SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM NAGAR, KATTANKULATHUR – 603 203

ME3764 MECHATRONICS AND AUTOMATION LABORATORY MANUAL

(Seventh Semester B.E/B.Tech Students for the Academic Year 2026-2027)

R2023

Prepared By

Faculty Members

Department of Mechanical Engineering

(Private Circulation Only)

SRM VALLIAMMAI ENGINEERING COLLEGE, SRM NAGAR,

KATTANKULATHUR-603203

P.Ramu,M.E, Asst. Professor, Department of Mechanical Engineering_SRM-VEC

Department of Mechanical Engineering

Instructions to the students

The following instructions must be followed by the students in their laboratory classes.

1. Students are expected to be punctual to the lab classes. If they are late, they will be considered absent for that particular session.
2. Students should strictly maintain the dress code (i.e.) they have to wear the lab uniform with black shoes.
3. Students must bring their observation notes, record notes (completed with previous experiment) and the calculator to every lab class without fail.
4. Students are advised to come with full preparation for their lab sessions by
    a. Reading the detailed procedure of the experiment from the laboratory manual.
    b. Completion of observation notebook (i.e.) Aim, Apparatus required, Formula (with description), least count calculation, diagrams, and the tabular column should be written in the observation note before entering into the laboratory.
5. Data entered in the observation notebook must be by pen only.
6. Students must get attestations immediately for their observed readings.
7. Students are advised to get their results evaluated in the observation note book on the same day of that experiment.
8. Class assessment marks for each experiment is based only on their performance in the laboratory.
9. Record note has to be completed then and there and get corrected when the students are coming or the next lab class.
10. Students must strictly maintain silence during lab classes.
11. If any of the students is absent for the lab class for genuine reasons, he/she will be permitted to do the experiment during the repetition class only.
12. Students are advised to perform their experiments under safety care.
13. If any student is found causing damage to the lab equipments, he/she shall replace the same with a new.

Department of Mechanical Engineering

VII Semester Mechanical Engineering

ME3764- MECHATRONICS AND AUTOMATION LABORATORY

SYLLABUS

OBJECTIVES:

The main learning objective of this course is to prepare the students:

1. To introduce students to the principles of mechatronics and automation through practical laboratory experiments.
2. To develop skills in designing, modelling, and analyzing pneumatic, hydraulic, and electrical systems.
3. To provide hands-on training in programming and interfacing microcontrollers for control of actuators and motors.
4. To familiarize students with IoT concepts, sensors, actuators, and communication protocols for automation.
5. To enable students to integrate hardware and software for real-time monitoring and control of mechatronic systems.

MECHATRONICS LIST OF EXPERIMENTS: 20

1. Measurement of Linear/Angular Position, Direction, and Speed using Transducers.
2. Speed and direction control of DC servomotor.
3. Addition, Subtraction, and Multiplication Programming in 8051.
4. Programming and Interfacing of Stepper motor Using 8051
5. Sequencing of pneumatic circuits.
6. Sequencing of hydraulic, pneumatic, and electro-pneumatic circuits using Software.

AUTOMATION (IoT) LIST OF EXPERIMENTS 25

1. Familiarization with the concept of IoT and its open-source microcontroller/SBC.
2. Write a program to turn ON/OFF the motor using a microcontroller/SBC through the internet.
3. Write a program to interface sensors to display the data on the screen through the internet.
4. Interface the sensors with the microcontroller/SBC and write a program to turn ON/OFF the solenoid valve through the internet when sensor data is detected.
5. To interface the sensor with a microcontroller/SBC and write a program to turn ON/OFF the linear/rotary actuator through IoT when sensor data is detected.
6. To interface Bluetooth/Wi-Fi with a microcontroller/SBC and write a program to send sensor data to a smartphone using Bluetooth/Wi-Fi.

TOTAL : 45 PERIODS

OUTCOMES:

Upon the completion of this course, the students will be able to

1. Demonstrate the working principles of pneumatic, hydraulic, and electrical systems in mechatronics applications.
2. Apply microcontroller programming to control motors, actuators, and sequencing of circuits.
3. Design and implement automation solutions using IoT boards, sensors, and actuators.
4. Interface communication modules (Bluetooth/Wi-Fi) to transmit sensor data and enable remote control.
5. Integrate mechatronic subsystems into complete automation solutions and evaluate their performance.

LIST OF EQUIPMENTS:

1. Basic Pneumatic Trainer Kit (1 No's)
2. Basic Electro-Pneumatic Trainer Kit (1 No's)
3. Basic Electro-Pneumatic with PLC Trainer Kit (1 No's)
4. 8051 Microcontroller kit with steeper motor (2 No's)
5. Hydraulic and Pneumatic Systems Simulation Software (5 User)
6. Arduino ESP32 Trainer Kit (2 No's)
7. Level Control System Trainer (2 No's)
8. Conveyor Control Trainer (2 No's)

ME3663	**PROGRAM OUTCOMES**											**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO 1	3	2	3	2	3	1	-	2	2	1	2	3	3
CO 2	3	2	3	2	3	1	-	2	2	1	2	3	3
CO 3	3	2	3	2	3	1	-	2	2	1	2	3	3
CO 4	3	2	3	2	3	1	-	2	2	1	2	3	3
CO 5	3	2	3	2	3	1	-	2	2	1	2	3	3
Average	3	2	3	2	3	1	-	2	2	1	2	3	3

(1 – LOW, 2 – MEDIUM, 3 – HIGH)

INDEX

EXPT NO	DATE	NAME OF THE EXPERIMENT	CYCLE
-		Introduction to Mechatronics	
Experiments on Transducers Using 8051 & 8085			
1		Measurement of Linear/Angular Position, Direction, and Speed using Transducers.	
Speed Control of Dc Motor			
2		Speed Control of DC Drives Using PID Controller Interfacing Unit	
Experiments on Using 8051 & 8085			
3		Addition-Subtraction-Multiplication - using 8085 Assembly language programming	
		Stepper motor interface with 8051 Microcontroller kit	
Experiments on Pneumatic Trainer Kit			
4		Design and Testing of Pneumatic Circuits to Control the Speed of the Cylinder By Meter In And Meter Out Valve Circuit	
		Design and Testing of Pneumatic Circuits Impulse pilot operation of single acting cylinder.	
		Design and Testing of Pneumatic Circuits Operation of double acting cylinder with AND & OR logic circuit	
		Design and Testing of Pneumatic Circuits Single cycle automation of double acting cylinder using limit switch	
Experiments on Electro-Pneumatic Trainer Kit			
5		Design and Testing of Electro-Pneumatic Circuits Operation of single and double acting cylinder using single solenoid valve	

		Design and Testing of Electro-Pneumatic Circuits Operation of double acting cylinder using double solenoid valve.	
Experiments on Electro-Pneumatic with PLC Trainer Kit			
6		Control of double acting cylinder with UP and DOWN counter using PLC	
		Operation of single acting cylinder with AND and OR logic using PLC	
Experiments Using Fluid-SIM Software			
7		Modeling and analysis of basic Hydraulic, Pneumatic and Electrical circuits using Fluid SIM software	
Automation (IoT) List of Experiments			
8		Familiarization with concept of IoT and its open source microcontroller.	
9		Write a program to turn ON/OFF motor using Microcontroller through internet	
10		Write a program to interface sensors to display the data on the screen through internet.	
11		Interface the sensors with microcontroller and write a program to turn ON/OFF solenoid valve through internet when sensor data is detected	
12		To interface sensor with microcontroller and write a program to turn ON/OFF Linear Actuator through IoT when sensor data is detected	
13		To interface Bluetooth with microcontroller and write a program to send sensor data to smart phone using Bluetooth	
Additional and Advanced Experiment			
15		Actuation of pneumatic cylinder to find out Force Vs Pressure	

INTRODUCTION TO MECHATRONICS

Aim: To study about the important features, about Mechatronics system.

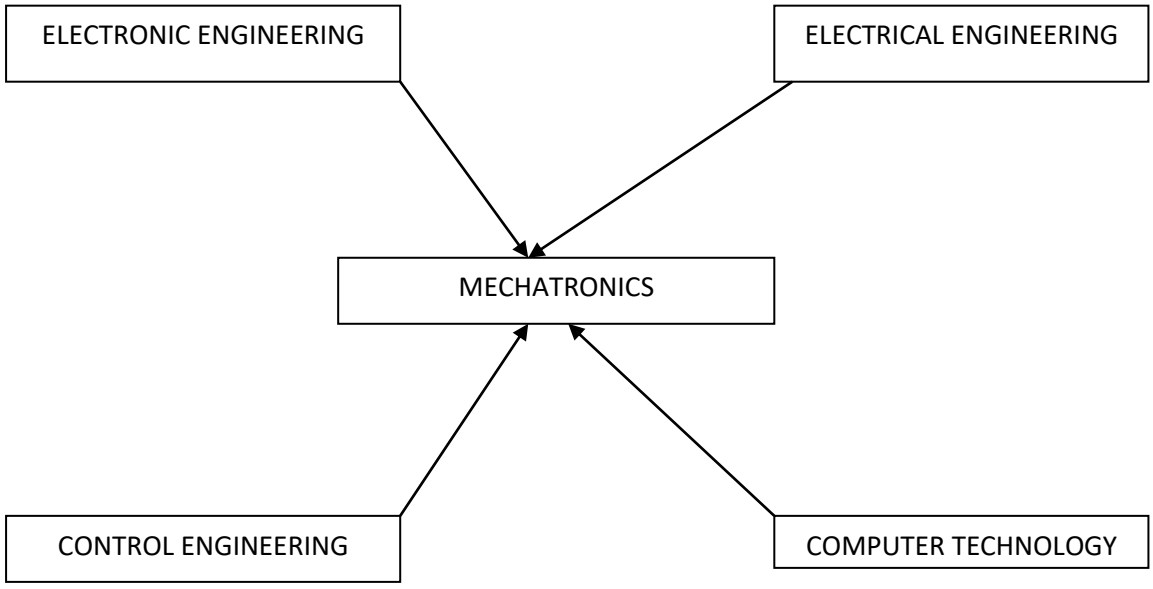
Introduction to Mechatronics System:

Mechatronics is a word originated in Japan in 1980s to denote the combination of technologies which go together to produce industrial needs. Mechatronics is one of the new and existing fields on the engineering landscape, subsuming parts of traditional engineering fields and requiring a broader approach to the design of system that we can formally call as Mechatronics system.

Today many industries improving their product though automation which is based on the inter connection between the electronics control systems and mechanical engineering. Such control systems generally use microprocessors as controllers and have electrical sensors extracting information from mechanical inputs through electrical actuators to mechanical systems.

It can be considered to be application of computer based digital control techniques through electronic and electric interface to mechanical engineering problems. Success fully design of mechatronics can lead to products that are extremely attractive to customer in quality cost-effectiveness.

GRAPHICAL REPRESENTATION OF MECHATRONICS:



Mechatronics is the synergistic integration of Mechanics and Mechanical Engineering, Electronics, Computer Technology, and IT to produce or enhance products and systems.

Mechatronics brings together areas of technology involving sensors and measurement systems, drive and actuation systems, analysis of the behaviour of systems microprocessor systems. The integration across the traditional boundaries of mechanical engineering, electrical engineering, electronics and control engineering has to occur at earliest stages of the design process if cheaper, more reliable; more flexible systems are to be developed.

ELEMENTS OF MECHATRONICS SYSTEMS:

- Actuators and sensors
- Signals and conditioning
- Digital logic systems
- Software and data acquisition systems
- Computers and display devices

APPLICATIONS OF MECHATRONICS ENGINEERING:

- Electronic home appliances
- Electronic entertainment products
- Engine systems (Cars)
- Large scale applications

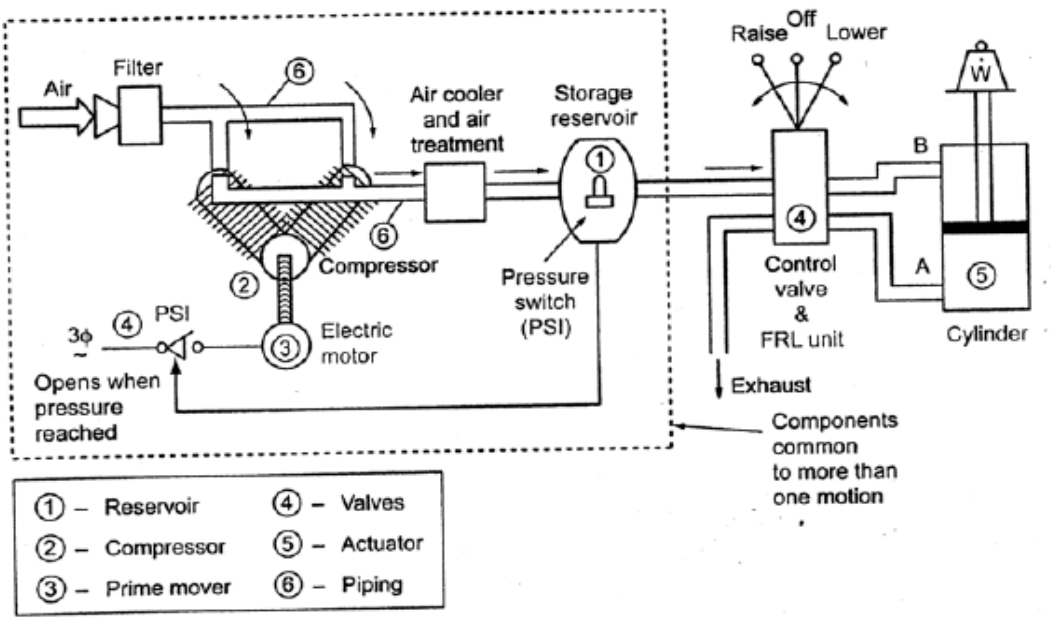
PNEUMATICS AND HYDRAULIC SYSTEMS

Most of mechatronics systems work based on motion or action by means of sort. This motion or actuation caused either by torque or force form which displacement and acceleration can be obtained. To obtain this force or acceleration, actuators are mainly used. Actuator is a device which provides enough force needed to stat the mechatronics systems. At the same, power should be supplied to the actuator to activate it. The power supplied to actuators might be any one of the following forms such as compressed air, pressurized fluid, electric power and mechanical power. If compressed air supplied to the system, it is called as pneumatic system. But if pressurized fluid is supplied to flow the system it is called as hydraulic system.

