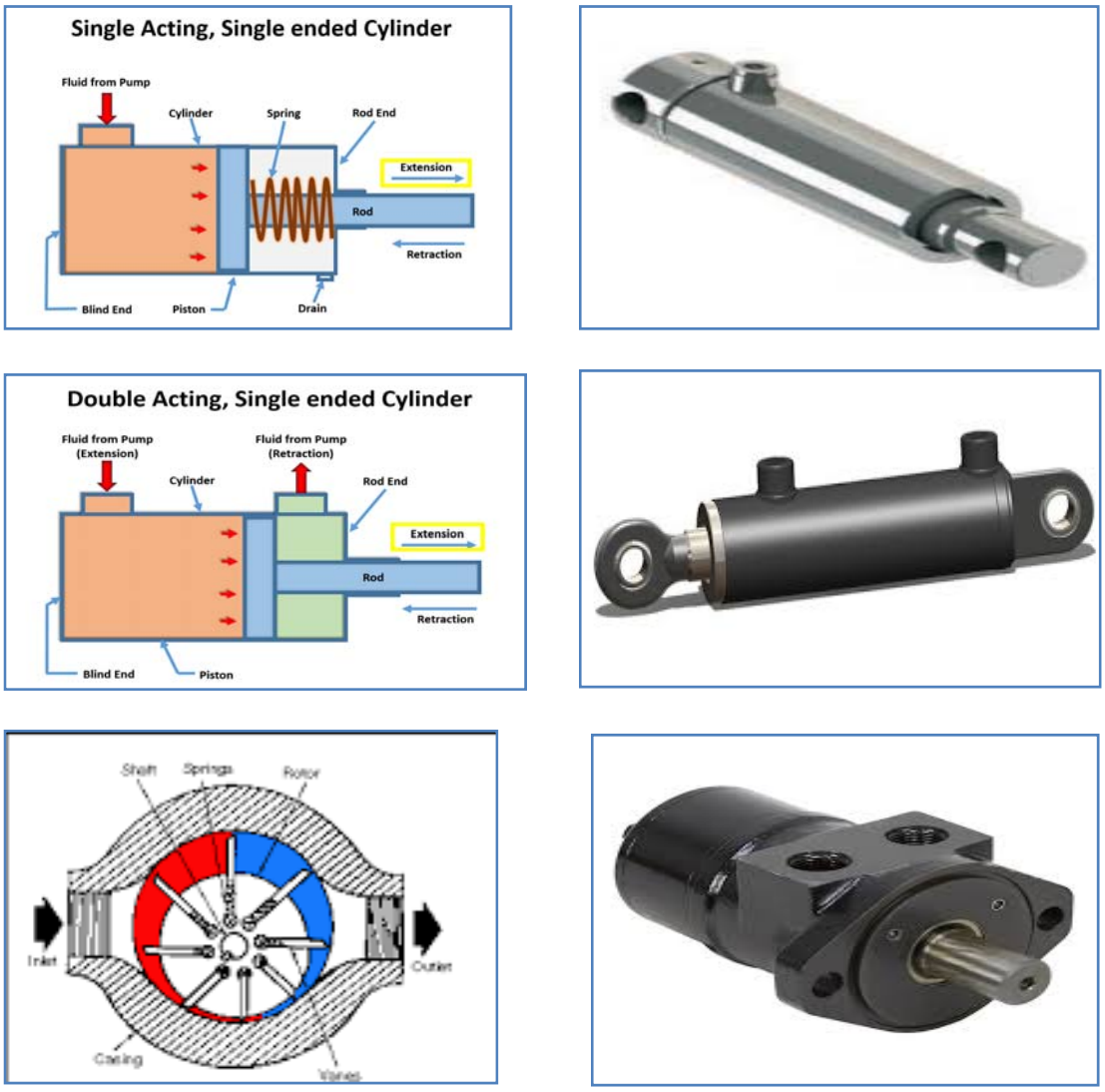
Actuators: In general, hydraulic or pneumatic systems are used for gripping and/or moving operations in industry. These operations are carried out by using actuators.

Actuators can be classified into three types.

1. **Linear actuators:** These devices convert hydraulic/pneumatic energy into linear motion.
2. **Rotary actuators:** These devices convert hydraulic/pneumatic energy into rotary motion.

The construction of hydraulic and pneumatic linear actuators is similar. However they differ at their operating pressure ranges. Typical pressure of hydraulic cylinders is about 100 bars and of pneumatic system is around 10 bar.

VIII Experimental setup



Hydraulic Motor

Fig.1 Hydraulic Actuators

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	**Hydraulic trainer**	Transparent /actual working components. 1. Gear or Vane pump with electric motor 2. Pressure relief valve 3. Pressure gauges 4. Flow control valve with check valve 5.Pressure reducing Valve 6. Sequence valve 7. Set of D.C.Valves 8. Actuators 9.Flowmeter 10.Tachometer	1

X Precautions to be Followed

1. Avoid improper/loose connections of components.
2. Do not forcefully connect to connectors to avoid the damage.

XI Procedure

1. Initially check the level of hydraulic oil to ensure adequate oil in the tank.
2. Make connections of pump discharge to the pressure gauge and flow meter.
3. Allow the trainer in ON position for 5 minutes for initial warm-up.
4. Note down the pressure and Flow rate generated by the pump.
5. Make necessary connections to the actuators like S.A.Cylinder, D.A.Cyinder, Hydraulic motors
6. Tabulate the readings.
7. Calculate forces developed during forward and return strokes of cylinders.
8. Measure speed of hydro motor using tachometer.

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

1. Pump

S.N.	Type of pump	Specification	Pressure developed(kg/cm²)	Flow rate (LPM)
1				
2				

2. Actuators

Hydraulic cylinder (specifications)

Stroke length:_____

Cylinder bore Diameter:_____

Piston rod diameter:_____

S.N.	Type of Actuator	No. of ports	Specification	Oil Pressure (kg/cm²)	Output Motion observed
1					
2					
3					

Hydraulic Motor

S.N.	Type of Actuator	No. of ports	Specification	Oil Pressure (kg/cm²)	Output Motion observed
1					
2					

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1 List pumps in ascending order according to the pressure developed by the pumps.
2 Write mounting methods of hydraulic cylinders.
3 Identify actuators in a. Hydraulic press machine 2.JCB arm

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XX References / Suggestions for Further Reading

1. https://www.youtube.com/watch?v=-x7XYLj6Jhg
2. https://www.youtube.com/watch?v=Zc13A6xJLKE
3. https://www.youtube.com/watch?v=O_2BZs3WiQY
4. https://www.youtube.com/watch?v=j8ALHGOQTQ0

XXI Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the components on trainer	20%
2	Observation of readings	10%
3	Calculation of final readings	10%
Product Related (15 Marks)		**(60%)**
4	Interpretation of result	20%
5	Conclusions	20%
6	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total (25)**	

Practical No. 3 : Analyze The Performance Of Control Valves Used In Hydraulics Pneumatics.

I Practical Significance

A hydraulic system can only function as per requirements by using control valves. Therefore correct type of hydraulic valve is to be selected to serve intended purpose. The selection of control valves depends upon the parameters to be controlled like pressure, flow and direction of medium used.

II Relevant Program Outcomes (POs)

PO1 - **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic Engineering to solve the broad-based Mechanical Engineering problems.

PO2 - **Discipline knowledge:** Apply mechanical engineering knowledge to solve broad-

Based mechanical engineering related problems.

PO3 - **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Mechanical Engineering problems.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency **''Use different types of hydraulic and pneumatic systems for engineering applications'**

1. Compare different types of control valves
2. Select control valves for relevant application

IV Relevant Course Outcome(s)

Select control valves for fluid operated systems.

V Practical Outcome

Analyze the performance of control valves used in hydraulics & pneumatics

VI Relative Affective Domain-

- Demonstrate working as a leader/a team member.

VII Minimum Theoretical Background

Pressure control valves: The most common types of pressure control valves are the pressure relief valve and the pressure reducing valve.

Directional control valves: They can control the start, stop and change in direction of flow of a pressure medium (i.e. hydraulic oil).

Flow control valves: It can manage the flow by decreasing or increasing the opening at the throttling point. This helps to determine speed of movement for the hydraulic actuators.

Pressure regulators: They are commonly called pressure-reducing valves; maintain constant output pressure in compressed-air systems regardless of variations in input pressure or output flow.

VIII Experimental setup

Pressure relief valve

D.C.valve

Flow control valve

pressure regulator

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Hydraulic trainer	Transparent /actual working components. 1. Pressure relief valve 2. Flow control valve with check valve 3.Set of D.C.Valves	1
2.	Pneumatic trainer	Transparent /actual working components. 1. Pressure regulator 2. Flow control valve 3.Set of D.C.Valves	1

X Precautions to be Followed

1. Avoid improper/loose connections of components.
2. Do not forcefully connect to connectors to avoid the damage.

XI Procedure

1. Initially check the level of hydraulic oil to ensure adequate oil in the tank.
2. Make connections.
3. Allow the trainer in ON position for 5 minutes for initial warm-up.
4. Note down the pressure and flow rate generated by the pump.
5. Make necessary connections to the actuators like S.A.Cylinder, D.A.Cyinder, Hydraulic motors
6. Tabulate the readings.
7. Calculate forces developed during forward and return strokes of cylinders.
8. Measure speed of hydro motor using tachometer.

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

- **Pressure relief valve**

S.N.	Type of valve	Specification	Pressure set(kg/cm²)	Observed reading (kg/cm²)
1				
2				

- **D.C. Valve**

a. Type of Actuator: S.A. Cylinder or_____

S.N.	Type of control (Lever/Push button/any other)	No. of ports and position	Actuated Position	Actuator movement (Direction)
1				
2				

b. Type of Actuator: D.A. Cylinder or_____

S.N.	Type of actuation	No. of ports and position	Actuated Position	Actuator movement (Direction)
1				
2				

- **Flow control Valve**
  Stroke length of actuator: _____ mm

S N	Setting level	Flow(LPM)	Time for piston movement(T) Sec	Actuator speed observed(L/T)mm/sec
1	Fully open			
2	50% open			

- **Pressure regulator**

S.N.	Type of regulator	Specification	Pressure set(kg/cm²)	Observed reading (kg/cm²)
1				
2				

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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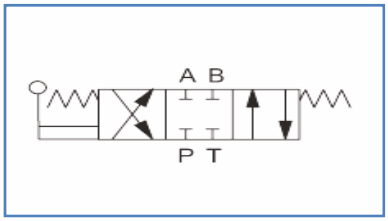
XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Select control valve for safety of hydraulic system against overload.
2. State the difference between 3/2 and 4/2 D.C.valve

3. Identify given symbol and state its practical application.



[Space for Answer]

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XX References / Suggestions for Further Reading

1. Pressure regulator: https://www.youtube.com/watch?v=Kf3xc1BGYGo
2. PRV:https://www.youtube.com/watch?v=vfz_CM0ygs4
3. DCV:https://www.youtube.com/watch?v=o-A_9nFpzek
4. DCV:https://www.youtube.com/watch?v=yIot4shcOkE
5. DCV:https://www.youtube.com/watch?v=leCy8Gb2k6U
6. FCV:https://www.youtube.com/watch?v=iFlPta8vaIk
7. FCV:https://www.youtube.com/watch?v=rgyWfN86uQU

XXI Assessment Scheme

Performance Indicators		Weightage
Process Related (40%)		
1	Handling of the components on trainer	10%
2	Observation of readings	30%
Product Related (60%)		
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total	100 %

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total (25)**	

Practical No. 4 : Analyze The Performance Of Compressor, FRL unit, Special Valves And Accessories Of Pneumatics.

I Practical Significance

Pneumatic system operates mainly using compressor, FRL unit and special valves to perform specific application. Selection of compressor is depends upon pressure requirement, air flow rate and other factors. Proper functioning of FRL unit is essential for efficient performance of pneumatic system. Selection of special valves like shuttle valve, Twin pressure valve is important for specific use in the pneumatic system.

II Relevant Program Outcomes (POs)

PO1 - **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic Engineering to solve the broad-based Mechanical Engineering problems.

PO3 - **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Mechanical Engineering problems.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency **'Use different types of hydraulic and pneumatic systems for engineering applications'**

1. Use of compressor, FRL unit, special valves and accessories of pneumatics.

IV Relevant Course Outcome(s)

- Select compressor and accessories for fluid operated systems.

V Practical Outcome

- Analyze the performance of compressor, FRL unit, special valves and accessories of pneumatics.

VI Relative Affective Domain-

- Follow safety practices.
- Practice good housekeeping.
- Practice energy conservation.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

VII Minimum Theoretical Background

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. The compressor can be classified into two main types a. Positive displacement compressors and b. Dynamic displacement compressor..

Air leaving a compressor is hot, dirty, and wet—which can damage and shorten the life of downstream equipment, such as valves and cylinders. Before air can be used it needs to be filtered, regulated and lubricated.

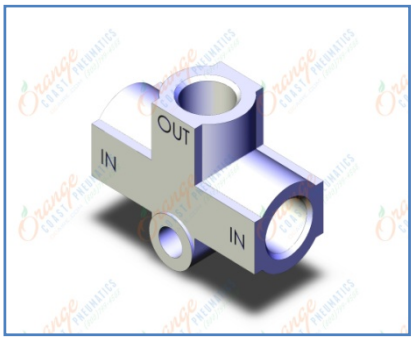
Special control valves includes **1.Shuttle valve:** It is known as OR gate valve or double check valve. It may be installed, for example, when a power unit (cylinder) or control unit (valve) is to be actuated from two points, which may be remote from one other.

2. **Twin pressure valve:** This valve is the pneumatic AND valve. It is also derivate of Non Return Valve. A two pressure valve requires two pressurized inputs to allow an output from itself.

VIII Experimental setup

Compressor unit

FRL unit



Shuttle valve

Twin pressure Valve

Figure No 1

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	**Pneumatic trainer**	Transparent /actual working components. 1. Compressor unit 2. FRL unit 3. Pressure gauges 4. Set of D.C.valves 5. Shuttle valve 6. Twin pressure valve 6. Actuators	1

X Precautions to be Followed

1. Avoid improper/loose connections of components.
2. Do not forcefully connect to connectors to avoid the damage.

XI Procedure

1. Connect compressor with power supply and Switch 'ON' unit
2. Run the compressor for specific period to develop pressure in the receiver.
3. Note down readings of pressure gauge.
4. Connect discharge pipe of compressor to the inlet of FRL unit.
5. The outlet of the FRL unit is to be connected to the manifold to supply air to the system.
6. Note down specifications of FRL unit.
7. Identify special valves on trainer kit.
8. Note down specifications of special valves.
9. Identify accessories like hoses, muffler available on trainer.
10. Note down their specifications.