BASIC ELEMENTS OF PNEUMATIC SYSTEM:

- Compressor and motor

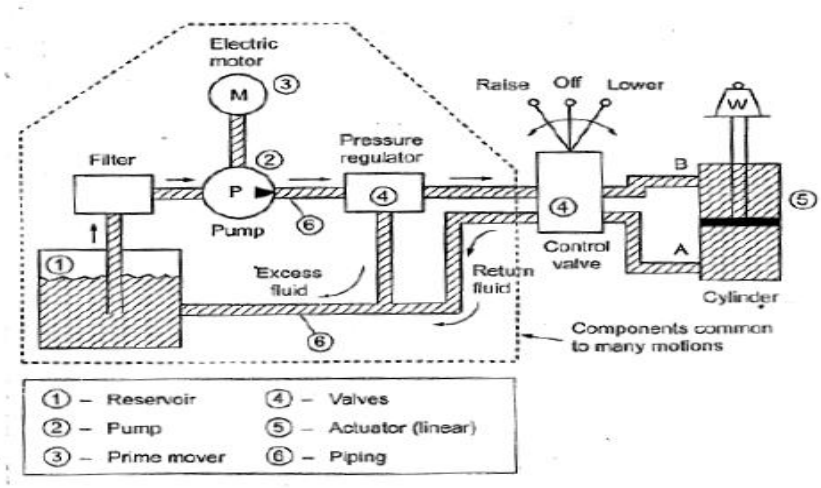
- Pressure relief valve and check valve
- Cooler, filter and water trap
- Air receiver
- Directional control valves
- Actuator or pneumatic cylinder



Schematic Layout of Pneumatic System

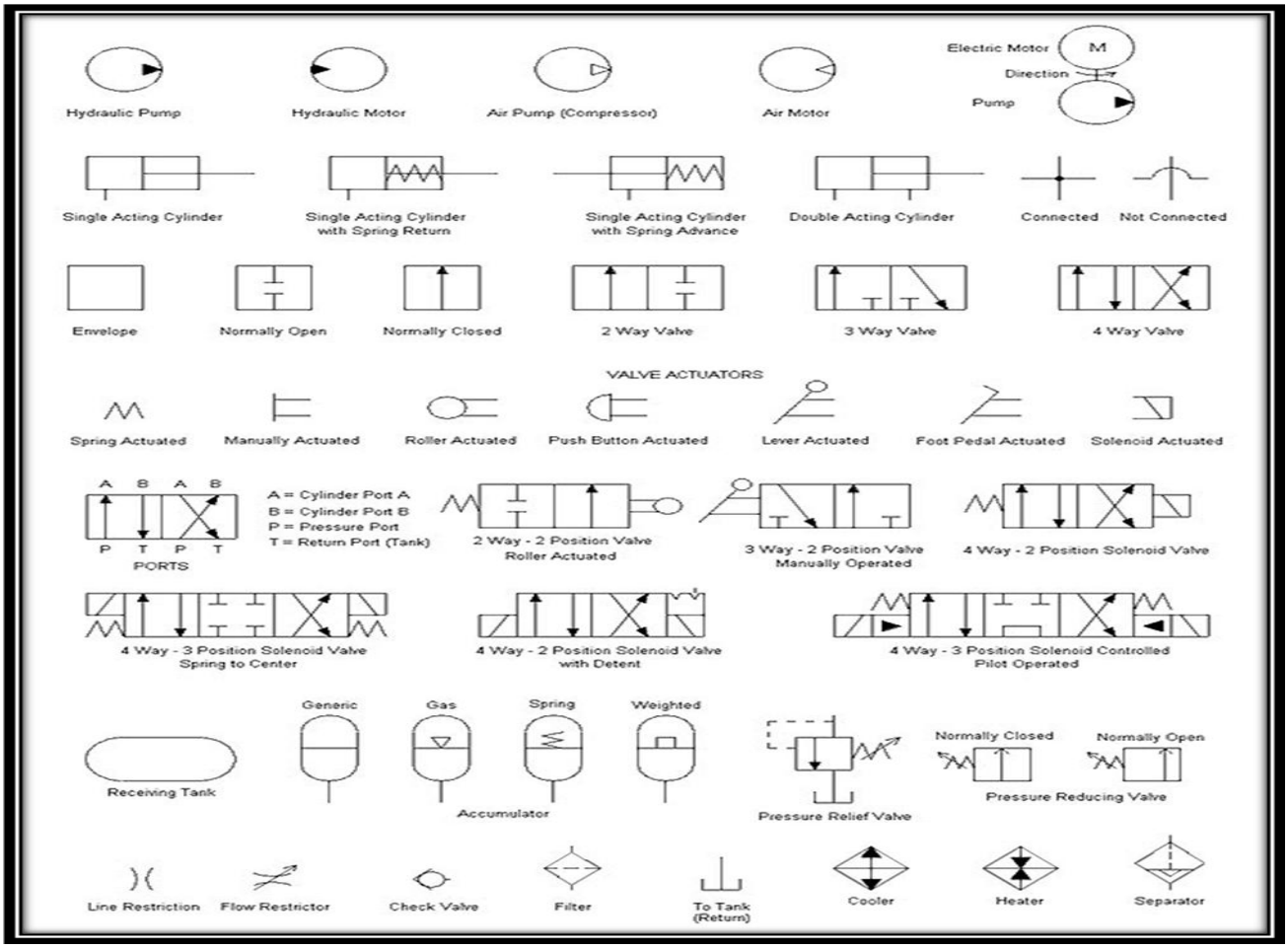
BASIC ELEMENTS OF HYDRAULIC SYSTEM:

- Reservoir (Or air tank)
- Pump
- Prime mover
- Valves
- Actuator
- Fluid-transfer piping



Schematic Layout of Hydraulic System

BASIC PNEUMATIC AND HYDRAULIC SYMBOL



STUDY OF LINEAR VARIABLE DIFFERENTIAL TRANSFORMER

AIM

Measurement of displacement using LVDT.

APPARATUS REQUIRED:

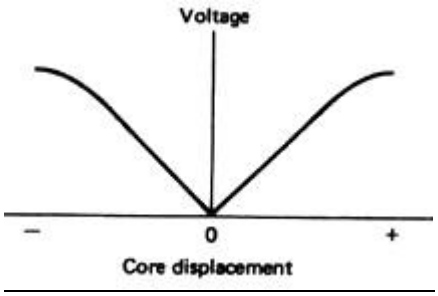
- LVDT Kit
- Multi-meter
- Connecting wires

PROCEDURE:

- Connect the sensor module on the corresponding place
- Switch on the power supply
- Connect LVDT output to the voltmeters terminals
- The core in initially brought to null position
- By varying zero setting change the voltmeter reading to zero value
- First turn the nut in clockwise direction to move core inwards i.e left of null position and take respective voltage readings on the voltmeter.
- If required adjust the span setting to change the voltmeter reading
- Now run nut in anticlockwise direction to move the core towards right of null point and again take respective voltage reading from voltmeter.
- Plot the graph from the observations taken.

OBSERVATIONS

SL.NO.	DISPLACEMENT MICROMETER	OUTPUT VOLTAGE



Result:

STUDY OF STRAIN GAUGE

AIM

Measurement of strain for the applied load using given strain gauge trainer.

APPARATUS REQUIRED:

- Strain cantilever
- Multi-meter
- Connecting wires

PROCEDURE:

- Connect the sensor module on the corresponding place
- Switch on the power supply
- Connect strains output +ve and -ve to the output to the voltmeters terminals
- constant voltage source are given as 5V. give some time to stabilize the instrument reading.
- By varying zero setting change the voltmeter reading to zero value
- Now apply weight at the cantilever beam
- Note down the readings in strain's corresponding voltage display on the trainer.
- If required adjust the span setting to change the voltmeter reading
- Tabulate the reading and plot the graph for applied load and the output voltage.

OBSERVATIONS

SL.NO.	Applied Load	Displayed output voltage

SAMPLE CALCULATION:

$$\text{Strain} = \frac{6PL}{bt^2 * 2 * 10^6}$$

Where,

P = Applied load in Kg

(L)length = **30 cm**

(b) Width = **3 cm**

(t) thickness = **0.25 cm**

Young's modulus = **$2*10^6$**

$$\% \text{ of Error} = \frac{\text{Strain}_{\text{Practical}} - \text{Strain}_{\text{theoretical}}}{\text{Strain}_{\text{theoretical}}} \times 100$$

Result:

STUDY OF SPEED TRANSDUCER

AIM

Measurement of speed of the PMDC motor using tacho generator transducer and verify the performance with displayed speed on the display.

APPARATUS REQUIRED:

- PMDC motor
- Sensor
- Multi-meter
- Connecting wires

PROCEDURE:

- Connect the sensor module on the corresponding place(Right side of the board)
- Switch on the power supply.
- Connect Speed transducer's output +ve and -ve to the Speed display's +ve and - ve terminals.
- By varying Zero setting change the voltmeter reading in to Zero value.
- Control voltage is varying from 0-12 V. This value can be verified across the motor.
- The op-amp based PWM generator and MOSFET based power driver along tacho generator feedback to get the speed output in terms of voltage.
- If required adjust the span setting to change the voltmeter reading (Max reading).
- Plot the graph between speed in RPM and the tacho generator output voltage.

OBSERVATIONS

SL.NO.	Speed in RPM	Output voltage in Volt

Result:

VIVA QUESTIONS AND ANSWERS

1. What are the two basic types of the displacement and the position transducers?

The two basic types are,

1. Contact sensors

2. Non contact sensors.

2. Write about the strain – gauged element?

The electrical resistance strain gauge is a metal wire, metal foil strip, or a strip of semiconductor material, which is wafer – like and can be stuck onto surfaces like a postage stamp.

3. Write about the gauge factors for different types of strain gauges?

The gauge factor of metal wire or foil strain gauges with the metals generally used is about 2.0. Silicon p – and n – type semiconductor strain gauges have gauge factors of about + 100 or more for p- type silicon and – 100 or more for n – type silicon.

4. Define gauge factor. The gauge factor is defined as the ratio of per unit change in resistance to per unit change in length. Gauge factor Gf= $\Delta R/R$ $\Delta L/L$

5. Define LVDT?

The Linear Variable Differential Transformer consists of three coils symmetrically spaced along an insulated tube. The central coil is the primary coil and the other two are identical secondary coils, which are connected in series in such a way that their outputs oppose each other.

6. Determine the working Principle of LVDT?

When there is an alternating voltage input to the primary coil, alternating e.m.f.s are induced in the secondary coils. With the magnetic core central, the amount of magnetic material in each of the secondary coil is the same.

7. What are the uses of LVDT?

The uses are as follows. a. Widely used as primary transducers for monitoring displacements. b. Also used as secondary transducers in the measurement of force, weight and pressure.

8. Write about inductive proximity switch?

Inductive proximity switch consists of a coil wound round a core. When the end of the coil is close to a metal object is inductance changes. This change can be monitored by its effect on a

resonant circuit and the change used to trigger a switch. It can only be used for the detection of metal objects and is best with ferrous metals.

9. What is an encoder?

An encoder is a device that provides a digital output as a result of a linear or angular displacement

10. What are the two types of position encoders?

The two types of position encoders are, a. Incremental encoders b. Absolute encoders.

SPEED CONTROL OF DC DRIVES USING PID CONTROLLER INTERFACING UNIT

AIM

To control the speed of the DC motor using PID controller interfacing unit.

THEORY

PID CONTROLLER

One of the most powerful but complex controller mode operation combines the proportional, integral and derivative mode. This system can be used for virtually any process condition. The analytical expression is.

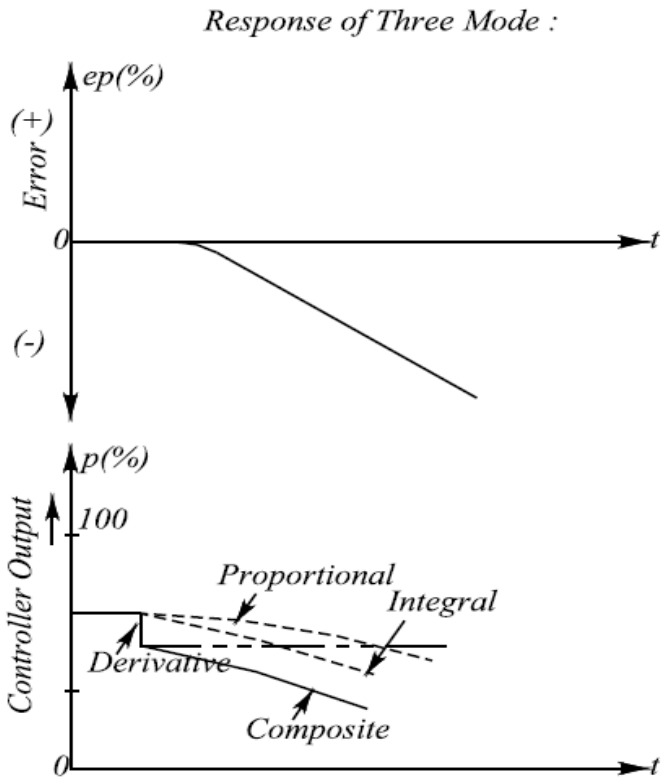
$$P = K + p\, e_p + K_p\, K_i \int_0^t e_p \,.\, dt + K_p\, K_D \frac{de_p}{dt} + P_I \quad (0)$$

Where K_P	=	Proportional gain between error and controller Ouptut (% per %)
de_p / dt	=	Rate of change of error (%S)
K_D	=	Derivative gain constant (% - S/%)
K_I	=	Scaling between error and controller output.

$K_i \int_0^t e_p \,.\, dt$ = *Controller output equal to the net are a under the e–time curve multiplied by* K_I. *We often say that the integral term accumulates error as a function of time.*

For every 1% *s of accumulated error time area*

Response of Three Mode



The mode eliminates the offset of the proportional mode and still provides fast response. The three mode controller action exhibits proportional, integral and derivative action.

PROCEDURE

- Switch ON the power button.
- User will see the following message.

Welcome to Vi Microsystems

Digital PID Controller

Select the PID Algorithm

INC-NORMAL PID DEC-SQUARE ROOT

- Press INC key to select NORMAL PID.

INC = AUTO MODE
DEC = MANUAL MODE

- Press INC key to run PID in Auto mode mode.

AUTO MODE
Max Range = 0000

- Set Max Range -500
- Set Point range-250
- $K_p = 0.1$
- $K_i = 0.01$
- $K_d = 1$
- Measure the motor speed CV and PV

S.No	Time (Secs)	Kp	Ki	Kd	Set Range	Max Range	Cv	Cp	Error= Set value- Pv value

Results:

VIVA QUESTIONS AND ANSWERS

1. What is an incremental encoder?

An incremental encoder is used for the measurement of angular displacement. A beam of light passes through slots in a disc and is detected by a suitable light sensor. When the disc is rotated, the sensor produces a pulsed output with the number of pulses being proportional to the angle through which the disc is rotated. Hence, the angular position of the disc is determined.

2. Write about absolute encoder?

An absolute encoder is used for the measurement of angular displacement. This gives an output in the form of a binary number of several digits, each such number representing a particular angular position. The rotating disc has three concentric circles of slots and three sensors to detect the light pulses.

3. What are the uses of photosensitive devices?

Photosensitive devices can be used to detect the presence of an opaque object by it breaking a beam of light or infrared radiation, falling on such a device or by detecting the light reflected back by the object.

4. Write about Hall Effect sensors?

When a beam of charged particles passes through a magnetic field, forces act on the particles and the beam is deflected from its straight line path. A current flowing in a conductor is like a beam of moving charges and thus can be deflected by a magnetic field.

5. What are digital signals?

Digital signals are discrete time signals in that they are not continuous functions of time but exist at only discrete times.

6. Why the signal conditioning is required?

Signal conditioning of analogue signals requires components such as amplifiers filter circuits and digital signal microprocessor.

7. Define Actuator.

An actuator is an output device which performs useful works

8. Classify actuator based on motion.

1. Linear motion

 Single acting cylinder

 Double acting cylinder

2. Rotary Motion

 Air motors

 Rotary actuators

3. Flow Control valve

9. When is cascade control Needed?

The need for cascade control will occur when a final control element experiences signal overlap i.e. when a trip valve mechanism is still held down , but the output signal has to been used and requires removal

10. Write down the principles of cascade control.

 A simple design procedure to determine the minimum number of groups in the circuit

 Evolve separate supply bus for each group

 Arrange selector valves to divert the supply to whichever is the active group

ADDITION-SUBTRACTION-MULTIPLICATION

AIM

To write an assembly language program for Add, Subtract and Multiplication- 8-bit numbers in memory and store the result in memory.

APPARATUS REQUIRED:

- 8085 Micro controller kit

THEORY:

The first data is brought to accumulator A and the second one in any one of the other registers says B. The addition is done using ADD. The result is then stored at 4152. The ADD instruction affects flags depending on result.

EXAMPLE ADDITION:

The two data to be added are at 4150 and 4151. The result is stored at 4152.

Data (4150) = 23

(4152) = 35

Result = 58

PROGRAM:

LDA 4150 ;

4150 (A) = 23

MOV B, A;

LDA 4151;

4151 A =35

ADD B;

(A) + (B) = (A)

STA 4152;

(A) 4152 = 58

HLT

OBJECT CODES FOR ADD:

MEMORY ADDRESS	OBJECT CODES	MNEMONICS
4100	3A	LDA@4150
4101	50	
4102	41	
4103	47	MOV B, A
4104	3A	LDA@4151
4105	51	
4106	41	
4107	80	ADD B
4108	32	STA@4152
4109	52	
410A	41	
410B	76	HLT

Procedure:

- Key in the opcodes from the address specified
- Enter data at 4150 and 4151 as specified in the Example
- Execute the program and check for the result ar 4152
- Change data at 4150 and execute each time and check for result

EXAMPLE SUBTRACT:

The two data to be added are at 4150 and 4151. The result is stored at 4152.

Data (4150) = 49

(4152) = 24

Result = 25

OBJECT CODES FOR SUBTRACT:

MEMORY ADDRESS	OBJECT CODES	MNEMONICS
4100	21	LXI H. 4150
4101	50	
4102	41	
4103	7E	MOV A, M
4104	23	INX H
4105	96	SUB M
4106	23	INX H
4107	77	MOV K, A
4108	76	HLT

Procedure:

- Key in the opcodes from the address specified
- Enter data at 4150 and 4151 as specified in the Example
- Execute the program and check for the result ar 4152
- Change data at 4150 and execute each time and check for result

OBJECT CODES FOR MULTIPLICATION :

MEMORY ADDRESS	OBJECT CODES	MNEMONICS
4100	3A	LDA 4152
4101	52	
4102	41	
4103	47	MOV B,A
4104	11	LXI D, 0000
4105	00	
4106	00	
4107	2A	LHLD 4150
4108	50	
4109	41	
410A	EB	XCHG
410B	19	LOOP DAD D
410C	05	DCR B
410D	C2	JNZ LOOP
410E	0B	
410F	41	
4110	22	SHLD 4154
4111	54	
4112	41	
4113	76	HLT

PROCEDURE:

- Key in the opcodes from the address specified.
- Enter data at 4150 and 4153 for execution
- Execute the program and check for the result at 4154 and 4155
- Change data at 4250 and 4151 and execute each time and check result

RESULT:

Thus the Add, Subtract and multiplication - 8-bit numbers in memory and store the result in memory are verified.

VIVA QUESTIONS AND ANSWERS

1. **What is a Microprocessor?**

   Microprocessor is a CPU fabricated on a single chip, program-controlled device, which fetches the instructions from memory, decodes and executes the instructions.

2. **What is Instruction Set?**

   It is the set of the instructions that the Microprocessor can execute.

3. **What is Band width?**

   The number of bits processed by the processor in a single instruction.

4. **What is clock speed?**

   Clock speed is measured in the MHz and it determines that how many instructions a processor can processed. The speed of the microprocessor is measured in the MHz or GHz.

5. **Define Interpreter.**

   An interpreter may be a program that either :-executes the source code directly; translates source code into some efficient intermediate representation (code) and immediately executes this; explicitly executes stored precompiled code[1] made by a compiler which is part of the interpreter system.

6. **Define Assembler.**

   An assembler is a program that takes basic computer instructions and converts them into a pattern of bits that the computer's processor can use to perform its basic operations.

7. **What is Assembly level language?**

   An assembly language is a low-level programming language for microprocessors. It implements a symbolic representation of the binary machine codes and other constants needed to program a particular CPU architecture. This representation is usually defined by the hardware manufacturer, and is based on mnemonics that symbolize processing steps (instructions), processor registers, memory locations, and other language features.

8. What are Mnemonics?

Mnemonics are instructions or commands to perform a particular operation given by user to microprocessor e.g MOV MIV ADD SUB IMUL.

9. What is a bus?

Information is transferred between units of the microcomputer by collections of conductors called buses.

There will be one conductor for each bit of information to be passed, e.g., 16 lines for a 16 bit address bus. There will be address, control, and data buses.

10. Distinguish between Microprocessor & Microcontroller.

- The microprocessor is a digital integrated circuit device that can be programmed with a series of instructions to perform specified functions on data.
- But micro controller is a computer on a chip which has memory, input, output on the chip itself.
- So, micro processor can perform only few functions but micro controller can perform so many functions.

STEPPER MOTOR INTERFACING WITH 8051 MICRO CONTROLLER FOR CLOCKWISE ROTATION

AIM

To write an assembly language program for driving the stepper motor in clockwise direction.

APPARATUS REQUIRED:

- Stepper motor
- 8051 Micro controller kit #SD 4100 - Enter

PROGRAM:

MEMORY ADDRESS	OBJECT CODES	MNEMONICS
4100	90	MOV R4. #FF
4101	45	
4102	00	START: MOV DPTR, #LOOK UP
4103	78	
4104	04	
4105	E0	MOV R0, #04
4106	C0	
4107	83	JO: MOVX A, @DPTR
4108	C0	PUSH DPH
4109	82	
410A	90	PUSH DPH
410B	FF	
410C	C0	MOV DPTR #FFCOH
410D	7A	

410E	04	
410F	79	MOVX @ DPTR, A
4110	0F	DJNZ R4, CALL
4111	7B	
4112	0F	HLT: SJMP HLT
4113	DB	
4114	FE	LOOK UP: DB 09H, 05H, 06H, 0AH
4115	D9	
4116	FA	
4117	DA	
4118	F8	
4119	F0	
411A	D0	DLY2: MOV R1, #FFH
411B	82	
411C	D0	DLY1: MOV R1, #FFH
411D	83	
411E	A3	DLY: DJNZ R3, DLY
411F	D8	
4120	E4	DJNZ R1, DLY1
4121	80	
4122	DD	DJNZ R2, DLY2

ENTER

. ENTER

SD SPACE

4500 09 05 06 0A

ENTER

. ENTER

GO SPACE

4100 ENTER

RESULT:

Thus the stepper motor was driven in clockwise direction.

VIVA QUESTIONS AND ANSWERS

1. What is zener voltage?

In the reverse direction, the diode conducts very little when the voltage is below the breakdown value. This critical limiting value of reverse voltage is known as zener voltage.

2. Name three output characteristics of transistor configuration.

a. Saturation region b. Active region c. Cut-off region.

3. What is a microprocessor?

A microprocessor is a multipurpose, programmable, clock driven, registers – based electronic device that reads binary instructions from a storage device called memory, accepts binary data as input and processes data according to those instructions, and provides results as output.

4. What are the four components of a programmable machine?

A typical programmable machine can be represented with four components. a. Microprocessor b. Memory c. Input d. Output.

5. Define the terms. a) Bus b) RAM c) ROM.

BUS – A group of lines used to transfer bits between the microprocessor and other components of the computer system. RAM – Random Access Memory. Data is stored in a read / write memory. ROM – Read only Memory. A memory that stores binary information permanently. The information can be read from this memory but cannot be altered.

6. What the types of languages used?

The types of languages used are, a. Machine language b. Assembly language c. Low – level language d. High – level language.

7. What is a machine language?

The binary medium of communication with a computer through a designed set of instructions specific to each computer.

8. What is a assembly language?

A medium of communication with a computer in which programs are written in mnemonics. An assembly language is specific to a given computer.

9. What is low – level language?

A medium of communication that is machine – dependent or specific to a given computer. The machine and the assembly language of a computer are considered low – level languages. Programs written in these languages are not transferable to different types of machines.

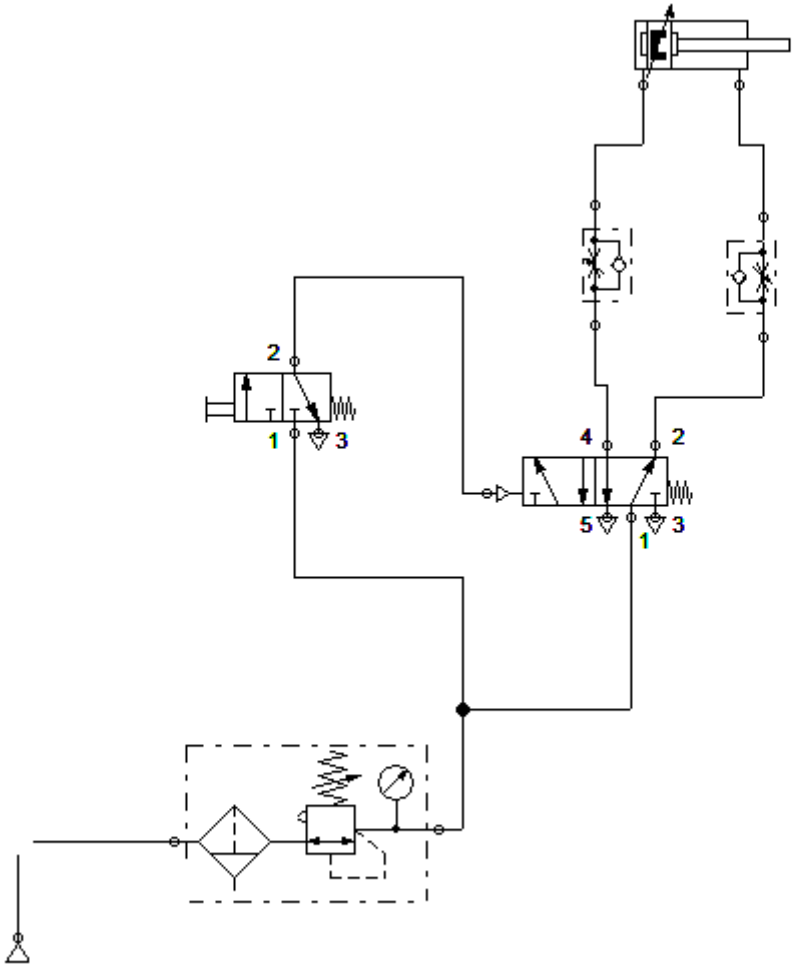
10. What is a high – level language?

A medium of communication that is independent of a given computer. Programs are written in English – lie words, and they can be executed on a machine using a translator (a compiler or an interpreter).

EXPERIMENTS USING PNEUMATIC TRAINER KIT

P.Ramu,M.E, Asst. Professor, Department of Mechanical Engineering_SRM-VEC

Ex. No:



Ex. No: **Date :**

DESIGN AND TESTING OF PNEUMATIC CIRCUITS TO CONTROL THE SPEED OF THE CYLINDER BY METER IN AND METER OUT VALVE CIRCUIT

AIM:

To control the speed of double acting cylinder using Meter In and Meter Out valve circuit in Basic Pneumatic Training Kit

APPARATUS REQUIRED:

- Air service unit (Power Source unit)
- FRL Unit
- Double acting cylinder
- 3/2 push button spring return DCV
- 5/2 single pilot DCV
- Connecting Tubes

PROCEDURE:

- Design and draw circuit diagram as per the given application.
- Connect the FRL unit to the main air supply.
- The various components are connected as per circuit.
- Block the valve operation if necessary.
- Check the leakage of air supply and correct it.
- Open the valve and operate the cylinder.

RESULT:

Thus the speed of double acting cylinder was controlled using Metering In and Metering Out circuit in Pneumatic Trainer Kit.

Viva Questions

1. Define Mechatronics.

The term Mechatronics is used for the integration of microprocessor control system, electrical systems and mechanical systems. Mechatronics is defined as the integration of precision mechanical & electronic control for the development of smart products & process.

2. **What is a system? Give an example.**

A system can be considered as a box, which has an input, and an output and where it is not concerned with what goes on inside the box but only the relationship between the output and the input. Example: A motor may be thought of as a system, which has as its input electric power and as output the rotation of a shaft.

3. **What is a measurement system?**

A measurement system can be considered as a black box, which is used for making measurements. It has as its input the quantity being measured and its output the value of that quantity.

4. **Write about the sensor and give an example.**

A sensor, which responds to the quantity being measured by giving as its output a signal which is related to the quantity. Example: A thermocouple is a temperature sensor. The input to the sensor is a temperature and the output is an e.m.f. which is related to the temperature value.

5. **Write about the signal conditioner?**

A signal conditioner takes the signal from the sensor and manipulates it in to a condition, which is suitable for either display, or in the case of a control system, for use to exercise control.

6. What are the elements of the closed loop control system?

The various elements of a closed loop control system are, a. Comparison element b. Control element c. Correction element d. Process element e. Measurement element

7. What are the two types of feedback loop?

The two types of feedback loop are, a. Positive feedback loop b. Negative feed back loop. "The feedback is said to be negative/positive feedback when the signal; which is feedback,

subtracts/adds from the input value. It is required to control a system. The control elements decide what action to take when it receives an error signal".

8. What are the types of control elements?

There are two types of control elements. They are a. Hard – wired systems b. Programmable systems.