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

1. Compressor

S.N.	Type of Compressor	Specifications	Speed of the motor	Pressure developed (kg/cm^2)
1				
2				

2. FRL Unit

S.N.	Element	Specifications	Operating range/capacity	Symbol
1	Filter			
2	Regulator			
3	Lubricator			

3. Special valves

S.N.	Type	Specifications (make)	Symbol	Output condition
1	Shuttle valve			
2	Twin pressure valve			
3				

4. Accessories

S.N.	Type	Specifications (make)	Symbol	Function
1				
2				
3				

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Write truth table of Shuttle valve and Twin pressure valve.
2. State the problems may occur if FRL unit may be connected in wrong manner.

[Space for Answer]

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XX References / Suggestions for Further Reading

1 Compressor: https://www.youtube.com/watch?v=bJluUxA7aaY
2 FRL unit: https://www.youtube.com/watch?v=QilLtDMXO1I
3 Shuttle Valve :https://www.youtube.com/watch?v=89_FEDe34tc
4 Twin pressure Valve:https://www.youtube.com/watch?v=mu1C_1NJIhQ
5 Accessories; https://www.youtube.com/watch?v=-9EIkxc9Cc0

XXI Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
	Handling of the components on trainer	10%
	Observation of readings	30%
Product Related (15 Marks)		**(60%)**
	Interpretation of result	20%
	Conclusions	20%
	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total (25)**	

Practical No. 5 : Construct and Actuate Hydraulic Circuit For SAC, DAC and Hydromotor For The Given Purpose

I. Practical Significance

A hydraulic control system is used to control position / speed of a load and provide necessary force for doing work. This is achieved by designing and building appropriate hydraulic circuits required for operating some kind of a hydraulic machine or hydraulic power system. Hydraulic circuits are used for various applications like material handling, agricultural equipments, machine tools, earth moving equipements, etc.

II. Relevant Program Outcomes (POs)

PO1 - Basic knowledge: Apply knowledge of basic mathematics, sciences and basic Engineering to solve the broad-based Mechanical Engineering problems.

PO 2 -Discipline knowledge: Apply mechanical engineering knowledge to solve broad-

Based mechanical engineering related problems

PO3 - Experiments and practice: Plan to perform experiments and practices to use the results to solve broad-based Mechanical Engineering problems.

III. Competency and Skills

This practical is expected to develop the following skills for the industry identified competency **'Use different types of hydraulic and pneumatic systems for engineering applications***':*

1. Select components for given hydraulic circuit.
2. Construct circuit for relevant application.

IV. Relevant Course Outcome(s)

a. Develop different hydraulic circuits for simple applications.

V. Practical Outcome

- Construct and actuate hydraulic circuit for SAC, DAC and Hydromotor for the given purpose

VI. Relative Affective Domain-

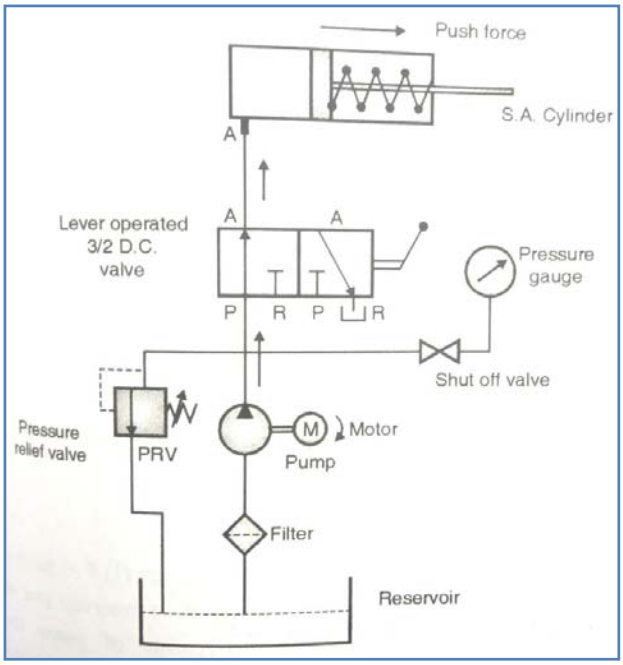
- Demonstrate working as a leader/a team member.

VII. Minimum Theoretical Background

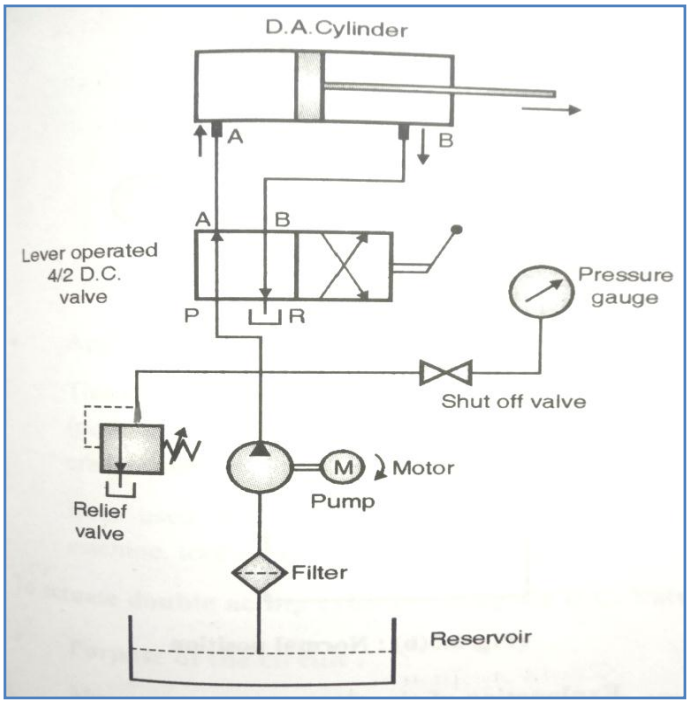
A hydraulic circuit consists of symbolic connections of various components like reservoir, pump, actuator, motor, pipes, hoses, clamps, accumulator, valves, intensifier etc. These components can be arranged in number of ways to get the desired output from the hydraulic circuit. There may be different types of hydraulic circuits as per the selection of an actuator in the circuit.

VIII. Experimental setup

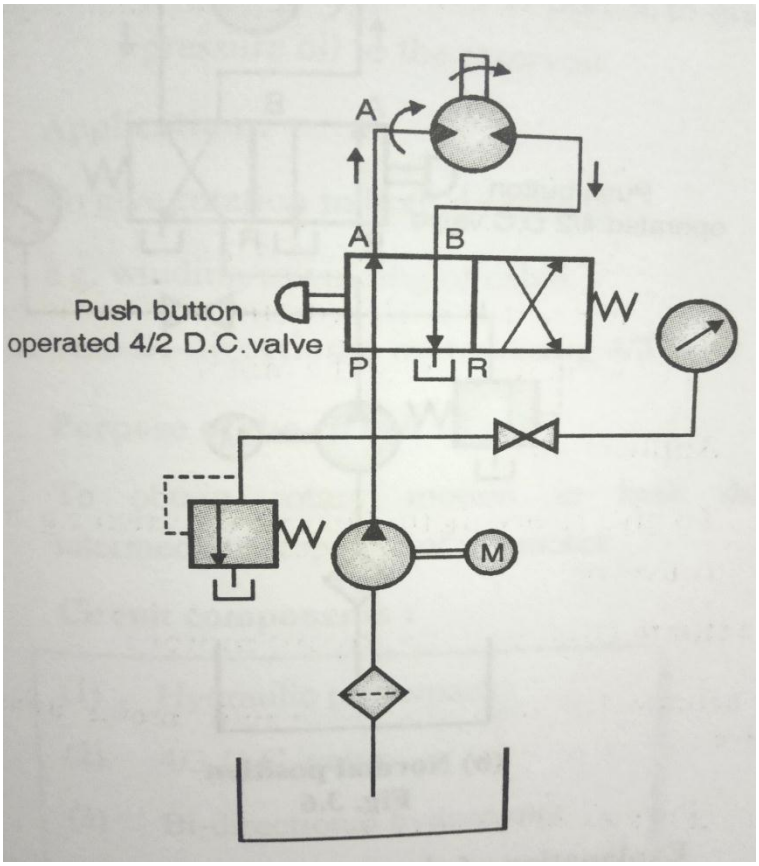
1. Circuit diagram for actuation of Single acting Cylinder



2. Circuit diagram for actuation of Double acting Cylinder



3. Circuit diagram for actuation of Bi- directional Hydraulic motor



IX. Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
•	**Hydraulic trainer**	Transparent /actual working components. 1. S A Cylinder of suitable stroke length 2. D A Cylinder of suitable stroke length 3. Unidirectional/Bidirectional Hydro motor	1

X. Precautions to be Followed

i. Avoid improper/loose connections of components.
ii. Do not forcefully connect to connectors to avoid the damage.
iii. Connections should never be made while the machine is running.
iv. If difficulty is encountered while attempting to make a connection, make sure that the machine is off and that the lines are not under pressure.
v. Any oil spills should be cleaned up immediately.

XI. Procedure

1. Initially check the level of hydraulic oil to ensure adequate oil in the tank.
2. Make connections as per circuit diagram.

3. Allow the trainer in ON position for 5 minutes for initial warm-up.
4. Note down the pressure and flow rate generated by the pump.
5. Make necessary connections to the actuators like S.A.Cylinder, D.A.Cylinder, Unidirectional /Bi-directional Hydraulic motor
6. Change PRV setting and oil pressure.
7. Tabulate the readings using tachometer, stop watch

XII. Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
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II					

XIII. Actual Procedure Followed

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XIV. Precautions Followed

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XV. Observations and Calculations

1. Actuation of SA Cylinder

SR No	Stroke length(mm)	Oil pressure (Kg/cm²)	Type of DC Valve	Type of Movement	Time in sec	Linear velocity (mm/sec)
1						
2						
3						
4						

2. Actuation of DA Cylinder

SR No	Stroke length(mm)	Oil pressure (Kg/cm²)	Type of DC Valve	Type of Movement	Time in sec	Linear velocity (mm/sec)
1						
2						
3						
4						

3. Actuation of Hydraulic motor

SR No	Type	Oil pressure (Kg/cm^2)	Type of DC Valve	Type of Movement	Angular Velocity(RPM)
1					
2					
3					
4					

Calculations:

XVI. Results

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XVII. Interpretation of Results

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XVIII. Conclusions

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XIX. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. List practical applications of SA Cylinder in hydraulic equipments.
2. List practical applications of hydro motor in hydraulic equipments.
3. identify the actuators in following application
   a. Hospital bed lifting mechanism b. Hydraulic press

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XX References / Suggestions for Further Reading

1. S A Cylinder circuit: https://www.youtube.com/watch?v=VfqCMqwJJK0
2. D A Cylinder circuit:https://www.youtube.com/watch?v=oCp-PNupoEU
3. Hydraulic motor circuit:https://www.youtube.com/watch?v=-ro_unB-XL4

XXI Assessment Scheme

Performance Indicators		Weightage
Process Related (15 Marks)		**(40%)**
1	Handling of the components on trainer	20%
2	Observation of readings	20%
Product Related (10 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1 ……..

2 …….

3 ……

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total (25)**	

Practical No. 6 : Construct And Actuate Meter-In, Meter Out Hydraulic Circuit For The Given Purpose

I Practical Significance

It is necessary to vary or change the speed of an actuator in most of machine tools and other mechanical equipments in order to increase their versatility. Speed control circuits finds applications in milling machines, Shaper machines, Broaching machines, etc.

II Relevant Program Outcomes (POs)

PO1 - **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic Engineering to solve the broad-based Mechanical Engineering problems.

PO 2 - **Discipline knowledge:** Apply mechanical engineering knowledge to solve broad-

Based mechanical engineering related problems

PO3 - **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Mechanical Engineering problems.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency **'Use different types of hydraulic and pneumatic systems for engineering applications***':*

1. Select components for given hydraulic circuit.
2. Construct circuit for relevant application

IV Relevant Course Outcome(s)

b. Develop hydraulic circuits for speed control applications.

V Practical Outcome

- Construct and actuate Meter-in, Meter-out hydraulic circuit for the given purpose.

VI Relative Affective Domain-

- Practice good housekeeping.
- Practice energy conservation.

VII Minimum Theoretical Background

The speed control circuits needs flow control valve at appropriate place in the circuit. Flow control valve with check valve are used to control flow of oil in the circuit. There are three methods of speed control circuits as per the location of flow control valve in the circuit.

a. **Meter-in speed control circuit**: FCV is placed before the inlet of an actuator.
b. **Meter-out speed control circuit**: FCV is placed after the outlet of an actuator.
c. **Bleed off/By-pass speed control circuit**: FCV is placed after the pump to divert flow to the reservoir.

VIII Experimental setup

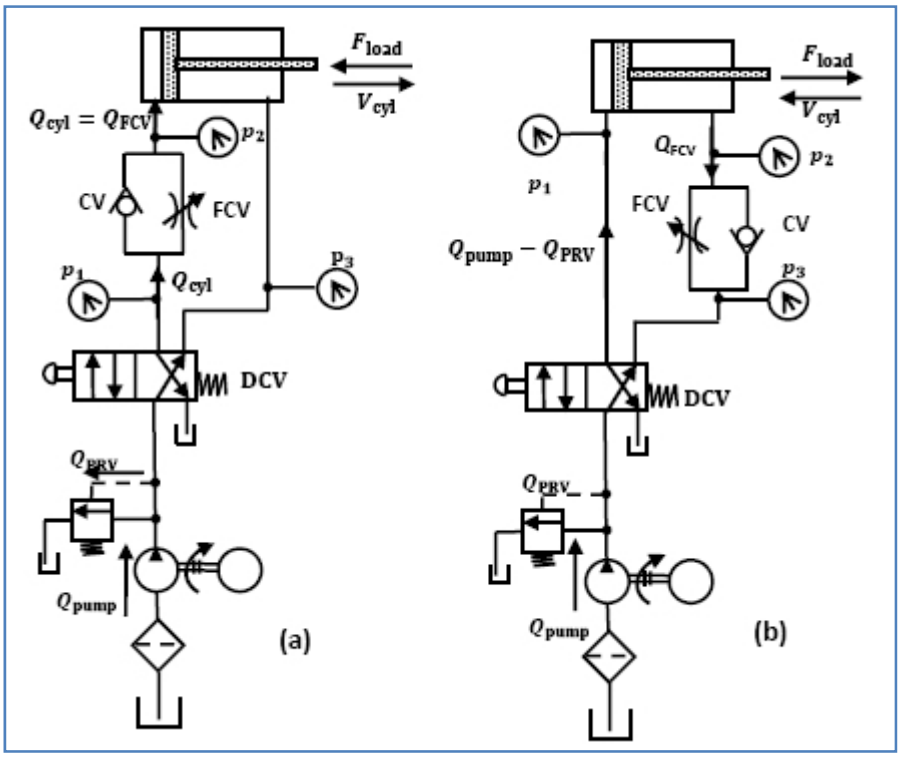

Figure1. a) Meter-In circuit b) Meter-Out circuit

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	**Hydraulic trainer**	Transparent /actual working components. 1. D A Cylinder of suitable stroke length 2. FCV with check valve 3.Flowmeter	1

X Precautions to be Followed

1. Avoid improper/loose connections of components.
2. Do not forcefully connect to connectors to avoid the damage.
3. Connections should never be made while the machine is running.
4. If difficulty is encountered while attempting to make a connection, make sure that the machine is off and that the lines are not under pressure.
5. Any oil spills should be cleaned up immediately.