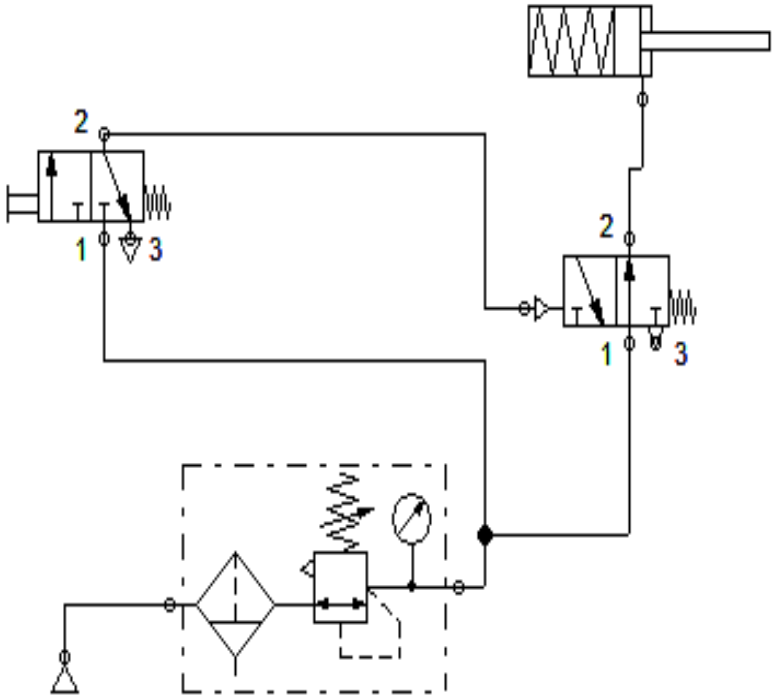
9. Write about the Mechatronics approach in a micro-processor – controlled washing machine?

In the microprocessor-controlled washing machine, a mechanical system has become integrated with electronic controls. As a consequence, a bulky mechanical system is replaced by a much more compact microprocessor system, which is readily adjustable to give a greater variety of programs.

10. What is the larger scale application of Mechatronics?

A larger scale application of Mechatronics is a Flexible Manufacturing engineering System (FMS) involving computer – controlled machines, robots, automatic material conveying and overall supervisory control.

Ex. No:



Ex. No: **Date :**

DESIGN AND TESTING OF PNEUMATIC CIRCUITS IMPULSE PILOT OPERATION OF SINGLE ACTING CYLINDER

AIM:

To operate a single acting cylinder using an impulse pilot valve in pneumatic trainer kit

APPARATUS REQUIRED:

- Air service unit (Power Source unit)
- FRL Unit
- Single acting cylinder
- 3/2 push button spring return DCV
- 3/2 Pilot operated spring return DCV.
- Connecting Tubes

PROCEDURE:

- Design and draw circuit diagram as per the given application.
- Connect the FRL unit to the main air supply.
- The various components are connected as per circuit.
- Block the valve operation if necessary.
- Check the leakage of air supply and correct it.
- Open the valve and operate the cylinder.

RESULT:

Thus the single acting cylinder was operated an impulse pilot valve in Pneumatic Trainer kit.

Viva Questions

1. **What is pneumatic direction control valve?**

   Pneumatic direction control valve is used to control the direction of air path. These Valves have generally two, three, four (or) five ports: These ports are designated as P: Compressor line port R: Exhaust port (T is case of hydraulics) A, B: Working ports connected to actuator.

2. **What is the use of Time Delay Valves**?

   Pneumatic time delay valves are used to delay operations where time based sequences are required.

3. **What is a fast exhaust valve?**

   A fast exhaust valve is used to vent cylinder quickly. It is primary used with spring return (single acting) pneumatic cylinders.

4. **Differentiate between hydraulic and pneumatic systems?**

   The working fluid of hydraulic system is water (or) oil (or) any liquid. The working fluid of pneumatic circuit is air Hydraulic systems are designed for heavy loads where as pneumatic systems are designed for low (or) medium loads.

5. **What is the function of pneumatic circuit using quick exhaust valve?**

   By quickly exhausting the air from the cylinder, the cylinder speed can be exhausted.

6. **What is Time delay circuit?**

   In certain applications, the impulse to the main direction control valve may have to be delayed to pre-determined time for different operational reasons. A pneumatic time delay valve may be used in such cases. A pneumatic circuit using this time delay valve is known as time delay circuit.

7. **What is the use of compressor?**

   A compressor is a machine which compresses air (or) any other gas from atmospheric pressure to a desired higher pressure level.

8. Define FRL unit.

Air is not clean and hence contamination may result in pneumatic circuit. Also, due to time fluctuations, the receiver air pressure does not remain constant. Also, some parts of the Pneumatic system have to be lubricated for proper maintenance. For cleaning the air, regulating the pressure of air and lubricating pneumatic parts, three units 'Filter - Pressure Regulator - Lubricator' (Trio unit) are put together and this combined unit - Trio unit - is called FRL unit.

9. Name two basic types of compressors?

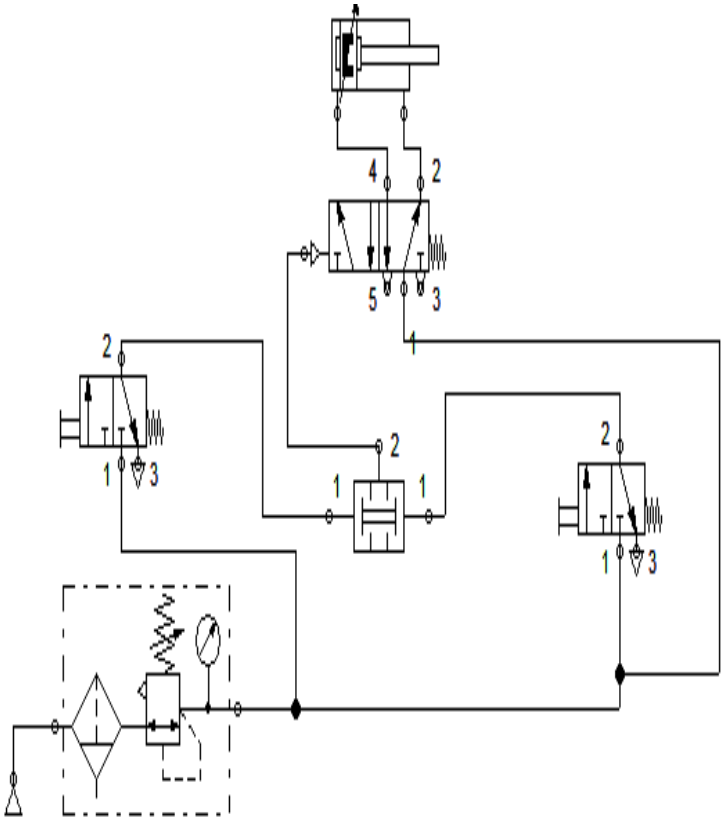
1. Positive displacement compressors

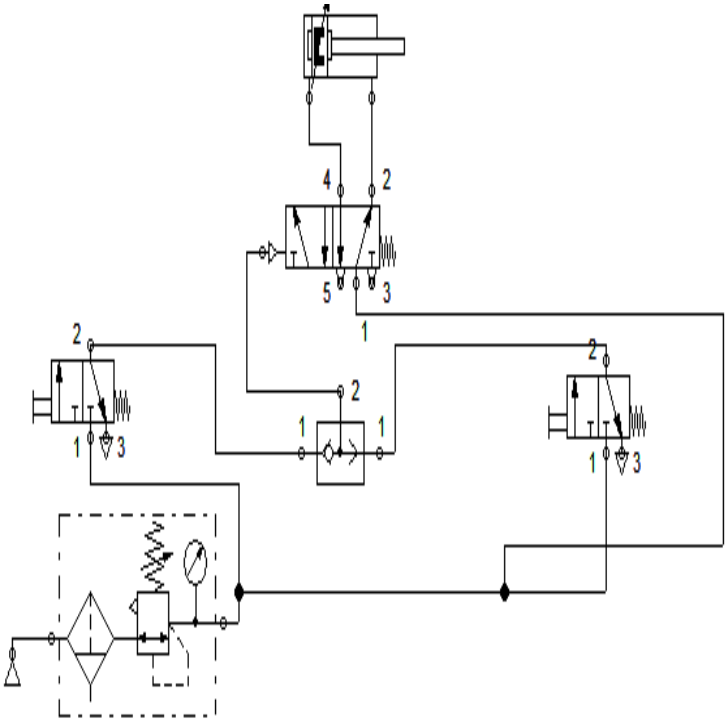
2. Dynamic (Turbo) compressors.

10. Differentiate between single acting and double acting compressors.

- In a single acting compressor, the compression takes place 011 one side of the piston for each revolution of crank shaft.
- In a double acting cylinder, compression takes place on both faces of the piston giving two compression strokes for each revolution of the crankshaft.

Ex. No:





Ex. No: **Date :**

DESIGN AND TESTING OF PNEUMATIC CIRCUITS OPERATION OF DOUBLE ACTING CYLINDER WITH AND & OR LOGIC CIRCUIT

AIM:

To operate a double acting cylinder using AND & OR logic circuit in Pneumatic Trainer Kit

APPARATUS REQUIRED:

- Air service unit (Power Source unit)
- FRL Unit
- Double acting cylinder
- 3/2 push button spring return DCV
- 3/2 single pilot spring return DCV
- AND/OR logic valve
- Connecting Tubes

PROCEDURE:

- Design and draw circuit diagram as per the given application.
- Connect the FRL unit to the main air supply.
- The various components are connected as per circuit.
- Block the valve operation if necessary.
- Check the leakage of air supply and correct it.
- Open the valve and operate the cylinder.

RESULT:

Thus the double acting cylinder using AND & OR logic circuit was operated in Pneumatic Trainer kit.

Viva Questions:

Viva Questions

1. Define kinematic pair.

The two links or elements are joined together to form a pair. If the relative motion between them is completely or successfully constrained, the pair is known as kinematic pair.

2. When is cascade control needed?

The need for cascade control will occur when a final control element experiences signal overlap ie; when a trip valve mechanism is still held down, but the output signal has been use and requires removal.

3. List the features of synchronous motor.

 It operates at a current speed from no load to full load Power factor of the motor can be controlled easily

4. What is a stepper motor?

A stepper motor is a rotating machine which converts a DC voltage pulse into a series of discrete rotational steps. Each step position is an equilibrium position without further excitation; this makes it ideally suitable for the use with digital control

5. What is stepper motor?

A stepper motor is a device which transforms electrical pulses into equal increments of rotary shaft motion called steps.

6. What is servomotor?

The motors used in automatic control systems or in servomechanism are called servomotors. They are used to convert electrical signal into angular motion.

7. What is synchro?

A synchro is a device used to convert an angular motion to an electrical signal or vice versa.

8. At what conditions SPDT, DPST an DPDT switches are used?

a. SPDT (Single Pole, Double Throw): When we require ON and OFF operation as the circuit is actuated, SPDT is used. b. DPST (Double Pole, Single Throw): When we need to turn two separate circuits ON and OFF simultaneously with a single switch, DPST is used. c. DPDT (Double Pole, Double Throw): When a switch is turned ON and OFF between N and O with double pole switches, DPDT is used.

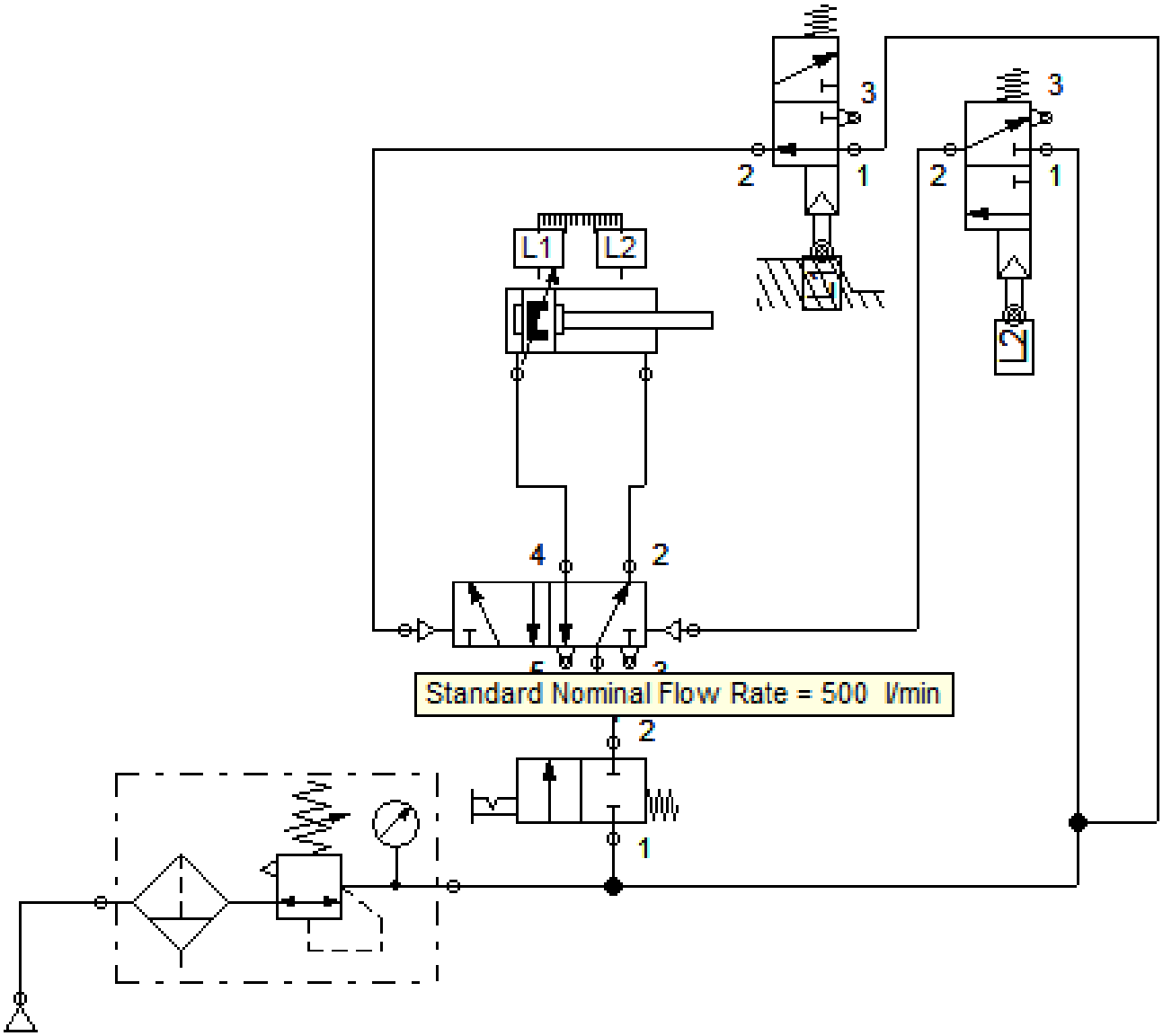
9. What are the factors to be considered for selecting solenoids?

a. The size of the mechanical load. b. The movement distance of plunger. c. The type of electrical connections. d. The type of value of current and voltage.

10. What is the principle of relay?

Relay is used for many control functions and essentially an electro-mechanical switch. It uses basic switching principles and solenoid actuation.

Ex. No:



Ex. No: **Date :**

DESIGN AND TESTING OF PNEUMATIC CIRCUITS SINGLE CYCLE AUTOMATION OF DOUBLE ACTING CYLINDER USING LIMIT SWITCH

AIM:

To operate automatic operation of double acting cylinder in a single cycle using limit switch in Pneumatic Trainer Kit.

APPARATUS REQUIRED:

- Double acting cylinder
- 3/2 Roller Operated Spring Return DCV
- 5/2 Pilot Operated DCV
- FRL unit
- Connecting Tubes

PROCEDURE:

- Design and draw circuit diagram as per the given application.
- Connect the FRL unit to the main air supply.
- The various components are connected as per circuit.
- Block the valve operation if necessary.
- Check the leakage of air supply and correct it.
- Open the valve and operate the cylinder.

RESULT:

Thus the single cycle automation of double acting cylinder was operated by using limit switch in Pneumatic Trainer Kit.

Viva Questions

1. **What is a Fluid Power System?**

   A system that transmits and controls power through use of a pressurized fluid within an enclosed circuit.

2. **Define Pascal's -Law.**

   A pressure applied to a confined fluid at rest is transmitted with equal intensity throughout the fluid.

3. **Define back Pressure.**

   The pressure encountered on the return side of a fluid system.

4. **State the Bernoulli's principle?**

   If the flow rate in the system is constant, then the total energy in the system will also be constant irrespective of the variation in the cross section of the fluid passages.

5. **Define Accumulator.**

   A container in which liquid is stored under pressure as a source of fluid power.

6. **Explain non-separator type gas loaded accumulator?**

   In this type, the gas is filled at the top and the heavy oil at the bottom of the shell. There is no separator between the gas and oil and thus the pressurized gas pushes the oil directly.

7. **What is the function of accumulator?**

   Accumulator is used as an auxiliary power source. It is a device which stores the potential energy of the fluid. The stored potential energy in the accumulator acts as a quick secondary source of power and does useful work as required by the system.

8. **What is the use of bleed-off circuit?**

   Bleed off circuit is used to .control the flow of fluid in both directions of flow (or) on a Specific line and limits speed in only one direction of the cylinder travel.

9. **What is a sequencing circuit?**

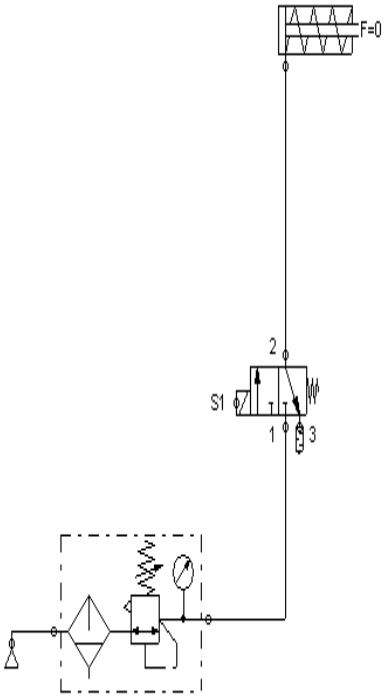
   Process control pneumatics is also called as sequencing. It means performing number of actions one after another which follows each other in a simple order or with an order determined by sensors.

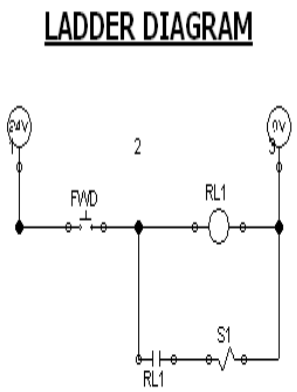
10. **What is pneumatic direction control valve?**

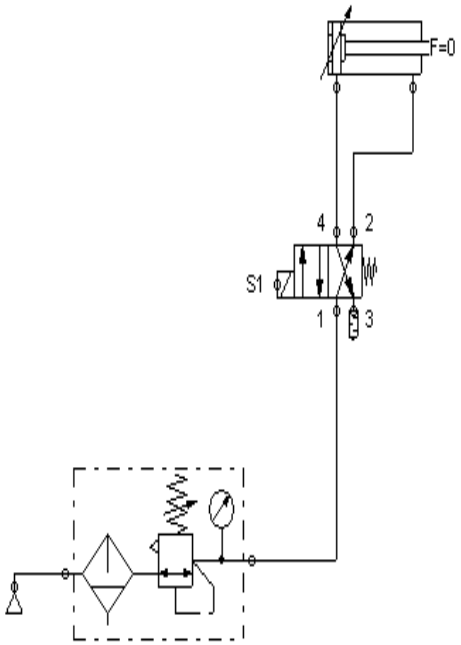
    Pneumatic direction control valve is used to control the direction of air path. These Valves have generally two, three, four (or) five ports: These ports are designated as P: Compressor line port R: Exhaust port (T is case of hydraulics) A, B: Working ports connected to actuator.

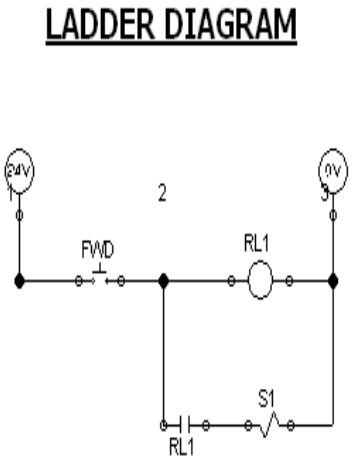
EXPERIMENTS ON ELECTRO-PNEUMATICS TRAINER KIT

Ex.No.


F=0
2
S1
1
3


LADDER DIAGRAM
2
FWD
RL1
S1
RL1


F=0
4
2
S1
1
3


LADDER DIAGRAM
2
FWD
RL1
S1
RL1

Ex. No: **Date :**

DESIGN AND TESTING OF ELECTRO-PNEUMATIC CIRCUITS OPERATION OF SINGLE AND DOUBLE ACTING CYLINDER USING SINGLE SOLENOID VALVE

AIM:

To operate single and double acting cylinder using the single solenoid valve in Electro Pneumatic Trainer Kit.

APPARATUS REQUIRED:

- Single and double acting cylinders
- Input / Output Relay Box
- 3/2 Solenoid operated spring return DCV
- 5/2 Solenoid operated spring return DCV
- FRL unit
- Connecting Tubes

PROCEDURE:

- Design and draw circuit diagram as per the given application.
- Connect the FRL unit to the main air supply.
- The various components are connected as per circuit.
- Block the valve operation if necessary.
- Check the leakage of air supply and correct it.
- Open the valve and operate the cylinder.

RESULT:

Thus the single and double acting cylinder was operated using the single solenoid valve in Electro Pneumatic Trainer Kit.

Viva Questions

1. Mention the various components of a hydraulic system.

 Motor

 Filter

 Pump

 Pressure Regulator

 Control Valve

 Piston and cylinder

2. What is called a pneumatic system?

System using gas for power transmission are called pneumatic systems and industrial system are usually based on air.

3. List down the components of pneumatic system.

 Motor driven compressor

 Air receiver

 Directional control

 Pneumatic cylinder

4. What is the purpose of using filters in the hydraulic systems?

Filters are used to prevent dirt or dust entering important elements of hydraulic system like valves, seals, etc. Filters are used to remove very finer particles.

5. What are the types of pumps used as energy source in a hydraulic system?

 Centrifugal Pump(Hydrodynamic Pumps)

 Positive displacement pump

1. Gear Pumps 2. Vane Pumps 3. Piston pumps

6. What are the factors to be considered for selecting compressors?

The type of air compressor is selected dependent on quality of air, pressure and cleanliness

7. What are the uses of air receiver?

An air receiver is used to store high pressure air and provide constant supply of air pressure in the pneumatic system regardless of varying and fluctuating consumption. It is used for the emergency supply of air to the system in case of power failure.

8. State the purpose of providing air dryers.

The aim is to reduce the temperature of the air to a dew point which ensures that the water in the air condenses and drops out easily.

9. State the function of a control valve.

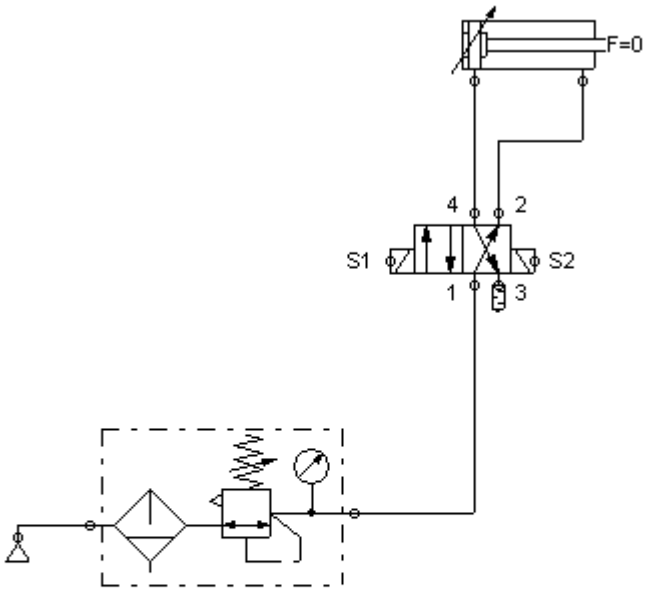
The primary function of the control valve is to direct and regulate the flow of fluid from an energy source to various loading devices. Normally the control valves are used for the purpose of sensing, processing ,and controlling. They are used for:

- Allowing the passage of air/fluid and directing it to a loading line
- Cancel the signal by blocking its passage
- Alert or generate the signal
- Release the air to atmosphere or return the fluid to tank

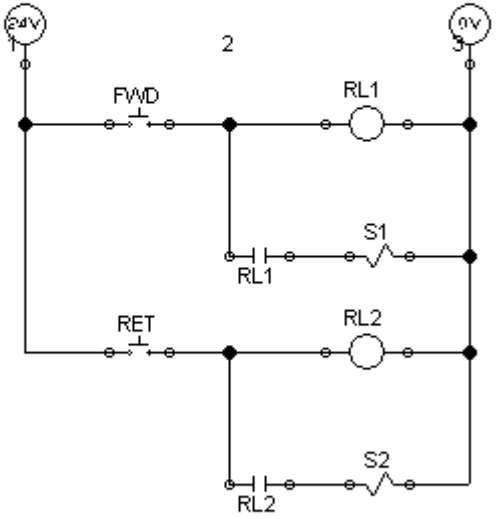
10. Define the term degrees of freedom.

The minimum number of independent displacement required to specify the system completely is called degrees of freedom

Ex. No:



LADDER DIAGRAM



Ex. No: **Date :**

DESIGN AND TESTING OF ELECTRO-PNEUMATIC CIRCUITS OPERATION OF DOUBLE ACTING CYLINDER USING DOUBLE SOLENOID VALVE

AIM:

To operate double acting cylinder using double solenoid valve in Electro Pneumatic Trainer Kit.

APPARATUS REQUIRED:

- Double acting cylinder
- Input / Output Relay Box
- 5/2 Double solenoid operated DCV
- FRL unit
- Connecting Tubes

PROCEDURE:

- Design and draw circuit diagram as per the given application.
- Connect the FRL unit to the main air supply.
- The various components are connected as per circuit.
- Block the valve operation if necessary.
- Check the leakage of air supply and correct it.
- Open the valve and operate the cylinder.

RESULT:

Thus the double acting cylinder was operated using the double solenoid valve in Electro Pneumatic Trainer Kit.

Viva Questions

1. What are the types of loops?

Loops can be classified in to two groups. They are, a. Continuous loop b. Conditional loop.

2. Write about the continuous loop?

A continuous loop is a set up by using the unconditional jump instruction. A program with a continuous loop does not stop repeating the tasks until the system is reset.

3. Write about the conditional loop?

A conditional loop is set up by the conditional jump instructions. The instructions check flags (Zero, Carry etc.,) and repeat the specified tasks if the conditions are satisfied. These loops usually include counting and indexing.

4. What are the instructions of a 8085 instruction set for data transfer from memory to the microprocessor?

The 8085 instruction set includes three memory transfer instructions. They are, a.MOV R,M : Move from Memory to Register b.LDAX B/D : Load Accumulator Indirect c.LDA 16 – bit : Load Accumulator Direct

5. What are the instructions of a 8085 instruction set for data transfer from microprocessor to the memory?

The 8085 instruction set includes three memory transfer instruction. They are, a. MOV. R,M : Move from Memory to Register b. STAX B / D : Store Accumulator Indirect c. STA 16 – bit : Store Accumulator Direct d. MVI M, 8 – bit : Load 8 – bit data in memory.

6. What are the opcodes related to rotating the accumulator bits?

The opcodes related to rotating the accumulator bits are, a. RLC – Rotate Accumulator Left through Carry b. RAL – Rotate Accumulator Left c. RRC – Rotate Accumulator Right through Carry d. RAR – Rotate Accumulator Right

7. What is dynamic debugging?

After the steps have been completed in the process of static debugging, and if the program still does not produce the expected output, attempt is made to debug the program by observing the execution of instructions. This is called dynamic debugging.

8. What are the tools used for dynamic debugging?

The tools used for dynamic debugging are, a. Single step b. Register examine c. Break point.

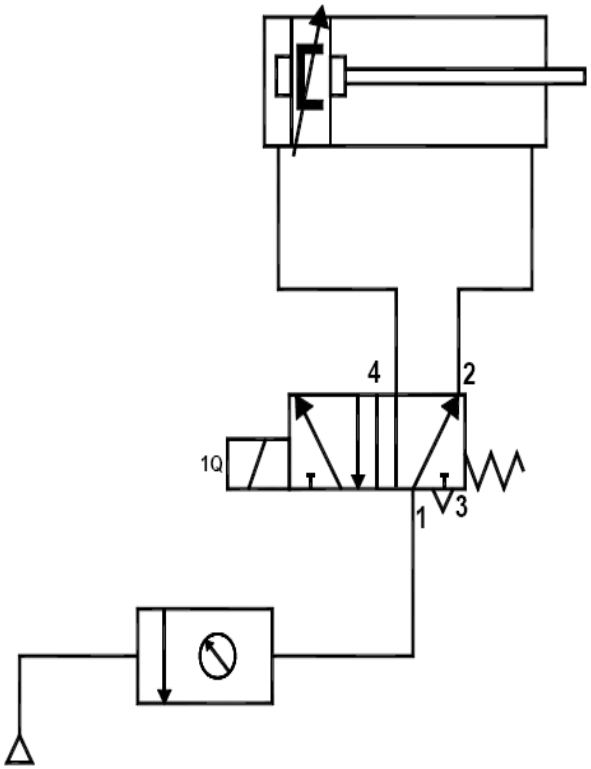
9. Write about single step?