XI Procedure

1. Initially check the level of hydraulic oil to ensure adequate oil in the tank.
2. Make connections as per circuit diagram.
3. Allow the trainer in ON position for 5 minutes for initial warm-up.
4. Note down the pressure and flow rate generated by the pump.
5. Make necessary connections to the actuators through FCV as per circuit diagram.

6. Change FCV setting and observe change in flow, pressure of oil.
7. Tabulate the readings using stop watch

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

1. Meter-in circuit

SR No	Setting level of FCV	Pressure before throttling	Pressure after throttling	Flow (LPM) After throttling	Time for piston movement (T) Sec	Actuator speed observed (L/T) mm/sec	Remark (Slow/fast)
1	Fully open						
2	50% closed						

2. Meter-Out circuit

SR No	Setting level of FCV	Pressure before throttling	Pressure after throttling	Flow (LPM) After throttling	Time for piston movement (T) Sec	Actuator speed observed (L/T) mm/sec	Remark (Slow/fast)
1	Fully open						
2	50% closed						

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. List the applications of Meter-in and Meter out circuits.
2. State the function of FCV with check valve used in the practical.
3. Differentiate between Meter-in and Meter out circuits.

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XX References / Suggestions for Further Reading

1. Meter In and Meter Out: https://www.youtube.com/watch?v=4eCuPVxezzY
2. https://www.youtube.com/watch?v=fXP805a5LGo

XXI Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the components on trainer	20%
2	Observation of readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total (25)**	

Practical No. 7 : Construct And Actuate Hydraulic Circuit For The Given Sequencing Of Operations.

I Practical Significance

Hydraulic system can be used for automation with the help of sequencing circuits. Hydraulic sequencing circuits can able to actuate more than one actuator as per the sequence of operations to be performed. Hydraulic cylinders can be operated sequentially using a sequence valve.

II Relevant Program Outcomes (POs)

PO1 - Basic knowledge: Apply knowledge of basic mathematics, sciences and basic Engineering to solve the broad-based Mechanical Engineering problems.

PO 2 -Discipline knowledge: Apply mechanical engineering knowledge to solve broad-based mechanical engineering related problems

PO3 - Experiments and practice: Plan to perform experiments and practices to use the results to solve broad-based Mechanical Engineering problems.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency **'Use different types of hydraulic and pneumatic systems for engineering applications***':*

i. Select components for given hydraulic circuit.
ii. Construct circuit for relevant application

IV Relevant Course Outcome(s)

Develop hydraulic circuits for sequencing applications.

V Practical Outcome

Construct and actuate hydraulic circuit for the given sequencing of operations.

VI Relative Affective Domain-

- Follow safety practices.
- Practice energy conservation.

VII Minimum Theoretical Background

There are two types of hydraulic sequencing circuit

a. **Pressure dependent sequencing-** It uses pressure sequence valve to obtain sequential operation.
b. **Travel dependent sequencing-** It uses cam and roller operated DC valve/limit switches to obtain sequential operation.

VIII Experimental setup

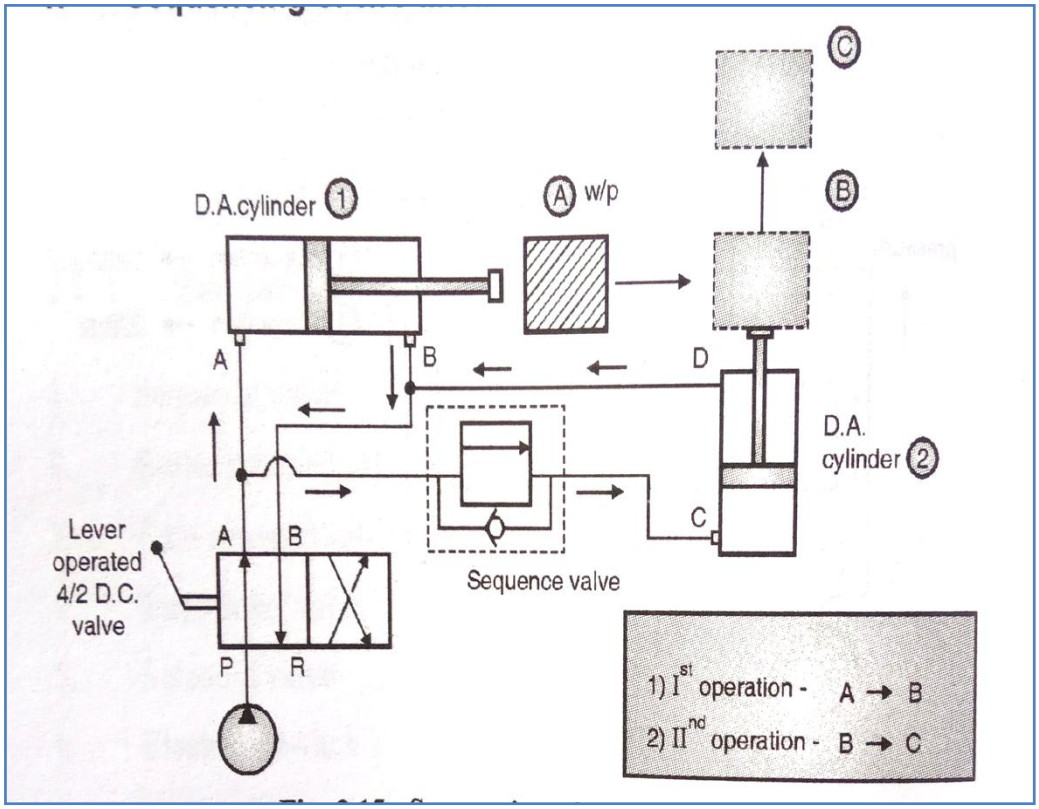

Figure No 1

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	**Hydraulic trainer**	Transparent /actual working components. 1. S A Cylinder of suitable stroke length 2. D A Cylinder of suitable stroke length 3. D A Cylinder of suitable stroke length 4.Pressure sequence valve	

X Precautions to be Followed

1. Avoid improper/loose connections of components.
2. Do not forcefully connect to connectors to avoid the damage.
3. Connections should never be made while the machine is running.
4. If difficulty is encountered while attempting to make a connection, make sure that the machine is off and that the lines are not under pressure.
5. Any oil spills should be cleaned up immediately.

XI Procedure

1. Initially check the level of hydraulic oil to ensure adequate oil in the tank.
2. Make connections as per circuit diagram.
3. Allow the trainer in ON position for 5 minutes for initial warm-up.
4. Note down the pressure and flow rate generated by the pump.

5. Make necessary connections to the actuators through sequence valve as per circuit diagram.

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

Sr No	Type of Actuator	Operation No	Movement observed	Remark
1				
2				
3				
4				

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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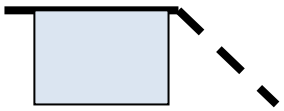
XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

I Draw sequence circuit for clamping and bending operation for given figure.



II List different practical applications of sequencing circuits.

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XX References / Suggestions for Further Reading

1. https://www.youtube.com/watch?v=YeYd0htafwo
2. https://www.youtube.com/watch?v=nyrDHoAVihs
3. https://www.youtube.com/watch?v=WOf9_ZIRFK8

XXI Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the components on trainer	20%
2	Observation of readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total (25)**	

Practical No. 8 : Develop Circuit For Simple Machine Tool Applications Such As Milling Machine, Shaper Machine, Grinding Machine.

I Practical Significance

Hydraulic circuits are used in machine tool applications like clamping, table movement, movement of ram, servo control mechanism, etc. Now days hydraulic circuits are useful in milling machine, shaper machine, broaching machine, hydraulic press, grinding machine, etc

II Relevant Program Outcomes (POs)

PO1 - **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic Engineering to solve the broad-based Mechanical Engineering problems.
PO 2 -Discipline knowledge: Apply mechanical engineering knowledge to solve broad-based mechanical engineering related problems
PO3 - **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Mechanical Engineering problems.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency **'Use different types of hydraulic and pneumatic systems for engineering applications***':*

1. Select components for given hydraulic circuit.
2. Construct circuit for relevant application

IV Relevant Course Outcome(s)

Develop hydraulic circuits for simple applications.

V Practical Outcome

Develop circuit for simple machine tool applications such as milling machine, shaper machine, grinding machine.

VI Relative Affective Domain-

- Follow safety practices.
- Practice good housekeeping.

VII Minimum Theoretical Background

Hydraulic system may be used in various machine tools for given applications

1. **Hydraulic Shaper machine**: The ram along with cutting tool will reciprocate using D A Cylinder.

2. **Hydraulic Milling machine:** The machine table along with work piece will reciprocate using D A Cylinder.
3. **Hydraulic Grinding machine:** The machine table along with work piece will reciprocate using D A Cylinder.

VIII Experimental setup

Figure 1 Hydraulic Shaper

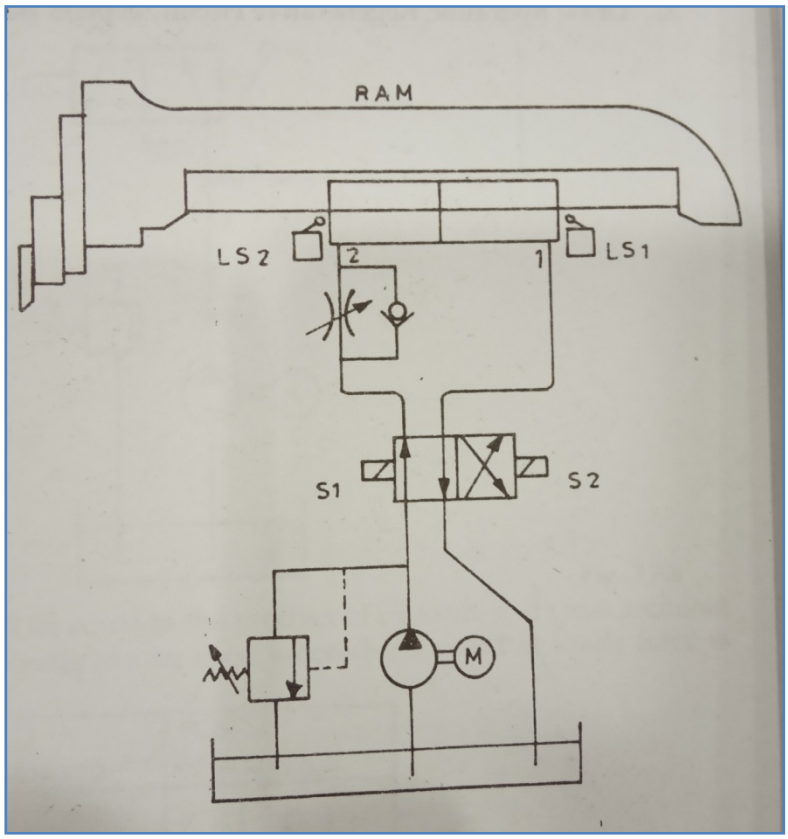

Figure 2 Shaper Machine circuit

Figure 3 Hydraulic Surface Grinder

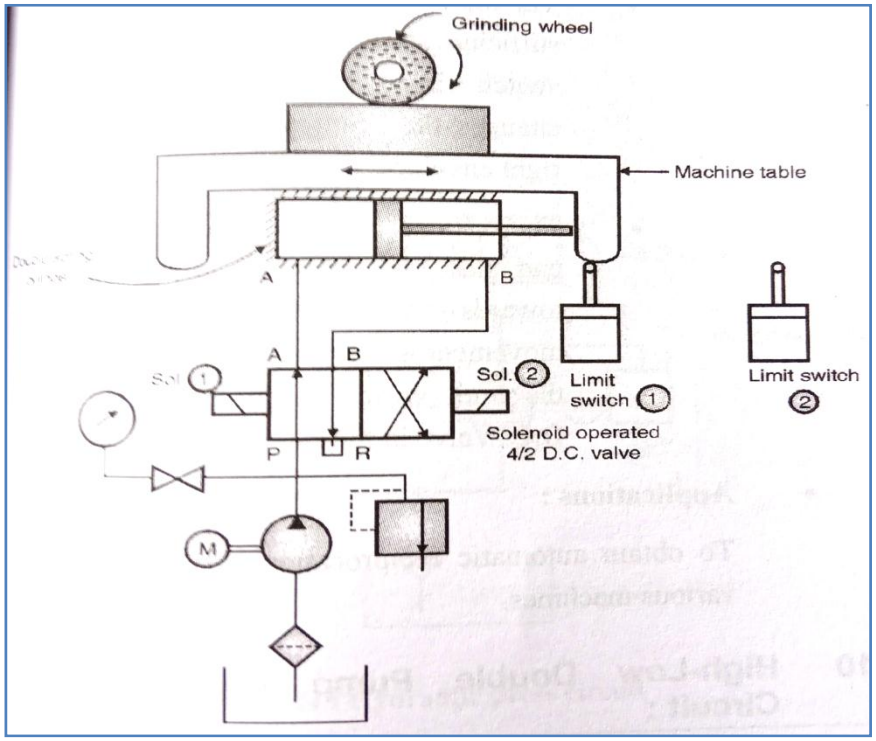

Figure 4 **Grinding Machine Circuit**

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Hydraulic trainer	Transparent /actual working components.	1
2	Hydraulic Shaper/Grinder/Milling	Actual machines/Demo models	1

X Precautions to be Followed

1. Avoid improper/loose connections of components.
2. Do not forcefully connect to connectors to avoid the damage.
3. Connections should never be made while the machine is running.
4. If difficulty is encountered while attempting to make a connection, make sure that the machine is off and that the lines are not under pressure.
5. Any oil spills should be cleaned up immediately.