The single step key on a keyboard allows to execute one instruction at a time, and to observe the results following each instruction. Generally, a single-step facility is built with a hard-wired logic circuit. When the single step key is pushed, addresses and codes are observed as they are executed.

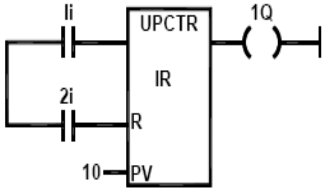
10. What are the advantages of single step?

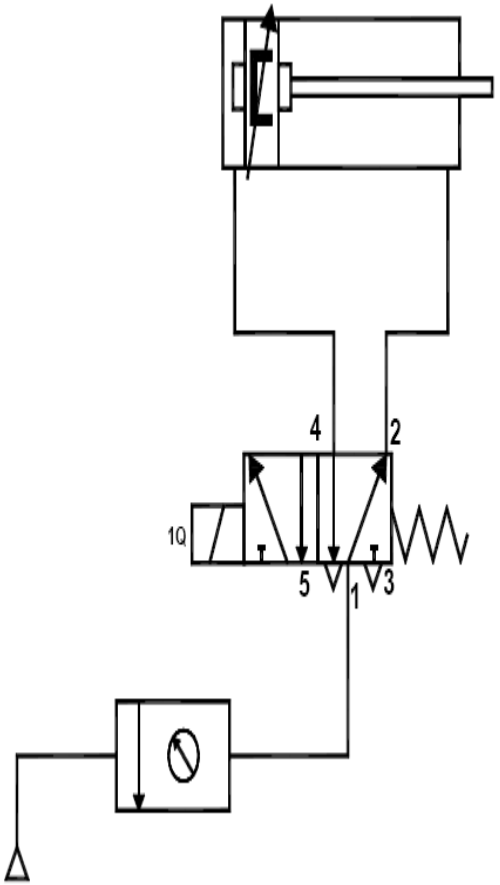
With the single step technique, it is able to spot, a. Incorrect addresses b. Incorrect jump locations for loops c. Incorrect data or missing codes.

EXPERIMENT ON ELECTRO-PNEUMATIC WITH PLC

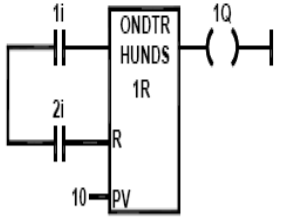


LADDER DIAGRAM





LADDER DIAGRAM



Ex. No: **Date :**

CONTROL OF DOUBLE ACTING CYLINDER WITH UP AND DOWN COUNTER USING PLC

AIM:

To simulate the double acting cylinder with UP and DOWN counter using Electro Pneumatic with PLC Trainer Kit.

APPARATUS REQUIRED:

- Double acting cylinder
- PLC
- Versa Pro Software
- Input / Output Relay Box
- 5/2 Solenoid operated DCV
- FRL unit
- Connecting Tubes

PROCEDURE:

- Draw the circuit diagram.
- Provide +24V and -24V from PLC trainer to panel
- Open the versa pro software in desktop
- Interface PLC with PC using RS2332 cable.
- Write a ladder diagram
- Output of PLC (Q1) is direct connecting to input of solenoid coil.
- Following the opening procedure of versa pro software.
- Check the ladder diagram.
- Connect the air supply to FRL unit.
- Run the PLC
- Some count the cylinder should be activated

RESULT:

Thus the actuation of double acting cylinder with UP and DOWN counter was done using Electro Pneumatic with PLC Trainer Kit.

Viva Questions

1. **Write about the conditional loop?**

   A conditional loop is set up by the conditional jump instructions. The instructions check flags (Zero, Carry etc.,) and repeat the specified tasks if the conditions are satisfied. These loops usually include counting and indexing

2. **How will you interface the I/O devices?**

   I/O devices can be interfaced using two techniques. They are,

   Peripheral – mapped I/O

   Memory – mapped I/O

3. **What are A/D and D/A converter?**

   The electronic signal that translates the analog signal into digital signal is called analog to digital (A/D) converter. The electronic signal that translates the digital signal into analog signal is called digital to analog (D/A) converter.

4. **What is a PLC?**

   A programmable Logic Controller (PLC) is defined as a digital electronic device that uses a programmable memory to store instructions and to implement functions such as logic, sequencing, timing, counting and arithmetic in order to control machines and processes.

1. **What is main advantage of PLC?**

   PLC's have great advantage that it is possible to modify a control system without having to rewire the connections to the input and output devices

2. **Write about the architecture of a PLC?**

   It consists essentially of a central processing unit (CPU), memory and input/output circuitry. The CPU controls and processes all the operations within the PLC. It is supplied with a clock with a frequency between 1 and 8 MHz. It also has a bus system, memory and input/output units, a system ROM for permanent storage, RAM for the users program and temporary buffers.

3. What is ladder programming?

The ladder programming involves each program task being specified as though a rung of a ladder. Thus such a rung could specify that the state of switches A and B, the inputs, be examined and if A and B are both closed then a solenoid, the output is energized.

4. How are programs entered?

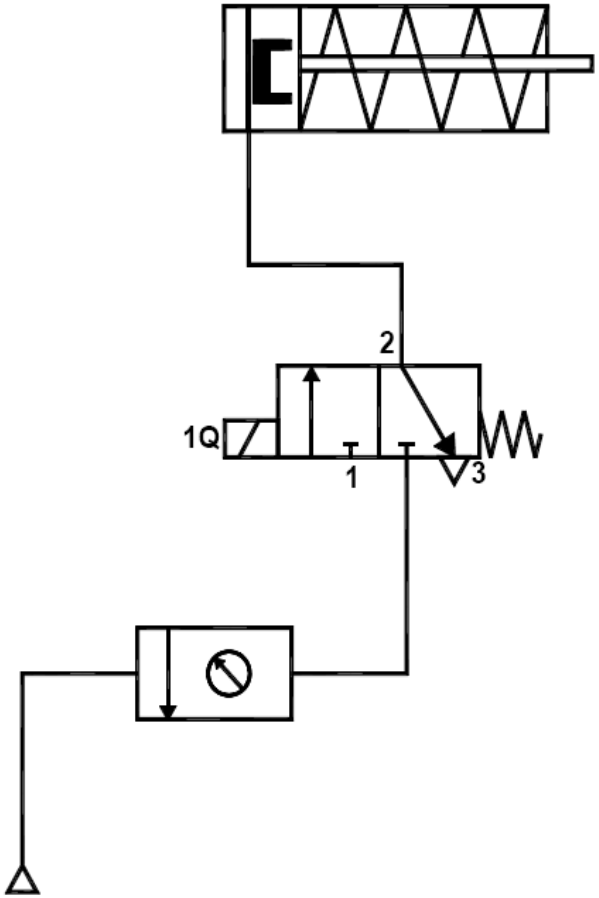
Programs are entered into the input / output unit from a panel, which can vary from small keyboards with liquid crystals to those using a visual display unit (VDU) with keyboard and screen display. Alternatively, the programs can be entered into the system by means of a link to a PC.

5. What are the features of PLC as a controller?

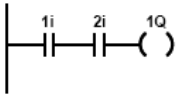
- They are rugged and designed to withstand vibrations, temperature, humidity and noise.
- The interfacing for inputs and outputs is inside the controller.
- They are easily programmed and have an easily understood programming language

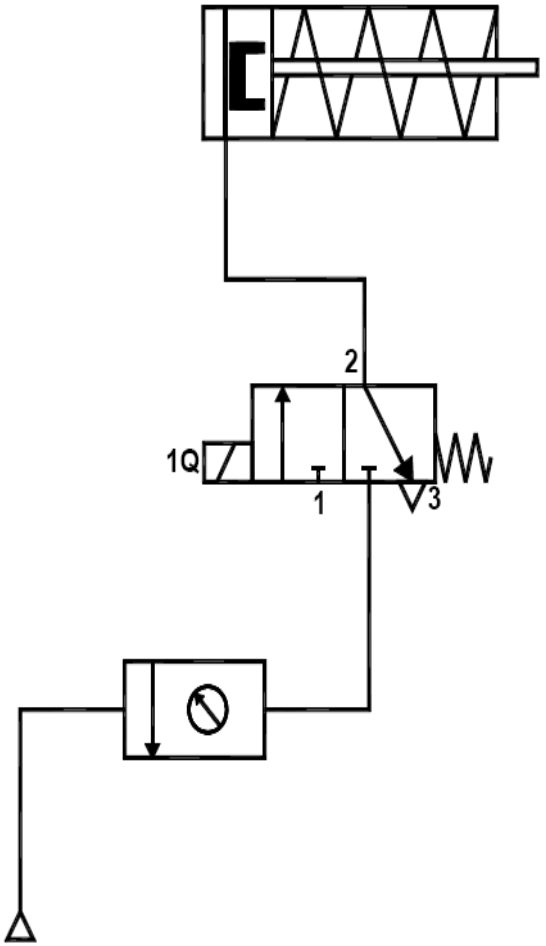
6. Write about the input / output channels?

The input/output channels provide signal conditioning and isolation functions so that sensors and actuators can be generally directly connected to them without the need for other circuitry. Common input voltages are 5 V and 24V. Common output voltages are 24 V and 240 V

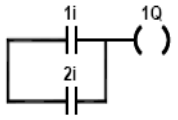


LADDER DIAGRAM





LADDER DIAGRAM



Ex. No: **Date :**

OPERATION OF SINGLE ACTING CYLINDER WITH AND & OR LOGIC USING PLC

AIM:

To simulate the single acting cylinder with AND & OR logic using Electro Pneumatic with PLC Trainer Kit.

APPARATUS REQUIRED:

- Single acting cylinder
- PLC
- Versa Pro Software
- Input / Output Relay Box
- 3/2 Solenoid operated DCV
- FRL unit
- Connecting Tubes

PROCEDURE:

- Draw the circuit diagram.
- Provide +24V and -24V from PLC trainer to panel
- Open the versa pro software in desktop
- Interface PLC with PC using RS2332 cable.
- Write a ladder diagram
- Output of PLC (Q1) is direct connecting to input of solenoid coil.
- Following the opening procedure of versa pro software.
- Check the ladder diagram.
- Connect the air supply to FRL unit.
- Run the PL
- When two input (1i & 2i) are high, the output is high (For AND gate)
- When any one input (1i & 2i) is high, the output is high (For OR gate)

RESULT:

Thus the double acting cylinder with AND & OR logic was done using Electro Pneumatic with PLC Trainer Kit.

Viva Questions

1. **Write about the relay?**

   With the relay type, the signal from the PLC output is used to operate a relay and so is able to switch currents of the order of a few amperes in an external circuit. The relay isolates the PLC from the external circuit and can be used for both D.C. and A.C. switching. Relays are, however, relatively slow to operate.

2. **What are opto isolators?**

   Opto isolators are used with transistor switches to provide isolation between the external circuit and the PLC. They are also used to provide isolation.

3. **What are the methods used for input / output processing?**

   There are two methods used for input / output processing. They are

   a. Continuous updating

   b. Mass input/output copying.

4. **What is continuous updating?**

   This involves the CPU scanning the input channels as they occur in the program instructions. Each input point is examined individually and its effect on the program determined. Each input is scanned with a 3 ms delay, before the program has the instruction for a logic operation to be executed and an output to occur. This process is called continuous updating.

5. **What is the disadvantage of continuous updating?**

   Because of the 3 ms delay in the continuous updating on each input, the time taken to examine several hundred input/output points can become comparatively long.

6. **Write about the mass input/output copying?**

   To allow a more rapid execution of a program, a specific area of RAM is used as a buffer store between the control logic and the input/output unit. At the start of each program cycle the CPU scans all the inputs and copies their status into the input/output address in RAM. At the end of each program cycle all the outputs are transferred from RAM to the output channels. The outputs are latched so that they retain their status until the next updating

7. **What is a LATCH circuit?**

   The term latch circuit is used for the circuit used to carry out such an operation. It is a self – maintaining circuit in that, after being energized, it maintains that state until another input is received. It remembers its last state.

8. **Define the term point and delay–on?**

   The term point is used for a data point and so is a timing, marker (internal relay) or counter element. Thus, the 16 points for timers means that there are 16 timer circuits. The term delay on is used to indicate that this type of timer waits for a fixed delay period before turning on.

9. **Write about timer circuit?**

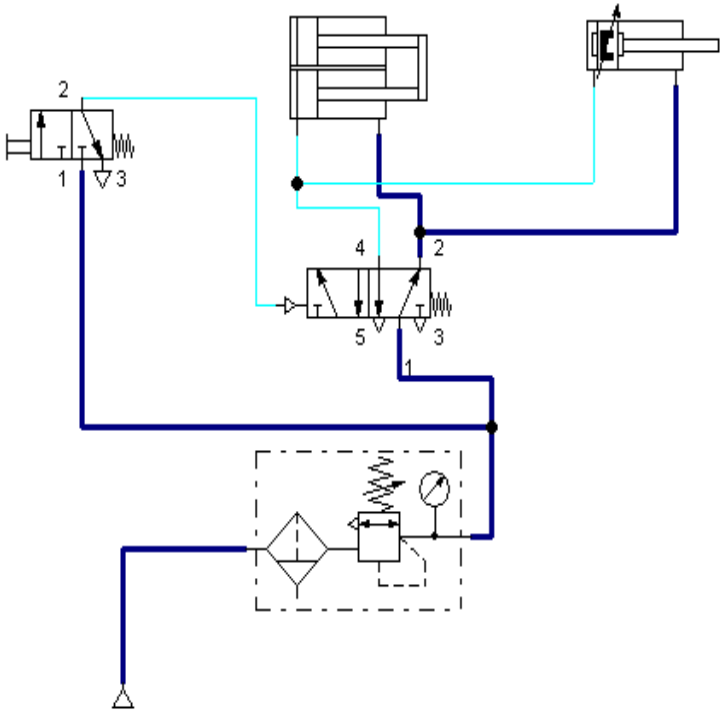
   A timer circuit is specified by stating the interval to be times and the conditions or events that are to start and / or stop the timer. They are commonly regarded as delays with coils which, when energized, result in the closing or opening of input contacts after some preset time.