XI Procedure

1. Initially identify the hydraulic system in hydraulic shaper/milling/grinding machine.
2. Note down the pressure and flow rate generated by the pump.
3. Record observations for motion of component.
4. If machines are not available, develop circuits on trainer.

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1	Hydraulic shaper/Grinding/ Milling machine		Working /demo models	1	
2	Hydraulic trainer		With required components	1	

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

Sr No	Name of Machine	Machine component with hydraulic system	Type of actuator used	Motion observed	Remark
1					
2					
3					
4					

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. State the working principle of hydraulic grinding machine.
2. Calculate the ratio of linear speed of cutting stroke and return stroke in hydraulic shaper.
3. Develop circuit for movement of tail stock of lathe machine for drilling operation.

[Space for Answer]

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XX References / Suggestions for Further Reading

1. https://www.youtube.com/watch?v=JfzsBAOTmv4
2. https://www.youtube.com/watch?v=Wa65TeEvV-w
3. https://www.youtube.com/watch?v=5QORgmnAVY4
4. https://www.youtube.com/watch?v=Ll-BugePIaQ

XXI Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the components on trainer	20%
2	Observation of readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total (25)**	

Practical No. 9 : Maintain Simple Parts Of Mobile Hydraulic System Such As In Earth Moving Equipment.

I Practical Significance

Maintenance is the activity to upkeep hydraulic system protects it from failure, proper maintenance will increase reliability, availability of the hydraulic system. Maintenance of hydraulic system is important as hydraulic system is sophisticated, complex and costly components are involved in it.

Proper cleanliness of system and effective filtration of working element i.e. oil will eliminate most of the problems. Oil is added in the system in a careful manner usually by portable filling pump unit with filters.

II Relevant Program Outcomes (POs)

PO1 - **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic Engineering to solve the broad-based Mechanical Engineering problems.

PO3 - **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Mechanical Engineering problems.

III Competency and Skills

- This practical is expected to develop the following skills for the industry identified competency **'Use different types of hydraulic systems for engineering applications.'**
- **Maintain simple parts of mobile hydraulic system such as in earth moving equipment**.

IV Relevant Course Outcome(s)

Develop different pneumatic circuits for simple applications.

V Practical Outcome

- Maintain simple parts of mobile hydraulic system such as in earth moving equipments.

VI Relative Affective Domain-

- Follow safety practices.
- Practice good housekeeping.
- Practice energy conservation.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

VII Minimum Theoretical Background

Three simple maintenance procedures have the greatest effect on hydraulic system performance, efficiency and life.

1. Maintaining a clean sufficient quantity of hydraulic fluid of the proper type and viscosity.
2. Changing filters and cleaning strainers.
3. Keeping all connections tight, but not to the point of distortion, so that air is excluded from the system.

The following are the key problems that commonly need to be addressed in servicing hydraulic systems:

- Contaminated oil
- Poor fluid filtration
- Incorrect fluid selection
- Low fluid level
- High fluid temperature
- Loose supply lines
- Faulty seals.

VIII Experimental setup

Figure No 1 Hydraulic tool kit

Figure No 2 Hydraulic repair and maintenance tool kit

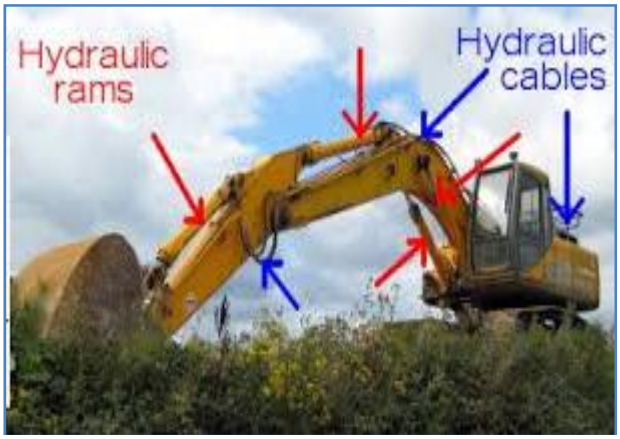

Figure 3 Hydraulic Exacavator

Figure 4 Hydraulic Crane

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Hydraulic oil	As recommended by manufacturer	1
2.	Tool kit	As recommended by manufacturer	1

X Precautions to be Followed

1. Avoid improper handling of hydraulic oil.
2. Don't apply excessive pressure on actuator .

XI Procedure

- Go through the instruction and operating manual supplied by the manufacturers and also follow the instructions given by teacher.
- Go through the safety precautions, guidelines given for maintenance in lab manual.

- Run the system for at least 10 min. and observe working of various components and fill up the information in the inspection format for each component.
- Go through the fault, cause and remedial actions table from book. Search out remedial action for observed fault.
- By following instructions, safety takes the appropriate remedial actions using tool kit under the teacher's guidance.

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

Name of the mobile hydraulic equipment:-

Brief description/specification/make/ of mobile hydraulic equipment:-

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Table 1.Inspection table

Sr No	Component	Condition observed
1	Pump	Smooth running or making noise
2		
3		

Table 2.Observed faults and remedial action taken

Sr No	Observed fault and its indications.	Probable cause	Remedial action.
1			
2			
3			

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. State the importance of filtering in hydraulic system.
2. List causes of seal failure.
3. State the causes of excessive fast motion of actuator.
4. Name the two ways in which a hydraulic fluid becomes contaminated.

[Space for Answer]

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XX References / Suggestions for Further Reading

1. https://www.crossco.com/services/mobile-systems-integration/hydraulic-system-design.
2. https://www.coastalhydraulics.net/services-products/hydraulic-system-preventive-maintenance-program/
3. https://www.cat.com/en_US/support/maintenance/mini-excavator-maintenance.html.
4. https://www.youtube.com/watch?v=iQg0DshhhLs.

XXI Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	20%
2	Calculation of final readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total (25)**	

Practical No. 10 : Maintain Simple Parts Of Any One Stationary Hydraulic System Such As In Any Machine Tool.

I Practical Significance

Maintenance is the activity to upkeep hydraulic system protects it from failure, proper maintenance will increase reliability, availability of the hydraulic system. Maintenance of hydraulic system is important as hydraulic system is sophisticated, complex and costly components are involved in it.

Proper cleanliness of system and effective filtration of working element i.e. oil will eliminate most of the problems. Oil is added in the system in a careful manner usually by portable filling pump unit with filters.

II Relevant Program Outcomes (POs)

PO1 - **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic Engineering to solve the broad-based Mechanical Engineering problems.

PO3 - **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Mechanical Engineering problems.

III Competency and Skills

- This practical is expected to develop the following skills for the industry identified competency **'Use different types of hydraulic systems for engineering applications.'**

1. **Maintain simple parts of mobile hydraulic system such as in earth moving equipment**

IV Relevant Course Outcome(s)

Develop different pneumatic circuits for simple applications.

V Practical Outcome

- Maintain simple parts of mobile hydraulic system such as in earth moving equipment.

VI Relative Affective Domain-

- Follow safety practices.
- Practice good housekeeping.
- Practice energy conservation.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

VII Minimum Theoretical Background

Three simple maintenance procedures have the greatest effect on hydraulic system performance, efficiency and life.

1. Maintaining a clean sufficient quantity of hydraulic fluid of the proper type and viscosity.
2. Changing filters and cleaning strainers.
3. Keeping all connections tight, but not to the point of distortion, so that air is excluded from the system.

The following are the key problems that commonly need to be addressed in servicing hydraulic systems:

- Contaminated oil
- Poor fluid filtration
- Incorrect fluid selection
- Low fluid level
- High fluid temperature
- Loose supply lines
- Faulty seals.

VIII Experimental setup

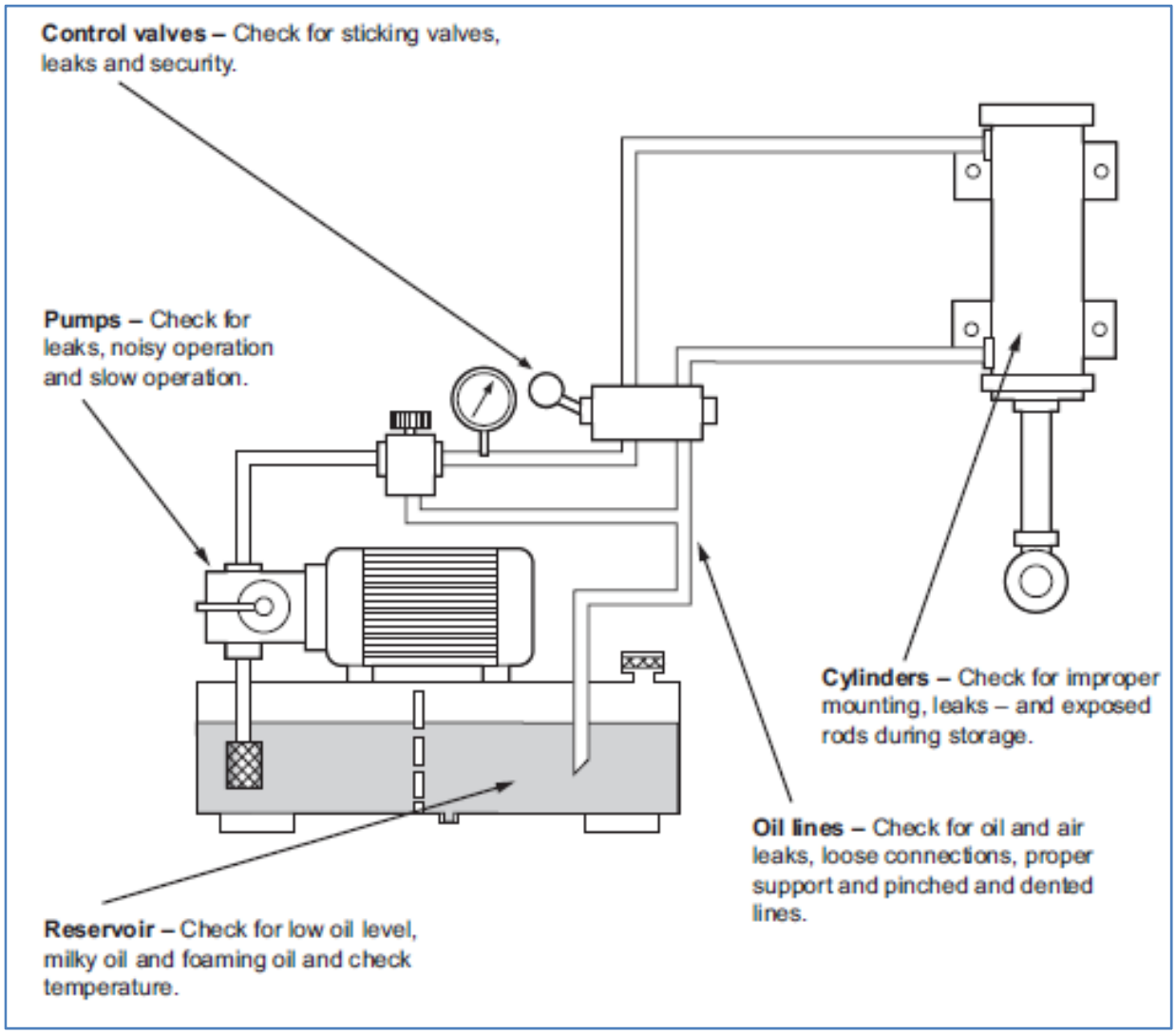

Figure No 1. System check

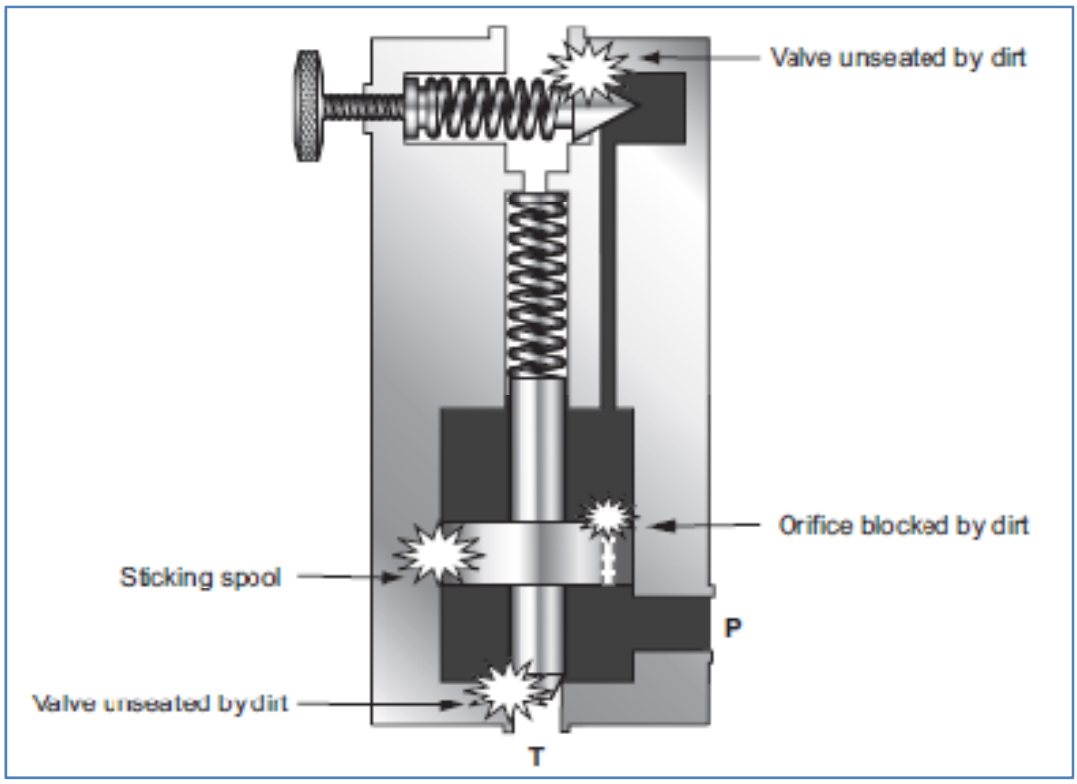

Figure No 2. Compound relief valve – common contamination sites

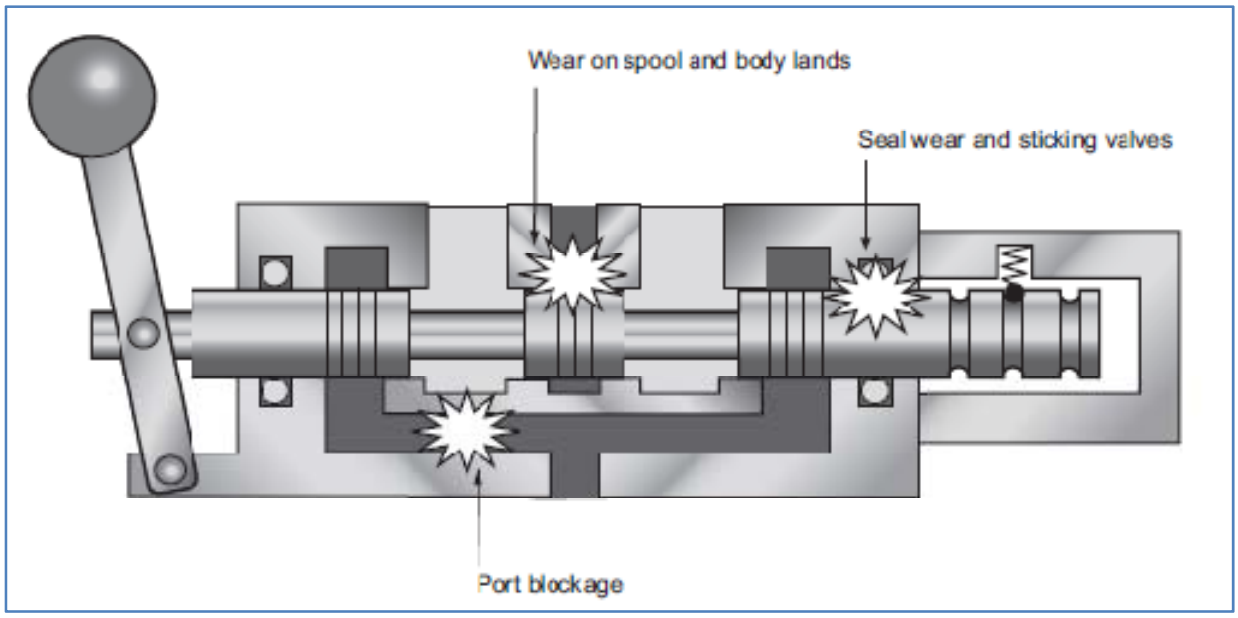

Figure No 3. Effects of contamination on directional control valves

hydraulic ram lifter

hydraulic lift table

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Hydraulic oil	As recommended by manufacturer	1
2.	Tool kit	As recommended by manufacturer	1

X Precautions to be Followed

1. Avoid improper handling of hydraulic oil.
2. Don't apply excessive pressure on actuator .

XI Procedure

- Go through the instruction and operating manual supplied by the manufacturers and also follow the instructions given by teacher.
- Go through the safety precautions, guidelines given for maintenance in lab manual.
- Run the system for at least 10 min. and observe working of various components and fill up the information in the inspection format for each component.
- Go through the fault, cause and remedial actions table from book. Search out remedial action for observed fault.
- By following instructions, safety takes the appropriate remedial actions using tool kit under the teacher's guidance.

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
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1.					
2.					
3.					

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

Name of the mobile hydraulic equipment:-_____

Brief description/specification/make/ of mobile hydraulic equipment:-

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Table 1.Inspection table

Sr No	Component	Observed Condition
1		
2		
3		

Table 2.Observed faults and remedial action taken

Sr No	Observed fault and its indications.	Probable cause	Remedial action.
1			
2			
3			

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Name five reasons for the overheating of the fluid in a hydraulic system.
2. Name four causes of low or erratic pressure.
3. List four recommendations that should be followed for properly maintaining and disposing hydraulic fluid.
4. If an actuator fails to move, name four possible causes.

[Space for Answer]

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XX References / Suggestions for Further Reading

1. http://www.cmafh.com/enewsletter/PDFs/Hydraulic_Maintenance.pdf
2. https://www.youtube.com/watch?v=QePiimWI-YQ
3. https://www.youtube.com/watch?v=KMpDurIEJSA
4. https://www.youtube.com/watch?v=MI5Nk5pfd4s
5. https://www.youtube.com/watch?v=hfIXLFJrajU
6. https://www.youtube.com/watch?v=Av5ZbahEBRk

XXI Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	20%
2	Calculation of final readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. ……..
2. ……..
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total (25)**	

Practical No. 11 : Maintain Simple Parts Of Any One Stationary Pneumatic System Such As In Any Machine Tool.

I Practical Significance

In pneumatic systems, regular maintenance of all the components is of utmost importance so as to ensure that the system works at its complete potential. If not properly taken care of, frequent damages and breakdowns are bound to happen, and this will in turn reduce the life of the equipment and will incur additional costs. Regular maintenance will allows you to find the damaged or malfunctioning parts of the system and will also allow you to take timely measure for the same. Thus, one should ensure that they have a special team to manage the maintenance of the pneumatic systems and take steps to further enhance their knowledge about the latest in pneumatic systems to ensure adequate maintenance with the best and latest of knowledge.

Relevant Program Outcomes (POs)

PO1 - **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic Engineering solve the broad-based Mechanical Engineering problems.

PO3 - **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Mechanical Engineering problems.

II Competency and Skills

- This practical is expected to develop the following skills for the industry identified competency **'Use different types of hydraulic systems for engineering applications.'**
- **Maintain simple parts of mobile hydraulic system such as in earth moving equipment**

III Relevant Course Outcome(s)

Develop different pneumatic circuits for simple applications.

IV Practical Outcome

- Maintain simple parts of mobile hydraulic system such as in earth moving equipments.

V Relative Affective Domain-

- Follow safety practices.
- Practice good housekeeping.
- Practice energy conservation.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

VI Minimum Theoretical Background

As compared to other mechanical systems, a pneumatic system is far better as far as the problems are concerned, but that doesn't mean that they do not require maintenance. Problems that do come up every now and then are not that difficult to resolve as other systems, but only when proper maintenance and care is taken.

Pneumatic systems result in less trouble only when the maintenance is carried out on a daily basis. Thus, daily maintenance is of utmost importance to ensure that the system runs in its best possible state.

There are a number of guidelines that can make the daily maintenance of pneumatic systems easier, let us check some of the guidelines:

- Always ensure that you have an accurate circuit as well as the functional diagram of the pneumatic system. If any changes are made after installation, ensure that they are made in the directions as well.
- Do take care that the impulse valves of the system is protected from excess of dirt, mechanical shocks and cooling water.
- Imprints of the elements and the units should be accurate and easily visible.
- The valve openings that are given by the manufacturers should only be used.
- Do not drill the elements of the system for a new opening.
- If you need an additional opening, discuss it with the manufacturer and they might design a custom system for you.
- The service unit of the system should be clearly visible and easy to service. If possible, also ensure that it is placed higher that the other elements.
- Do not increase the throttle that what is needed and specified by the manufacturer.
- If you are dismantling the cylinders or valves, do take care of its sealing materials. Even while assembling them again, ensure that they are properly placed.
- Actuated valves, though appear easy to work with, but are known to cause serious problems. Thus, it is good to ensure that they are controlled in the proper direction and at the required speeds only.

VII Experimental setup

Figure No 1. Good maintenance

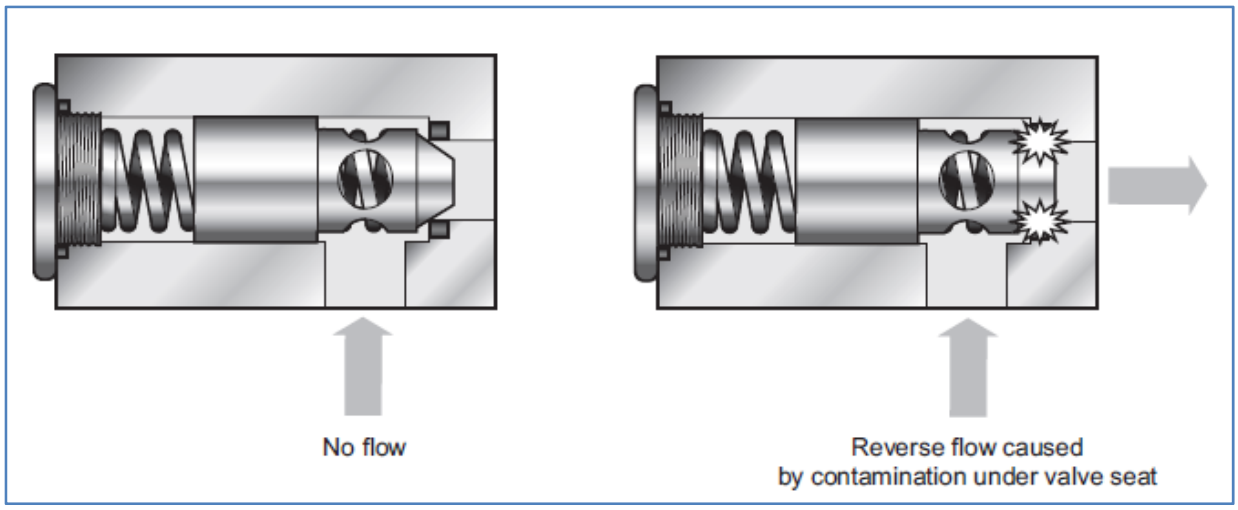

Figure No 2. Check valve malfunction

VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Pneumatic system	As per available in lab, industry.	1
2.	Tool kit	As recommended by manufacturer	1

IX Precautions to be Followed

1. Avoid improper handling of hydraulic oil.
2. Don't apply excessive pressure on actuator .

X Procedure

- Go through the instruction and operating manual supplied by the manufacturers and also follow the instructions given by teacher.
- Go through the safety precautions, guidelines given for maintenance in lab manual.
- Run the system for at least 10 min. and observe working of various components and fill up the information in the inspection format for each component.
- Go through the fault, cause and remedial actions table from book. Search out remedial action for observed fault.
- By following instructions, safety takes the appropriate remedial actions using tool kit under the teacher's guidance.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

Table 1.Inspection table

Sr No	Component	Observed Condition
1		
2		
3		

Table 2.Observed faults and remedial action taken

Sr No	Observed fault and its indications.	Probable cause	Remedial action.
1			
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XV Results

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XVI Interpretation of Results

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XVII Conclusions

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XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. List five possible causes of a pressure drop in a pneumatic system.
2. List protective devices that can be found on a compressor.
3. List four maintenance problems common to pneumatic systems.
4. List three advantages of using a preventative maintenance program for a pneumatic system.

[Space for Answer]

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XIX References / Suggestions for Further Reading

1. https://gpmhydraulic.com/basic-pneumatic-troubleshooting/
2. https://www.valmet.com/media/articles/up-and-running/reliability/RTPneuTrouble/
3. https://blog.gesrepair.com/2018/10/21/pneumatic-system/
4. https://www.youtube.com/watch?v=ljjqFZiuAB0
5. https://www.youtube.com/watch?v=jbXW62A-YsA
6. https://www.youtube.com/watch?v=nGT8eM0ZnW4
7. https://www.youtube.com/watch?v=JS46bsryKg4

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	20%
2	Calculation of final readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total (25)**	

Practical No. 12 : Construct and actuate Pneumatic circuit for SAC, DAC and Air motor for the given purpose.

I Practical Significance

Pneumatic control systems can be designed in the form of pneumatic circuits. A pneumatic circuit is formed by various pneumatic components, such as cylinders, directional control valves, flow control valves, pressure regulator, signal processing elements such as shuttle valve, two pressure valve etc. Pneumatic circuits have the following functions

- To control the entry and exit of compressed air in the cylinders and air motor.
- To use one valve to control another valve
- To control actuators or any other pneumatic devices

A pneumatic circuit diagram uses pneumatic symbols to describe its design. Some basic rules must be followed when drawing pneumatic diagrams.

To be able to design pneumatic circuits, it is better for one to have basic knowledge on the designing simple pneumatic circuits. With this foundation, one would be able to move on to the designing more complicated circuits involving many more cylinders or air motor.

II Relevant Program Outcomes (POs)

PO1 - **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Mechanical Engineering problems.

PO3 - **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Mechanical Engineering problems.

III Competency and Skills

- This practical is expected to develop the following skills for the industry identified competency **'Use different types of hydraulic and pneumatic systems for engineering applications.'**
- Construct pneumatic circuit for SAC, DAC and Air motor for the given purpose.
- Actuate pneumatic circuit for SAC, DAC and Air motor for the given purpose.

IV Relevant Course Outcome(s)

Develop different pneumatic circuits for simple applications.

V Practical Outcome

- Construct Pneumatic circuit for SAC, DAC and Air motor for the given purpose.
- Actuate Pneumatic circuit for SAC, DAC and Air motor for the given purpose.

VI Relative Affective Domain-

- Follow safety practices.
- Practice good housekeeping.
- Practice energy conservation.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

VII Minimum Theoretical Background

Pneumatic actuators are the energy consumers to do useful work. They produce linear, rotary or limited rotary motion as output. Various types of actuators are Single Acting Cylinder (SAC), Double Acting Cylinder(DAC), Air motor.

Single acting cylinder is an actuator which receives compressed air and utilize it for useful work. It gives linear motion as output. Forward piston stroke is completed by pneumatic means and retracting piston stroke by spring force or by gravity force.

Double acting cylinder is an actuator which receives compressed air and utilize it for useful work. It gives linear motion as output. Forward and retracting piston stroke are completed by pneumatic means.

Air motor converts energy of compressed air into rotary motion to do useful work.