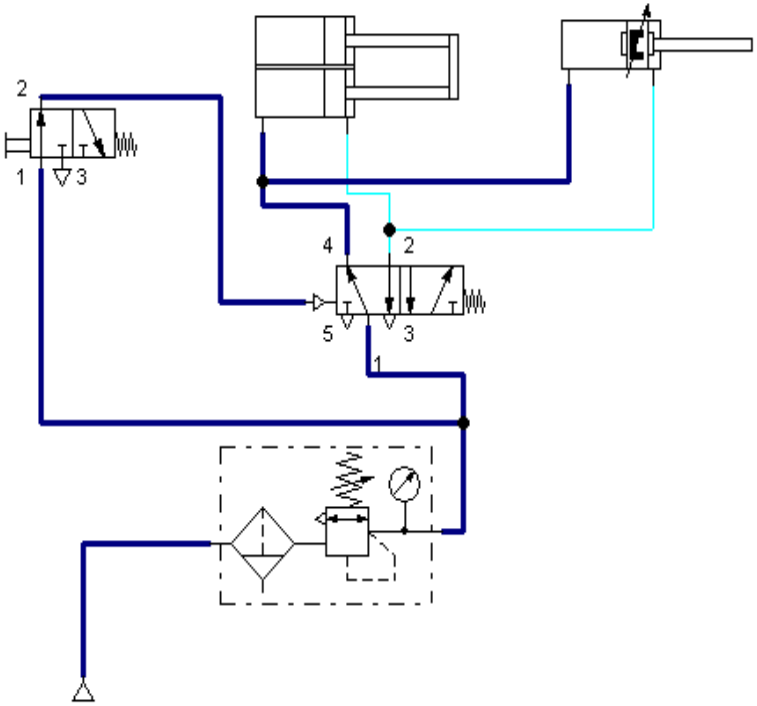
10. **Write about internal relays?**

    The term internal relay, auxiliary relay or marker is used for what can be considered as an internal relay in the PLC. These behave like relays with their associated contacts, but in reality are not actual relays with their associated by the software of the PLC. Internal relays are often used when there are programs with multiple input conditions.

EXPERIMENTS ON FLUID SIM SOFTWARE

Ex. No:





Ex. No: **Date :**

SIMULATION OF BASIC PNEUMATIC, HYDRAULIC AND ELECTRICAL CIRCUITS USING FLUID-SIM SOFTWARE

AIM:

To simulate the Pneumatic, Hydraulic and Electrical circuit with single acting, double acting cylinders by manual and automatic mode using pneumatic simulation software (Fluid-SIM).

REQUIREMENTS:

- Personal Computer
- FLUID SIM (Pneumatic and Hydraulic) Software's

PROCEDURE:

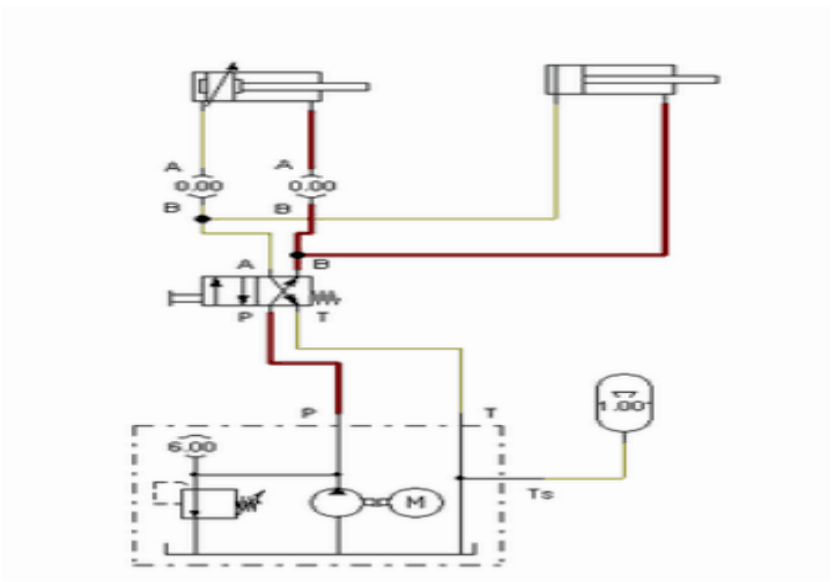
SIMULATION OF PNEUMATIC CIRCUITS

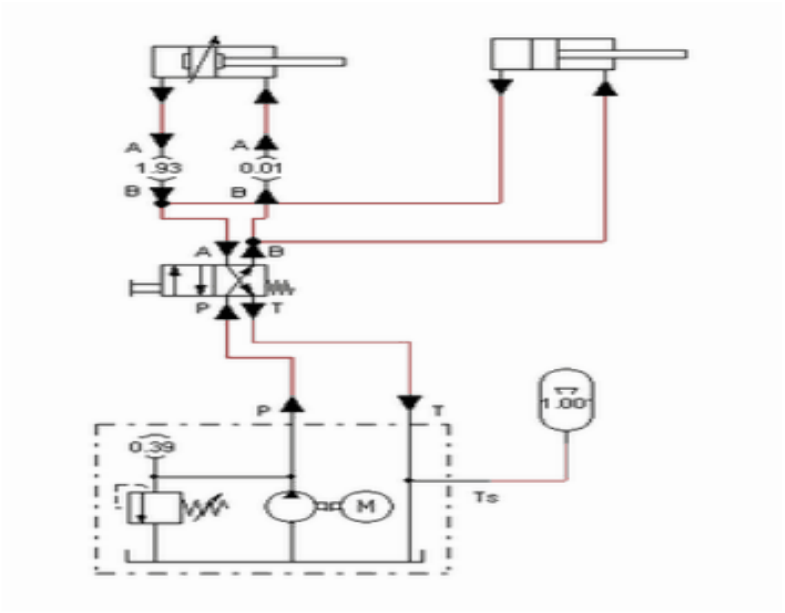
- Open the software in the personal computer.
- Select the new file in it.
- Click on the supply elements and then select, copy, paste the compressor.
- Click the attenuator and then select copy, paste the single and double acting cylinder.
- Then select, copy, paste the required components as per the given application 3/2, 5/2 single and double solenoid valve etc.
- Select the air supply unit.
- Connect all the components.
- Start and operate the single, double acting cylinders.

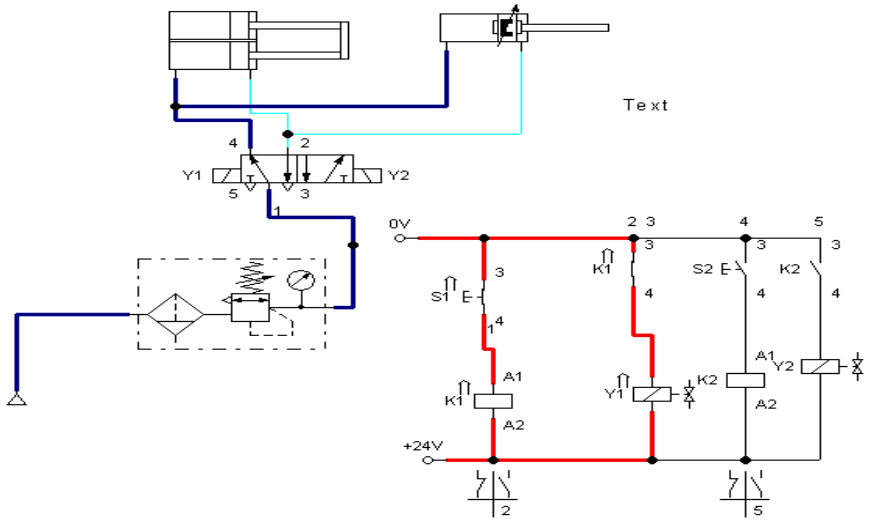
SIMULATION OF HYDRAULIC CIRCUITS

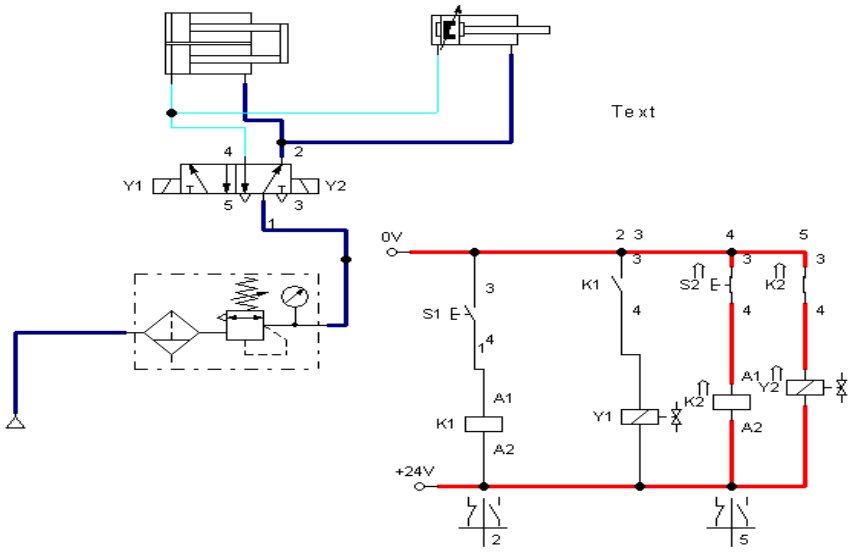
- Open the software in the personal computer.
- Select the new file in it.
- Click on the supply elements and then select, copy, paste the pump and tanks.
- Click the attenuator and then select copy, paste the single and double acting cylinder.
- Then select, copy, paste the required components as per the given application 3/2, 5/2 single and double solenoid valve.
- Connect all the components
- Start and operate the single, double acting cylinders.

Ex. No:


A
0.00
B
A
0.00
B
A
B
P
T
P
T
6.00
M
Ts
1.00


A
1.93
B
A
0.01
B
A
B
P
T
P
T
0.39
M
Ts
1.00


Text
4
2
Y1
Y2
5
3
1
0V
2 3
4
5
3
3
3
S1
K1
S2
K2
4
4
4
A1
K1
Y1
K2
Y2
A2
+24V
2
5


Text
4
2
Y1
Y2
5
3
1
0V
2 3
4
5
3
3
3
S1
K1
S2
K2
4
4
4
A1
K1
Y1
K2
Y2
A2
+24V
2
5

SIMULATION OF ELECTRICAL CIRCUITS

- Open the software in the personal computer.
- Select the new file in it.
- Click on the supply elements and then select, copy, paste the power supply (24 V and 0V) unit, compressor and pump and tanks.
- Click the attenuator and then select copy, paste the single and double acting cylinder.
- Then select, copy, paste the required components as per the given application 3/2, 5/2 single and double solenoid valve, electrical switches and relay etc.
- Connect all the components
- Start and operate the single, double acting cylinders.

RESULT:

Thus the Pneumatic, Hydraulic and Electrical circuit for single acting and double acting cylinder was simulated using FLUIDSIM software.

Viva Questions

1. Give an example for event-based and time–based sequential control.

 Time-based Water Heater

 Event-based Domestic washing machine

2. What is the purpose of a sensor?

Sensor is used for an element which produces a signal relating to the quantity being measured. I.e., an electrical resistance temperature element, the quantity being measured is temperature and the sensor transforms an input of temperature into a change in resistance.

3. Define transducer?

The term transducer is often used in place of the term sensor. Transducer is defined as elements that when subject to some physical change experience a related change. Thus, sensors are transducers.

4. What are the terms that define the performance of the transducers?

1. Range and span

2. Error

3. Accuracy

4. Sensitivity

5. Hysteresis error

6. Non – linearity error

7. Repeatability / reproducibility

8. Stability

9. Dead band / time

10. Resolution

11. Output impedance.

5. Define static characteristics?

The static characteristics are the values given when the steady – state conditions occur. i.e., the values given when the transducer has settled down after having received some input.

6. Define dynamic characteristics?

The dynamic characteristics refer to the behavior between the time that the input value changes and the times that the value given by the transducer settles down to the steady – state value. Dynamic characteristics are stated in terms of the response of the transducer to inputs in particular forms.

7. What are the terms that you can find from the dynamic characteristics?

1. Response time.

2. Time constant.

3. Rise time

4. Settling time.

8. What is a displacement sensor?

Displacement sensors are concerned with the measurement of the amount by which some object has been moved

9. What is a position sensor?

Position sensors are concerned with the determination of the position of some object with reference to some reference point.

10. What is a proximity sensor?

Proximity sensors are a form of position sensor and are used to determine when an object has moved to within some particular critical distance of the sensor

. **Ex. No:** **Date :**

FAMILIARIZATION WITH CONCEPT OF IOT AND ITS OPEN SOURCE MICROCONTROLLER.

AIM:

To write the ARDUINO program for Turn on & Off a LED..

REQUIREMENTS:

1. Microcontroller: ATmega328
2. Operating Voltage: 5V
3. Input Voltage (recommended): 7-12V
4. Input Voltage (limits): 6-20V
5. Digital I/O Pins: 14 (of which 6 provide PWM output)
6. Analog Input Pins: 6
7. DC Current per I/O Pin: 40 mA
8. DC Current for 3.3V Pin: 50 mA
9. Flash Memory: 32 KB of which 0.5 KB used by bootloader
10. SRAM: 2 KB (ATmega328)
11. EEPROM: 1 KB (ATmega328)
12. Clock Speed: 16 MHz

Program:

```
void setup() {
pinMode (2,OUTPUT);
}
void loop() {
```

```
digitalWrite(13,HIGH);
delay(1000);
digitalWrite(13,LOW);
delay(1000);
}
```

Result:

. **Ex. No:** **Date :**

WRITE A PROGRAM TO TURN ON/OFF MOTOR USING MICROCONTROLLER THROUGH INTERNET

AIM:

To write the ARDUINO program for turn on/off DC motor through Internet.

REQUIREMENTS:

1. Microcontroller: ATmega328
2. Operating Voltage: 5V
3. Input Voltage (recommended): 7-12V
4. Input Voltage (limits): 6-20V
5. Digital I/O Pins: 14 (of which 6 provide PWM output)
6. Analog Input Pins: 6
7. DC Current per I/O Pin: 40 mA
8. DC Current for 3.3V Pin: 50 mA
9. Flash Memory: 32 KB of which 0.5 KB used by bootloader
10. SRAM: 2 KB (ATmega328)
11. EEPROM: 1 KB (ATmega328)
12. Clock Speed: 16 MHz

Program:

```
#include "ThingSpeak.h"
#include <ESP8266WiFi.h>
const char* ssid = "IElec Systems";//Replace with your Wifi Name
const char* password = "9840838264";// Replace with your wifi Password
```

```
unsigned long channel = 2507585;//Replace with your own ThingSpeak Account
Channle ID
unsigned int led1 = 1;
WiFiClient client;
void setup()
{
Serial.begin(115200);
delay(100);
pinMode(D1, OUTPUT);
digitalWrite(D1, 0);  // We start by connecting to a WiFi network
Serial.println();
Serial.print("Connecting to ");
Serial.println(ssid);
WiFi.begin(ssid, password);
while (WiFi.status() != WL_CONNECTED)
{
delay(500);
Serial.print(".");
}
Serial.println("");
Serial.println("WiFi connected");
Serial.println("IP address: ");
Serial.println(WiFi.localIP());
Serial.print("Netmask: ");
```

```
Serial.println(WiFi.subnetMask());
Serial.print("Gateway: ");
Serial.println(WiFi.gatewayIP());
ThingSpeak.begin(client);
}
void loop() {
//get the last data of the fields
int led_1 = ThingSpeak.readFloatField(channel, led1);
if(led_1 == 1)
{
digitalWrite(D1, 1);
Serial.println("D1 is On..!");
}
else if(led_1 == 0)
{
digitalWrite(D1, 0);
Serial.println("D1 is Off..!");
}
delay(5000);
}
```

Result:

Ex. No: **Date :**

WRITE A PROGRAM TO INTERFACE SENSORS TO DISPLAY THE DATA ON THE SCREEN THROUGH INTERNET.