VIII Experimental setup

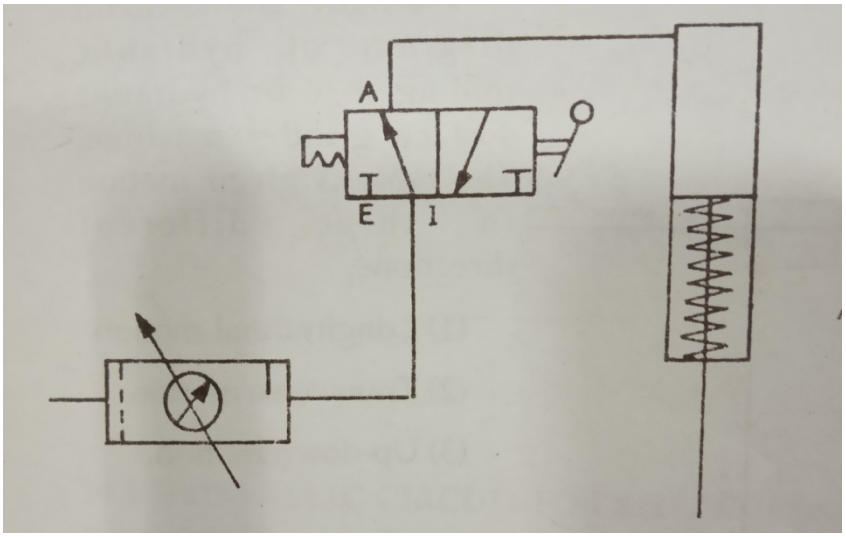

Figure No 1 Actuation of Single acting cylinder.

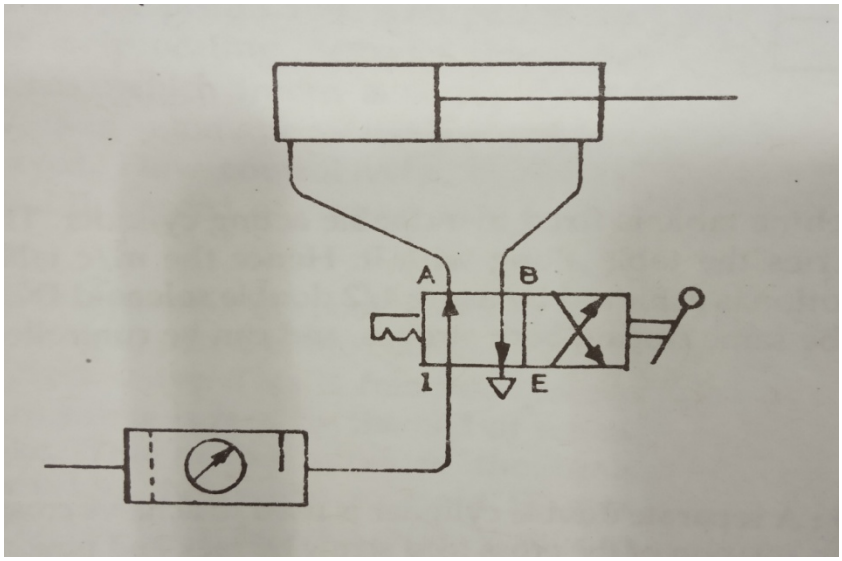

Figure No 2 Actuation of double acting cylinder.

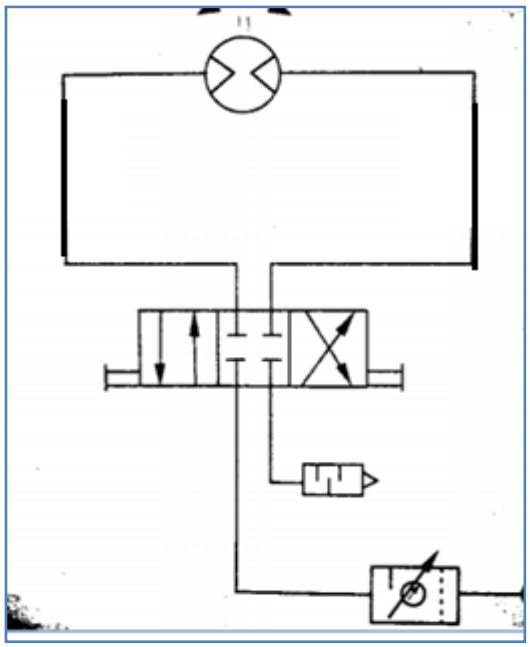

Figure No 3 Actuation of Bi Directional Airmotor.

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1			1
2			

X Precautions to be Followed

1. Avoid improper handling of flow control valve
2. Don't apply excessive pressure on tips of Transducer .

XI Procedure

- Clean the trainer unit to ensure clean working environment.
- Follow the instructions given by the teacher and in operating manual.
- Know the specifications of all components either from operators manual or from the specification given on each component and note down in the table.
- Read circuit diagram, select component to be used.
- Connect all selected components as per circuit diagram for indirect control of single acting and double acting cylinder.
- Check all connections for proper fitting. Start and run the compressor to store sufficient pressure up to 6 bar in reservoir. Check FRL unit for lubricating oil level.
- Observe actuation of cylinder.

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

1. Actuation of SA Cylinder

SR No	Stroke length(mm)	Air pressure (Kg/cm²)	Type of DC Valve	Type of Movement	Time in sec	Linear velocity (mm/sec)
1						
2						
3						
4						

2. Actuation of DA Cylinder

SR No	Stroke length(mm)	Air pressure (Kg/cm²)	Type of DC Valve	Type of Movement	Time in sec	Linear velocity (mm/sec)
1						
2						
3						
4						

3. Actuation of Air motor

SR No	Type	Air pressure (Kg/cm²)	Type of DC Valve	Type of Movement	Angular Velocity(RPM)
1					
2					
3					
4					

XVI Results

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XVII Interpretation of

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XVIII Conclusions

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Explain exhaust air throttling for speed control of double acting cylinder.
2. Differentiate between supply and exhaust air throttling for speed control of pneumatic cylinder.

[Space for Answer]

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XX References / Suggestions for Further Reading

1. https://www.youtube.com/watch?v=cYBIq74IikE
2. https://slideplayer.com/slide/3620641/

XXI Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	20%
2	Calculation of final readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total (25)**	

Practical No. 13 : Construct And Actuate Speed Control Pneumatic Circuits For The Given Purpose.

I Practical Significance

A pneumatic circuit diagram uses pneumatic symbols to describe its design. Some basic rules must be followed when drawing pneumatic diagrams. To be able to design pneumatic circuits, it is better for one to have basic knowledge on the designing simple pneumatic circuits. With this foundation, one would be able to move on to the designing more complicated circuits involving many more cylinders or air motor.

II Relevant Program Outcomes (POs)

PO1 - **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Mechanical Engineering problems.
PO3 - **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Mechanical Engineering problems.

III Competency and Skills

- This practical is expected to develop the following skills for the industry identified competency **'Use different types of hydraulic and pneumatic systems for engineering applications.'**
- Construct pneumatic circuit for the given purpose.

IV Relevant Course Outcome(s)

Develop different pneumatic circuits for simple applications.

V Practical Outcome

- Construct Pneumatic circuit for the given purpose.
- Actuate Pneumatic circuit for the given purpose.

VI Relative Affective Domain-

- Follow safety practices.
- Practice good housekeeping.
- Practice energy conservation.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

VII Minimum Theoretical Background

Pneumatic actuators are the energy consumers to do useful work. They produce linear, rotary or limited rotary motion as output. Various types of actuators are Single Acting Cylinder (SAC), Double Acting Cylinder(DAC), Air motor.

Single acting cylinder is an actuator which receives compressed air and utilize it for useful work. It gives linear motion as output. Forward piston stroke is completed by pneumatic means and retracting piston stroke by spring force or by gravity force.

Double acting cylinder is an actuator which receives compressed air and utilize it for useful work. It gives linear motion as output. Forward and retracting piston stroke are completed by pneumatic means.

Air motor converts energy of compressed air into rotary motion to do useful work.

Multi cylinder pneumatics circuits can be designed in various methods. There is no universal circuit design method that suits all types of circuits. Some methods are commonly used for compound circuits but would be too expensive for simple circuits.

VIII Experimental setup

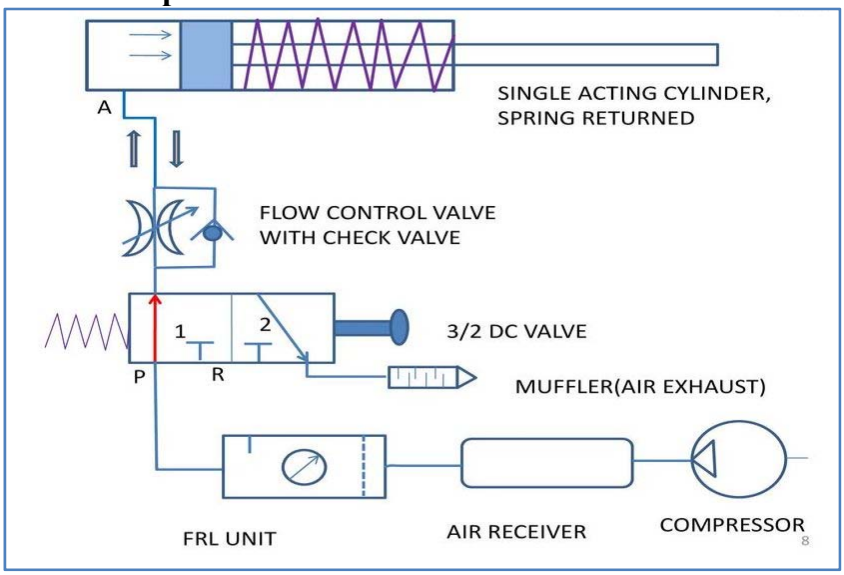

Figure No 1 Control of Single acting cylinder.

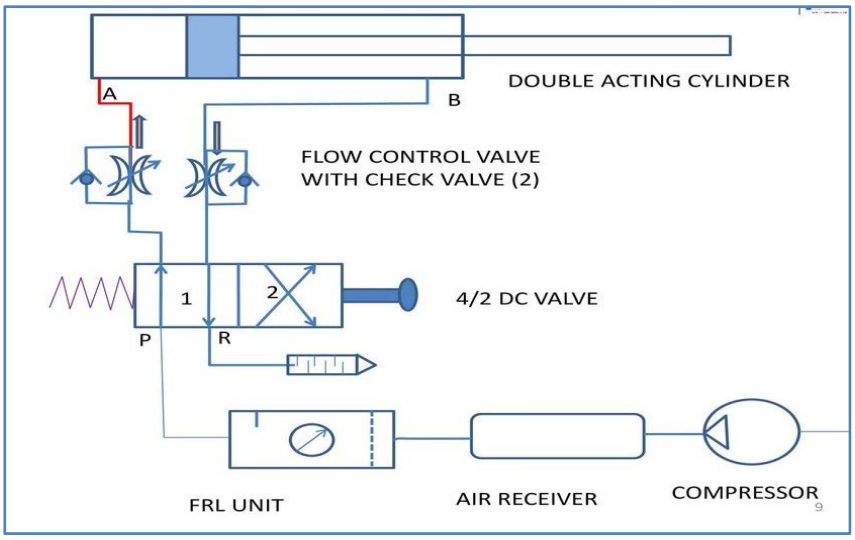

Figure No 2 control of double acting cylinder.

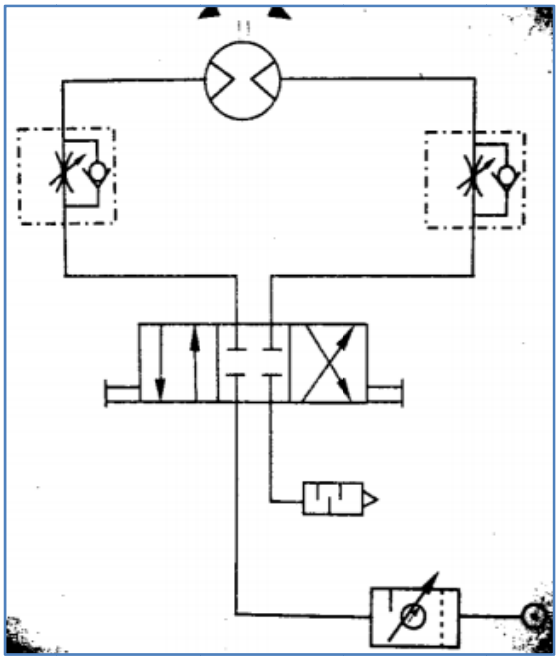

Figure No 3 Speed control of Airmotor

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Pneumatic trainer	Compressor, Reservoir, FRL, SAC, DAC , Air motor, Direction control valves , flow control valves,pipes,time delay valve connectors, logic gates.	1
2.			

X Precautions to be Followed

1. Avoid improper handling of compressed air.
2. Don't apply excessive pressure on actuator .

XI Procedure

- Clean the trainer unit to ensure clean working enviornment.
- Follow the instructions given by the teacher and in operating manual.
- Know the specifications of all components either from operators manual or from the specification given on each component and note down in the table.
- Read circuit diagram, select component to be used.
- Connect all selected components as per circuit diagram for indirect control of single acting and double acting cylinder.
- Check all connections for proper fitting. Start and run the compressor to store sufficient pressure up to 6 bar in reservoir. Check FRL unit for lubricating oil level.
- Observe actuation of cylinder.

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

Sr No	Flow rate	Time to complete stroke in seconds	Actuator speed in mm / sec	Actuator speed in mm / min
1	Minimum(For SAC)			
2	Medium (For SAC)			
3	Maximum(For SAC)			
4	Minimum(For DAC)			
5	Medium (For DAC)			
6	Maximum(For DAC)			

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. List the basic five rules that are important in design of pneumatic circuits..
2. Explain any one control valves used in experiment for given pneumatic application.

[Space for Answer]

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XX References / Suggestions for Further Reading

1. https://www.youtube.com/watch?v=lfDTBY-tdf0
2. https://www.youtube.com/watch?v=534CzKUF7oM
3. https://www.youtube.com/watch?v=EuwXRMWhLnw
4. https://www.youtube.com/watch?v=BOdjSU34xQQ

XXI Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	20%
2	Calculation of final readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total (25)**	

Practical No. 14 : Construct And Actuate Indirect (Pilot) Control Pneumatic Circuit For The Given Purpose.

I Practical Significance

Large cylinders as well as cylinders operating at high speed are generally actuated indirectly as the final control valve is required to handle large quantity of air. In the case of pilot operated valves, a signal input valve [3/2 way N.C type, 1S1] either actuated manually or mechanically is used to generate the pilot signal for the final control valve. The signal pressure required can be around 1-1.5 bar. The working pressure passing through the final control valve depends on the force requirement [4-6 bar].

Indirect control as permits processing of input signals. Single piloted valves are rarely used in applications where the piston has t o retract immediately on taking out the set pilot signal -.suitable for large single acting cylinders.