AIM:

To write the program for interface Temperature sensors(LM35) to display the data on the screen through internet.

REQUIREMENTS:

1. Microcontroller: ATmega328
2. Operating Voltage: 5V
3. Input Voltage (recommended): 7-12V
4. Input Voltage (limits): 6-20V
5. Digital I/O Pins: 14 (of which 6 provide PWM output)
6. Analog Input Pins: 6
7. DC Current per I/O Pin: 40 mA
8. DC Current for 3.3V Pin: 50 mA
9. Flash Memory: 32 KB of which 0.5 KB used by bootloader
10. SRAM: 2 KB (ATmega328)
11. EEPROM: 1 KB (ATmega328)
12. Clock Speed: 16 MHz

Program:

```
#include <ESP8266WiFi.h>

String apiKey = "74085BCYRZG0G9YJ";     //  Enter your Write API key from

ThingSpeak

const char *ssid =  "IElec Systems";     // replace with your wifi ssid and wpa2 key
```

```
const char *pass =  "9840838264";
//Wifi Password
const char* server = "api.thingspeak.com";
WiFiClient client;
void setup()
{
Serial.begin(115200);
delay(10);
Serial.println("Connecting to ");
Serial.println(ssid);
WiFi.begin(ssid, pass);
while (WiFi.status() != WL_CONNECTED)
{
delay(500);
Serial.print(".");
}
Serial.println("");
Serial.println("WiFi connected");
}
void loop()
{
float vout = analogRead(A0);
vout = (vout/1023)*3300;
vout = vout/10;
```

```
Serial.print(vout);
  if (client.connect(server,80))   //   "184.106.153.149" or
api.thingspeak.com
      {
urlencoded\n");
String postStr = apiKey;
 postStr +="&field1=";
 postStr += String(vout);
 postStr += "\r\n";
 client.print("POST /update HTTP/1.1\n");
 client.print("Host: api.thingspeak.com\n");
 client.print("Connection: close\n");
 client.print("X-THINGSPEAKAPIKEY: "+apiKey+"\n");
 client.print("Content-Type: application/x-www-form
 client.print("Content-Length: ");
 client.print(postStr.length());
 client.print("\n\n");
 client.print(postStr);
 Serial.print("Temperature: ");
 Serial.print(vout);
 Serial.println("Send to Thingspeak.");
}
      client.stop();
      Serial.println("Waiting...");
```

```
delay(5000);// thingspeak needs minimum 15 sec delay between updates  }
```

Result:

Ex. No: **Date :**

INTERFACE THE SENSORS WITH MICROCONTROLLER AND WRITE A PROGRAM TO TURN ON/OFF SOLENOID VALVE THROUGH INTERNET WHEN SENSOR DATA IS DETECTED

AIM:

To write the program for interface the Soil moisture sensors with microcontroller and write a program to turn on/off solenoid valve through internet when sensor data is detected.

REQUIREMENTS:

1. Microcontroller: ATmega328
2. Operating Voltage: 5V
3. Input Voltage (recommended): 7-12V
4. Input Voltage (limits): 6-20V
5. Digital I/O Pins: 14 (of which 6 provide PWM output)
6. Analog Input Pins: 6
7. DC Current per I/O Pin: 40 mA
8. DC Current for 3.3V Pin: 50 mA
9. Flash Memory: 32 KB of which 0.5 KB used by bootloader
10. SRAM: 2 KB (ATmega328)
11. EEPROM: 1 KB (ATmega328)
12. Clock Speed: 16 MHz

Program:

```
#include "ThingSpeak.h"

#include <ESP8266WiFi.h>

const char* ssid = "IElec Systems";//Replace with your Wifi Name
```

```
const char* password = "9840838264";// Replace with your wifi Password
unsigned long channel = 2507585;//Replace with your own ThingSpeak Account
Channle ID
unsigned int led1 = 1;
int f=0;
boolean a = false;
boolean b = true;
WiFiClient client;
void setup()
{
Serial.begin(115200);
delay(100);
pinMode(D1,OUTPUT);
pinMode(D2,INPUT);
digitalWrite(D1, 0);  // We start by connecting to a WiFi network
digitalWrite(D2, 1);
Serial.println();
Serial.print("Connecting to ");
Serial.println(ssid);
WiFi.begin(ssid, password);
while (WiFi.status() != WL_CONNECTED)
{
delay(500);
  Serial.print(".");
```

```
  }
  Serial.println("");
  Serial.println("WiFi connected");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
  Serial.print("Netmask: ");
  Serial.println(WiFi.subnetMask());
  Serial.print("Gateway: ");
  Serial.println(WiFi.gatewayIP());
  ThingSpeak.begin(client);
}
void loop() {
//get the last data of the fields
int led_1 = ThingSpeak.readFloatField(channel, led1);
if((led_1 == 1)&(digitalRead (D2)==0))
{
  digitalWrite(D1,1);
Serial.println("D1 is On..!");
}
else if(led_1 == 0)
{
digitalWrite(D1,0);
Serial.println("D1 is Off..!");
}
```

```
delay(5000);
}
```

Result:

Ex. No: **Date :**

TO INTERFACE SENSOR WITH MICROCONTROLLER AND WRITE A PROGRAM TO TURN ON/OFF LINEAR ACTUATOR THROUGH IOT WHEN SENSOR DATA IS DETECTED

AIM:

To write the program for To interface sensor with microcontroller and write a program to turn ON/OFF Linear Actuator through IoT when sensor data is detected

REQUIREMENTS:

1. Microcontroller: ATmega328
2. Operating Voltage: 5V
3. Input Voltage (recommended): 7-12V
4. Input Voltage (limits): 6-20V
5. Digital I/O Pins: 14 (of which 6 provide PWM output)
6. Analog Input Pins: 6
7. DC Current per I/O Pin: 40 mA
8. DC Current for 3.3V Pin: 50 mA
9. Flash Memory: 32 KB of which 0.5 KB used by bootloader
10. SRAM: 2 KB (ATmega328)
11. EEPROM: 1 KB (ATmega328)
12. Clock Speed: 16 MHz

Program:

```
#include "ThingSpeak.h"

#include <ESP8266WiFi.h>

const char* ssid = "IElec Systems";//Replace with your Wifi Name
```

```
const char* password = "9840838264";// Replace with your wifi Password
unsigned long channel = 2507585;//Replace with your own ThingSpeak Account
Channle ID
unsigned int led1 = 1;
int f=0;
boolean a = false;
boolean b = true;
WiFiClient client;
void setup()
{
Serial.begin(115200);
delay(100);
pinMode(D1,OUTPUT);
pinMode(D2,OUTPUT);
digitalWrite(D1, 0);  // We start by connecting to a WiFi network
digitalWrite(D2, 0);
Serial.println();
Serial.print("Connecting to ");
Serial.println(ssid);
WiFi.begin(ssid, password);
while (WiFi.status() != WL_CONNECTED)
{
delay(500);
Serial.print(".");
```

```
}
Serial.println("");
Serial.println("WiFi connected");
Serial.println("IP address: ");
Serial.println(WiFi.localIP());
Serial.print("Netmask: ");
Serial.println(WiFi.subnetMask());
Serial.print("Gateway: ");
Serial.println(WiFi.gatewayIP());
ThingSpeak.begin(client);
}
void loop() {
//get the last data of the fields
int led_1 = ThingSpeak.readFloatField(channel, led1);
if((led_1 == 1)&&(f==0))
{
a = !a;
b = !b;
digitalWrite(D1,a);
digitalWrite(D2,b);
delay(700);
digitalWrite(D1,0);
digitalWrite(D2,0);
f=1;
```

```
Serial.println("D1 is On..!");
}
else if((led_1 == 0)&(f==1))
{
f=0;
Serial.println("D1 is Off..!");
}
delay(5000);
}
```

Result:

Ex. No: **Date :**

TO INTERFACE BLUETOOTH WITH MICROCONTROLLER AND WRITE A PROGRAM TO SEND SENSOR DATA TO SMART PHONE USING BLUETOOTH

AIM:

To write the program for to interface Bluetooth with microcontroller and write a program to send sensor data to smart phone using Bluetooth

REQUIREMENTS:

1. Microcontroller: ATmega328
2. Operating Voltage: 5V
3. Input Voltage (recommended): 7-12V
4. Input Voltage (limits): 6-20V
5. Digital I/O Pins: 14 (of which 6 provide PWM output)
6. Analog Input Pins: 6
7. DC Current per I/O Pin: 40 mA
8. DC Current for 3.3V Pin: 50 mA
9. Flash Memory: 32 KB of which 0.5 KB used by bootloader
10. SRAM: 2 KB (ATmega328)
11. EEPROM: 1 KB (ATmega328)
12. Clock Speed: 16 MHz

Program:

```
#include <SoftwareSerial.h>

SoftwareSerial bt(A0, A1);

void setup() {
```

```
bt.begin(9600);
}
void loop() {
float Temp =analogRead(A2);  // Analog O/P Read
Temp = (Temp * 500)/1023;   // Celsius Conversion Calculation
bt.print(Temp);
bt.print(";");
delay(1000);
}
```

Result:

ACTUATION OF PNEUMATIC CYLINDER TO FIND OUT FORCE Vs PRESSURE

Aim

To actuate the double acting cylinder and find out the force vs. Pressure

Apparatus required

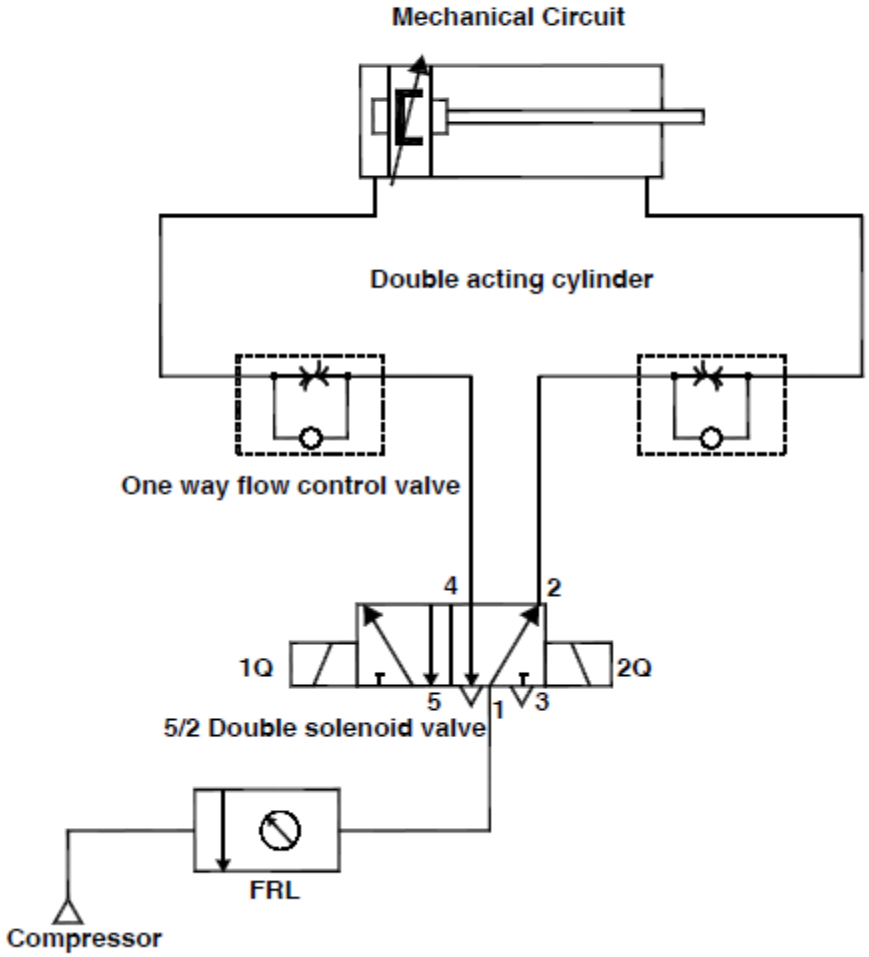
FRL unit, 5/2 double solenoid valve, double acting cylinder, load cell, and data actuation card than lab view software.

Procedure

- To slide the hand slide valve to FRL unit.
- Switch on the power supply to the control unit.
- Open the lab view software in the system.
- Inter face Pneumatic trainer with system using RS-232.
- Open the force. Go to operate, click the run. Than power on (below).
- Now extend the system by pressing the up button.
- Load cell indicate the force value in the monitor.
- Now adjust the pressure regulator and set the maximum pressure as (0 - 4) bar.
- Retract the cylinder.
- Once again forward the cylinder; you have adjusted the pressure in pressure regulator.
- You have seen the force value in monitoring.
- Repeat the force value for different pressure.

STUDY REPORT:

FORCE Vs PRESSURE



TABULATION:

S.No	Pressure in Kg/cm^2	Displayed Force in Kg	Calculated Forces in Kg	% of Error

CALCULATED FORCE (FORMULA)

$$PRESSURE = \frac{FORCE}{AREA}$$

PRESSURE in kg/cm^2

FORCE in kg

AREA in cm^2

$$AREA = \frac{3.1428}{4} \times D^2$$

D = Cylinder diameter

Cylinder dia = 80mm

Piston dia = 25mm

Cylinder stroke length = 160mm

$$\%\,OF\ ERROR = \frac{DISPLAYED\ FORCES - CALCULATER\ FORCES}{DISPLAYED\ FORCES} \times 100$$

1. Direction Control Valve:

5/2 Double solenoid valve

Operating Voltage: 24 V DC

2. Pressure Gauge:

Maximum Working Pressure 0 - 10 bar

Usable Pressure 0 - 4 bar

3. Actuator

Double Acting Cylinder

Stroke Length 160 mm

Cylinder Dia.: 80mm

Piston Dia : 25 mm

4. Load Cell:

Maximum Kg.: 200 Kg.

Type: Strain Gauge

Force: Bi Direction

Signal conditioner Output: 0 – 5 V DC

5. Data Acquiescing System:

AD・C 841Micro Controller:

62 KB Flash Memory

8 Channel 12 Bit ADC

2 Channel 12 Bit DAC