II Relevant Program Outcomes (POs)

PO1 - **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic Engineering to solve the broad-based Mechanical Engineering problems.

PO3 - **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Mechanical Engineering problems.

III Competency and Skills

- This practical is expected to develop the following skills for the industry identified competency **'Use different types of hydraulic and pneumatic systems for engineering applications.'**
- Construct indirect (pilot) control Pneumatic circuit for the given purpose.
- Actuate indirect (pilot) control Pneumatic circuit for the given purpose.

IV Relevant Course Outcome(s)

Develop different pneumatic circuits for simple applications.

V Practical Outcome

- Construct indirect (pilot) control Pneumatic circuit for the given purpose.
- Actuate indirect (pilot) control Pneumatic circuit for the given purpose.

VI Relative Affective Domain-

- Follow safety practices.
- Practice good housekeeping.
- Practice energy conservation.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

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VII Minimum Theoretical Background

Pneumatic control systems can be designed in the form of pneumatic circuits. A pneumatic circuit is formed by various pneumatic components, such as cylinders, directional control valves, flow control valves, pressure regulator, signal processing elements such as shuttle valve, two pressure valve etc. Pneumatic circuits have the following functions

- To control the entry and exit of compressed air in the cylinders.
- To use one valve to control another valve
- To control actuators or any other pneumatic devices

A pneumatic circuit diagram uses pneumatic symbols to describe its design. Some basic rules must be followed when drawing pneumatic diagrams.

To be able to design pneumatic circuits, it is better for one to have basic knowledge on the designing simple pneumatic circuits. With this foundation, one would be able to move on to the designing more complicated circuits involving many more cylinders.

VIII Experimental setup

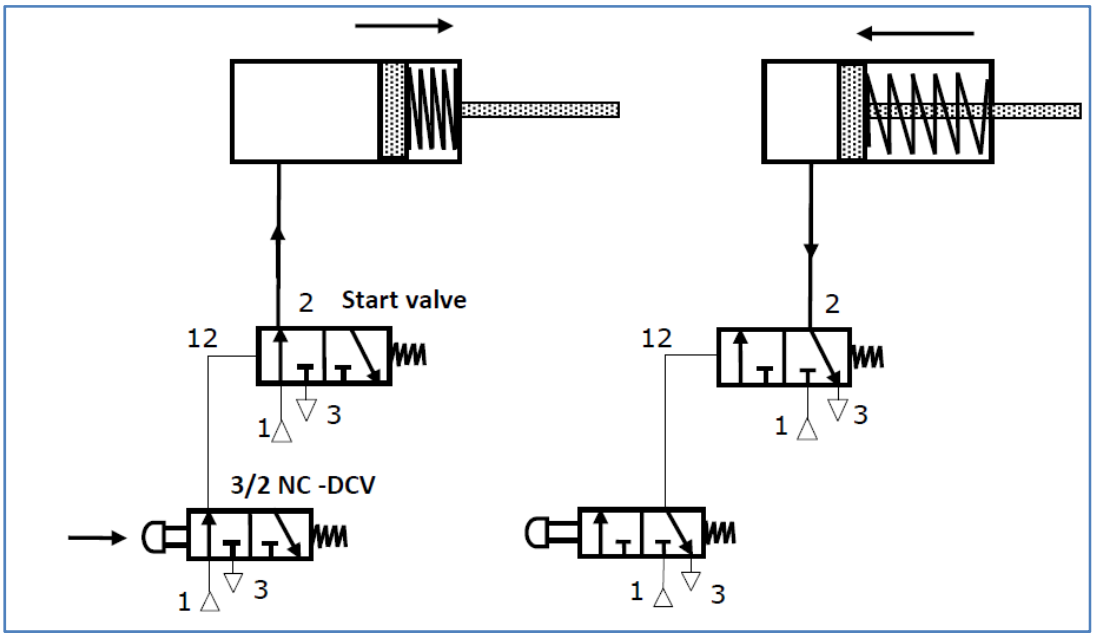

Figure No 1 Indirect control of a single acting cylinder.

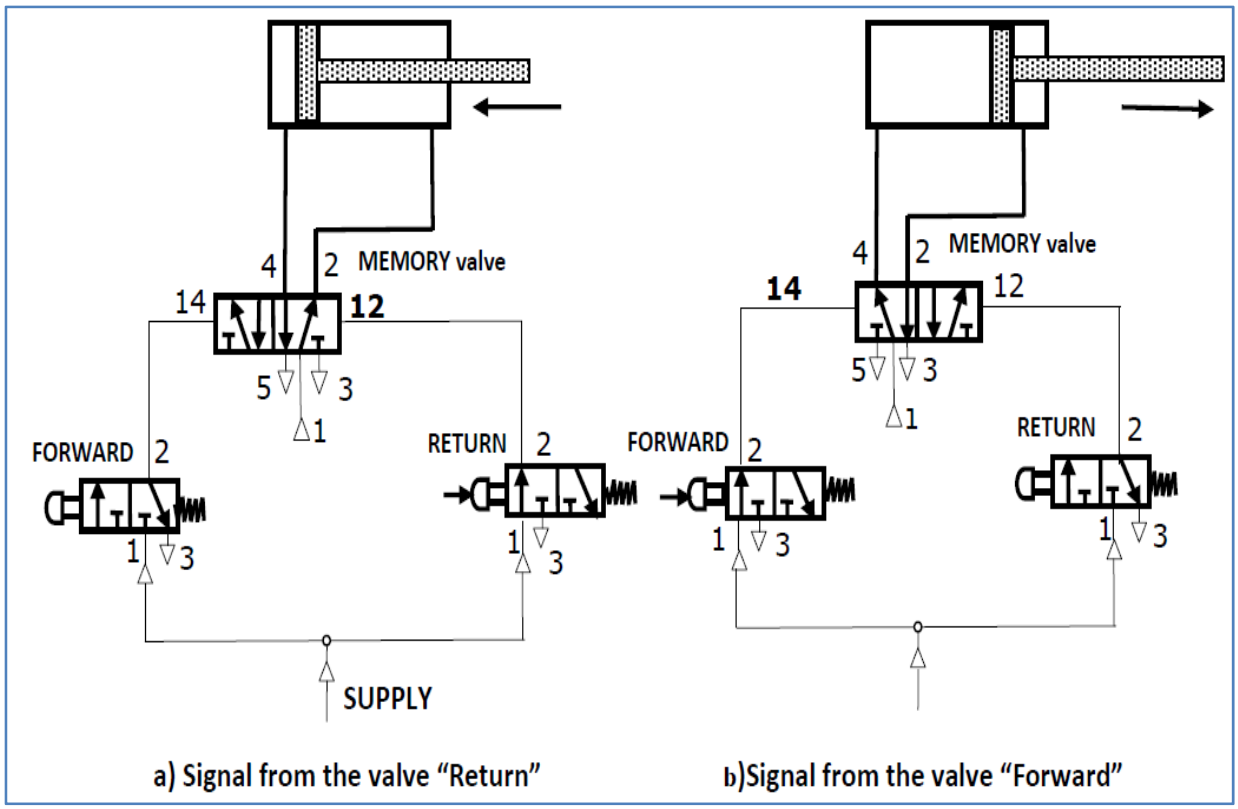

Figure No 2 Indirect control of Double acting cylinder using memory valve.

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Pneumatic trainer	Compressor, Reservior, FRL, SAC, DAC , Air motor, Direction control valves , pipes, connectors.	1
2			

X Precautions to be Followed

1. Avoid improper handling of compressed air.
2. Don't apply excessive pressure on actuator .

XI Procedure

- Clean the trainer unit to ensure clean working environment.
- Follow the instructions given by the teacher and in operating manual.
- Know the specifications of all components either from operators manual or from the specification given on each component and note down in the table.
- Read circuit diagram, select component to be used.
- Connect all selected components as per circuit diagram for indirect control of single acting and double acting cylinder.
- Check all connections for proper fitting. Start and run the compressor to store sufficient pressure upto 6 bar in reservior.Check FRL unit for lubricating oil level.
- Observe actuation of cylinder.

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

Draw indirect (pilot) control Pneumatic circuit for the given purpose (Actual Circuit constructed in laboratory)

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. A small single acting cylinder is to extend and clamp a work piece when a push button is pressed. As long as the push button is activated, the cylinder should remain in the clamped position. If the push button is released, the clamp is to retract. Use additional start button.
2. A filling system fills bottles with milk. The bottles are fed to the system on a conveyor belt and are stopped underneath the filler using pneumatic cylinders. The double acting cylinder 1A1 (due to its large size) has to be controlled indirectly.

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XX References / Suggestions for Further Reading

1. **https://slideplayer.com/slide/5668954/**
2. **https://www.youtube.com/watch?v=suk5GcR7_nY**

XXI Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	20%
2	Calculation of final readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total (25)**	

Practical No. 15 : Construct And Actuate Pneumatic Circuit For The Given Sequencing Of Operations.

I Practical Significance

Generally in mass type production industries when two (or) more than two operations / activities are done sequentially then sequencing circuit is used. For getting output we use double acting actuators in a predetermined sequence. Sequencing is done by two methods namely pressure dependents and position dependent.

II Relevant Program Outcomes (POs)

PO1 - **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic Engineering to solve the broad-based Mechanical Engineering problems.

PO3 - **Experiments and practice:**Plan to perform experiments and practices to use the results to solve broad-based Mechanical Engineering problems.

III Competency and Skills

- This practical is expected to develop the following skills for the industry identified competency **'Use different types of hydraulic and pneumatic systems for engineering applications.'**
- Construct pneumatic circuit for the given sequencing of operations.
- Actuate pneumatic circuit for the given sequencing of operations..

IV Relevant Course Outcome(s)

Develop different pneumatic circuits for simple applications.

V Practical Outcome

- Construct pneumatic circuit for the given sequencing of operations.
- Actuate pneumatic circuit for the given sequencing of operations.

VI Relative Affective Domain-

- Follow safety practices.
- Practice good housekeeping.
- Practice energy conservation.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

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VII Minimum Theoretical Background

In pneumatic system sometimes it is essential to operate number of cylinder in a particular order i.e. one after another this is called as sequencing. This is necessary due to tool movement, jigs and fixtures and work movements in a machine.

Sequencing is of two types, one is travel dependant or position based it means when one actuator is used to trigger roller operated valve for actuation of next actuator after

travelling predefined distance. Second sequencing method is pressure dependant in which pressure developed in first actuator is used to initiate next actuator movement through sequence valve.

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VIII Experimental setup

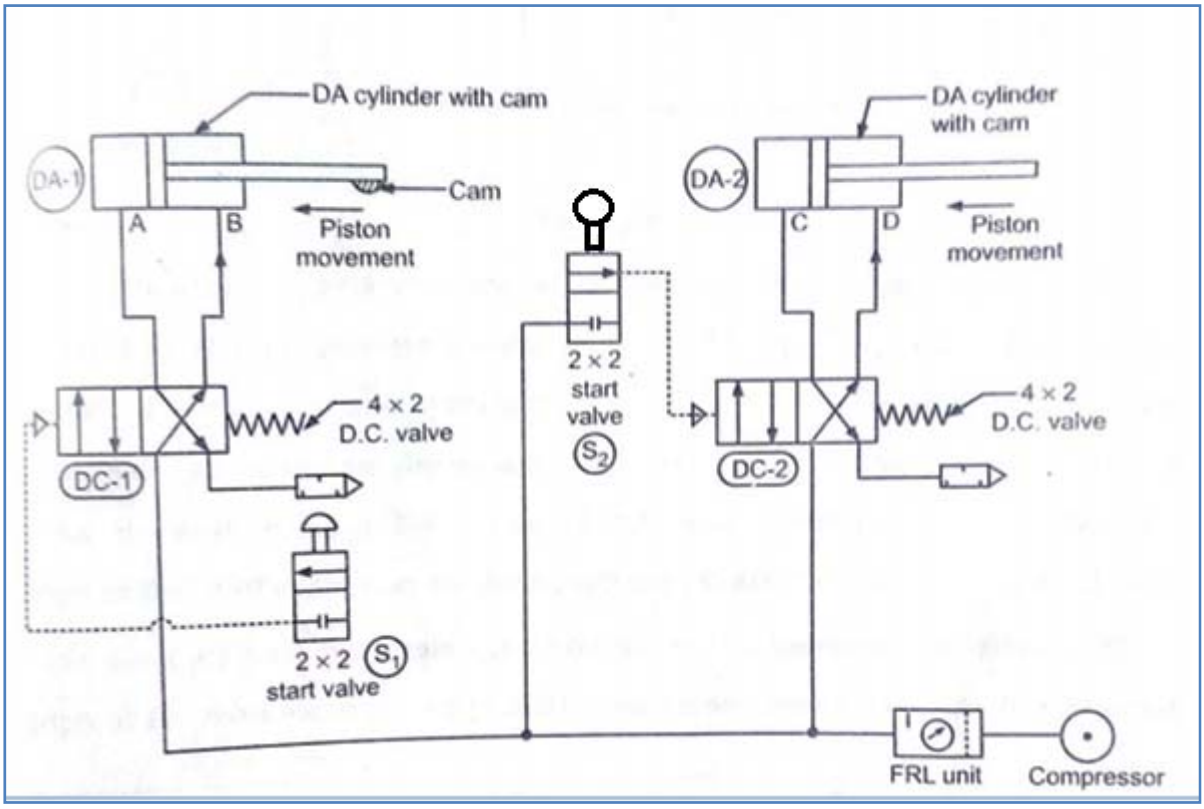

Figure No 1 Position based pneumatic sequencing circuit for two DAC .

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Pneumatic trainer	Compressor, Reservoir, FRL, SAC, DAC , Air motor, Direction control valves , pipes, connectors.	1
2.			

X Precautions to be Followed

1. Avoid improper handling of compressed air.
2. Don't apply excessive pressure on actuator .

XI Procedure

- Clean the trainer unit to ensure clean working environment.
- Follow the instructions given by the teacher and in operating manual.
- Know the specifications of all components either from operators manual or from the specification given on each component and note down in the table.

- Read circuit diagram, select component to be used.
- Connect all selected components as per circuit diagram .
- Check all connections for proper fitting. Start and run the compressor to store sufficient pressure up to 6 bar in reservior. Check FRL unit for lubricating oil level.
- Trigger the valve to actuate single acting cylinder.
- Observe that at the end of stroke of cylinder-1, roller operated 2/2 valve triggers. This will give signal to operate second cylinder.
- Repeat operations again to observe circuit operations.

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

Draw actual Pneumatic circuit for given sequencing of operations(as per resources available in laboratory)

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Give two applications of pneumatic sequencing circuit.
2. If one single acting cylinder and double acting cylinder are to be operated in sequence, draw pneumatic sequencing circuit diagram.
3. List types of sequencing in pneumatics.

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XX References / Suggestions for Further Reading

1. https://www.youtube.com/watch?v=Buj2gh30Pfo
2. https://www.youtube.com/watch?v=SIDsijnSTas

XXI Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	20%
2	Calculation of final readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total (25)**	

Practical No. 16 : Construct And Actuate Pneumatic Circuit For The Given Logic Functions (AND/OR/TIME DELAY).

I Practical Significance

Generally in mass type production industries when two (or) more than two operations / activities are done sequentially then sequencing circuit is used. For getting output we use double acting actuators in a predetermined sequence. Sequencing is done by two methods namely pressure dependents and position dependent..

II Relevant Program Outcomes (POs)

PO1 - **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic Engineering to solve the broad-based Mechanical Engineering problems.

PO3 - **Experiments and practice:**Plan to perform experiments and practices to use the results to solve broad-based Mechanical Engineering problems.

III Competency and Skills

- This practical is expected to develop the following skills for the industry identified competency **'Use different types of hydraulic and pneumatic systems for engineering applications.**'
- Construct pneumatic circuit for the given Logic functions (AND/OR/TIME DELAY).
- Actuate pneumatic circuit for the given Logic functions (AND/OR/TIME DELAY).

IV Relevant Course Outcome(s)

Develop different pneumatic circuits for simple applications.

V Practical Outcome

- Construct pneumatic circuit for the given Logic functions (AND/OR/TIME DELAY).
- Actuate pneumatic circuit for the given Logic functions (AND/OR/TIME DELAY).

VI Relative Affective Domain-

- Follow safety practices.
- Practice good housekeeping.
- Practice energy conservation.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

VII Minimum Theoretical Background

Electro pneumatics is now commonly used in many areas of Industrial low cost automation. They are also used extensively in production, assembly, pharmaceutical, chemical and packaging systems. There is a significant change in controls systems. Relays have increasingly been replaced by the programmable logic controllers in order to meet the growing demand for more flexible automation.

Electro-pneumatic control consists of electrical control systems operating pneumatic power systems. In this solenoid valves are used as interface between the electrical and pneumatic systems. Devices like limit switches and proximity sensors are used as feedback elements. Electromechanical relays and pneumatic logic have been used for many decades to perform logical functions in automated safety protection systems. These circuits can be wired (or piped) to perform AND, OR and even 2 to3 voting functions. Time delay relays provide filtering functionality. "Trip Amplifiers" are also available that convert analog inputs into a digital trip signal for use with relay logic. Generally such circuits have a bias toward a fail de-energized mode.

Pneumatic Timers are used to create time delay of signals in pilot operated circuits. Available as Normally Closed Timers and Normally Open Timers. Usually Pneumatic timers are On Delay Timers Delay of signals is very commonly experienced in applications such as Bonding of two pieces. Normally Open Pneumatic Timer are also used in signal elimination. Normally Open Pneumatic Timers are used as safety device in Two Hand Blocks.

VIII Experimental setup

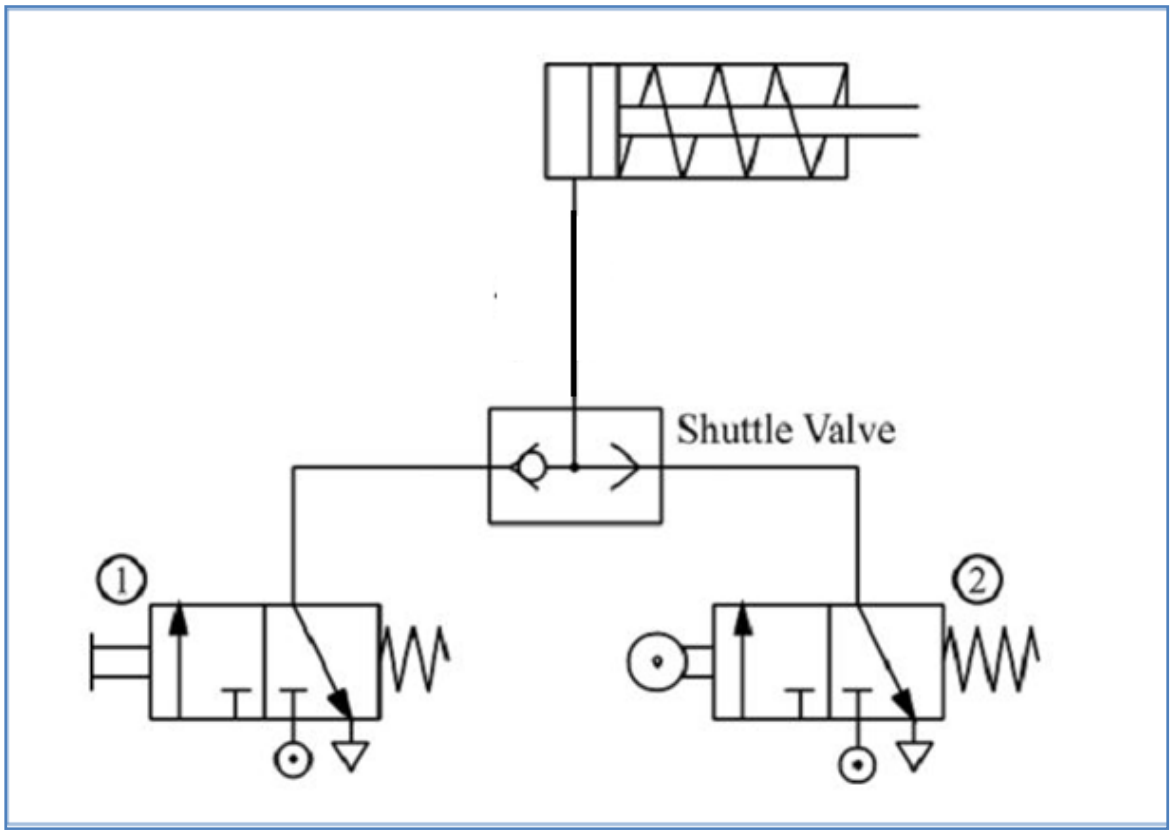

Figure No 1 Control of a single acting cylinder using OR valve .

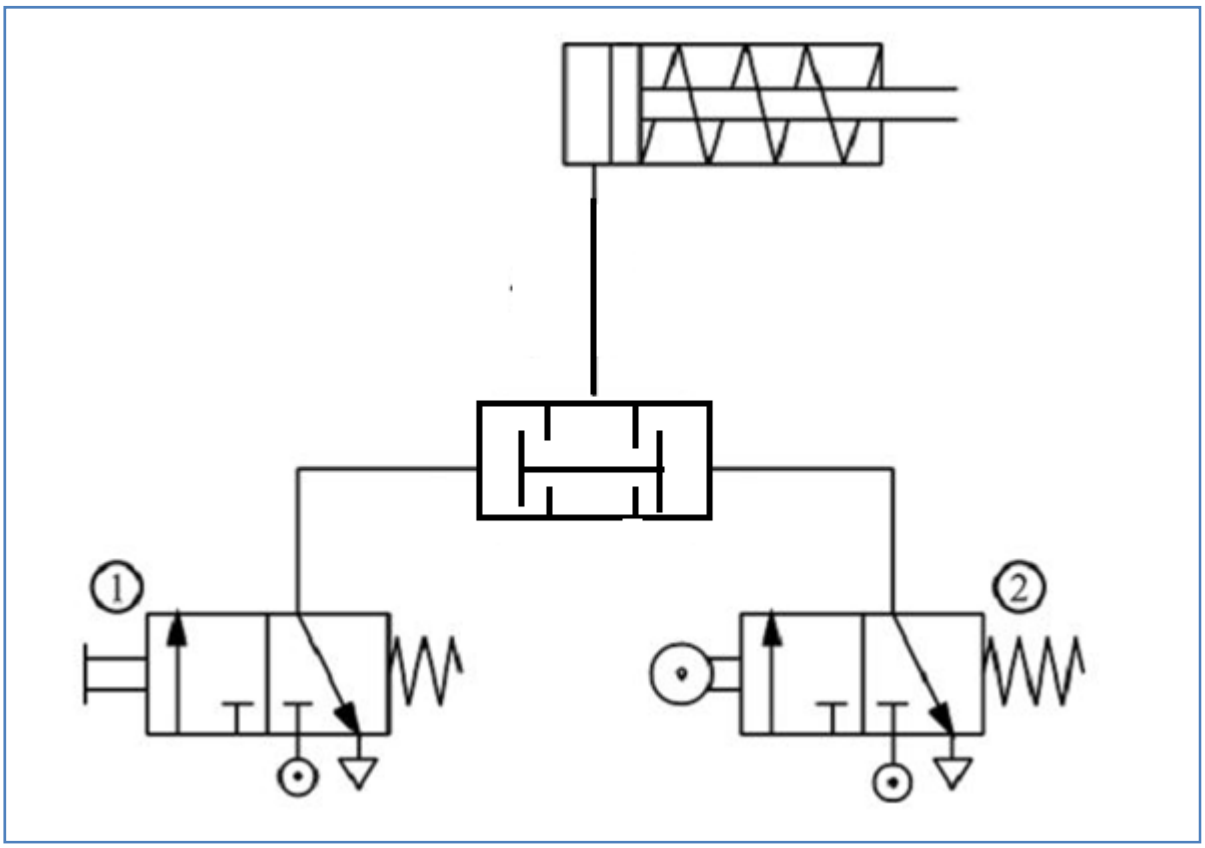

Figure No 2 Control of a single acting cylinder using AND valve.

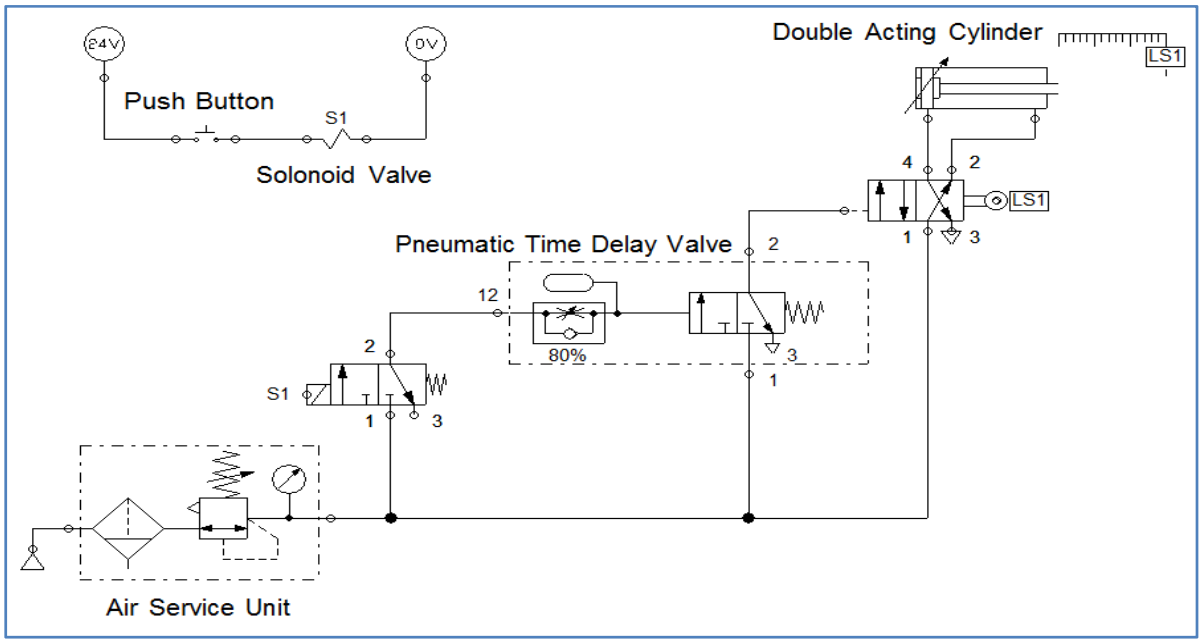

Figure No 3 Control of a Double acting cylinder using TIME DELAY valve.

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Pneumatic trainer	Compressor, Reservoir, FRL, SAC, DAC , Air motor, Direction control valves , pipes, connectors. Logic function valves- OR, AND, . Time delay valves.	1
2.			

X Precautions to be Followed

1. Avoid improper handling of compressed air.
2. Don't apply excessive pressure on actuator .

XI Procedure

- Clean the trainer unit to ensure clean working environment.
- Follow the instructions given by the teacher and in operating manual.
- Know the specifications of all components either from operators manual or from the specification given on each component and note down in the table.
- Read circuit diagram, select component to be used.
- Connect all selected components as per circuit diagram for the given Logic functions (AND/OR/TIME DELAY).
- Check all connections for proper fitting. Start and run the compressor to store sufficient pressure upto 6 bar in reservoir. Check FRL unit for lubricating oil level.
- Observe actuation of the given Logic functions (AND/OR/TIME DELAY).

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

Draw actual circuit constructed and prepare truth table for Logic functions AND / OR

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. A double acting cylinder is used to press together glued components . Upon operation of a press button, the clamping cylinder slowly advances. Once the fully extended position is reached , the cylinder is to remain for a time of t = 6 seconds and then immediately retract to the initial position. A new start cycle is only possible after the cylinder has fully retracted and after a delay of 5 seconds. During this delay the finished part is manually removed and replaced with new parts for gluing. The retracting speed should be fast, but adjustable.
2. List practical applications of AND , OR valve.
3. Write the functions of pneumatic timer delay valves.
4. Differentiate between ON time delay and OFF time delay with help of symbols

[Space for Answer]

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XX References / Suggestions for Further Reading

1. https://www.youtube.com/watch?v=7ucJV41LkXo
2. https://www.youtube.com/watch?v=uWwGPy7AjaA
3. https://www.youtube.com/watch?v=BX2XfIID7l0
4. https://www.youtube.com/watch?v=hTA-mLXZM5M
5. https://www.youtube.com/watch?v=cfjKk79uXr8
6. https://www.youtube.com/watch?v=i4aaNDDHVnE

XXI Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	20%
2	Calculation of final readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(10)	**Product Related(15)**	**Total (25)**	