1. What is mechatronics? Explain multidisciplinary scenario
2. Explain filtering process with types of filters.
3. Draw a logic diagram to meet following conditions:

Coffee/Tea vending machine

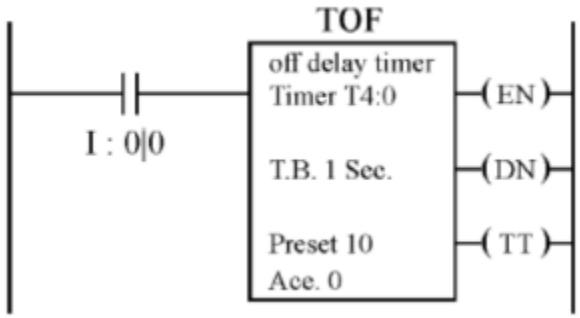
1) System dispenses tea or coffee when the appropriate button is pressed

2) AND logic will check for money input criteria and required drink.

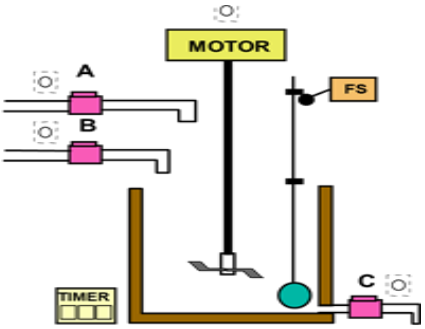
3) If by mistake both buttons are pressed (coffee and tea) machine should dispense tea.

4. Write a note on basic electrical components used in Mechatronics System.
5. Mention differences between hydraulic & pneumatic systems.
6. Draw the timing diagram for following timer instruction bit

i) I:0/0 ii) EN iii) DN iv) TT



7. Construct a ladder diagram for the objective given below:
   Fill the tank with liquids A and B
   Heat and Stir the liquid for three minutes
   Empty the tank
   Repeat the cycle



8. Draw & explain the programmable logic controller program scan.

⑤* The scan cycle :-

a) PLCs operate by continually scanning programs & repeat this process many times per second. When a PLC starts, it runs checks on the hardware & software for faults, also called a self-test. If there are no problems, then the PLC will start the scan cycle.

b) The scan cycle consist of 3 steps; ip scan, executing the program (s) & op scan

c) ip scan :-
A simple way of looking at this is the PLC takes a shapshot of the ips & solves the logic. The PLC looks at each ip card to determine if it is ON or OFF & saves this information in a data table, for use in the next step.

This makes the process faster & avoids the cases where an ip changes from the start to the end of the program.

d] Execute program (or logic execution).
The PLC executes a program one instruction at a time using only the memory copy of the ips & the ladder logic program. e.g. The program has the first ip as ON.

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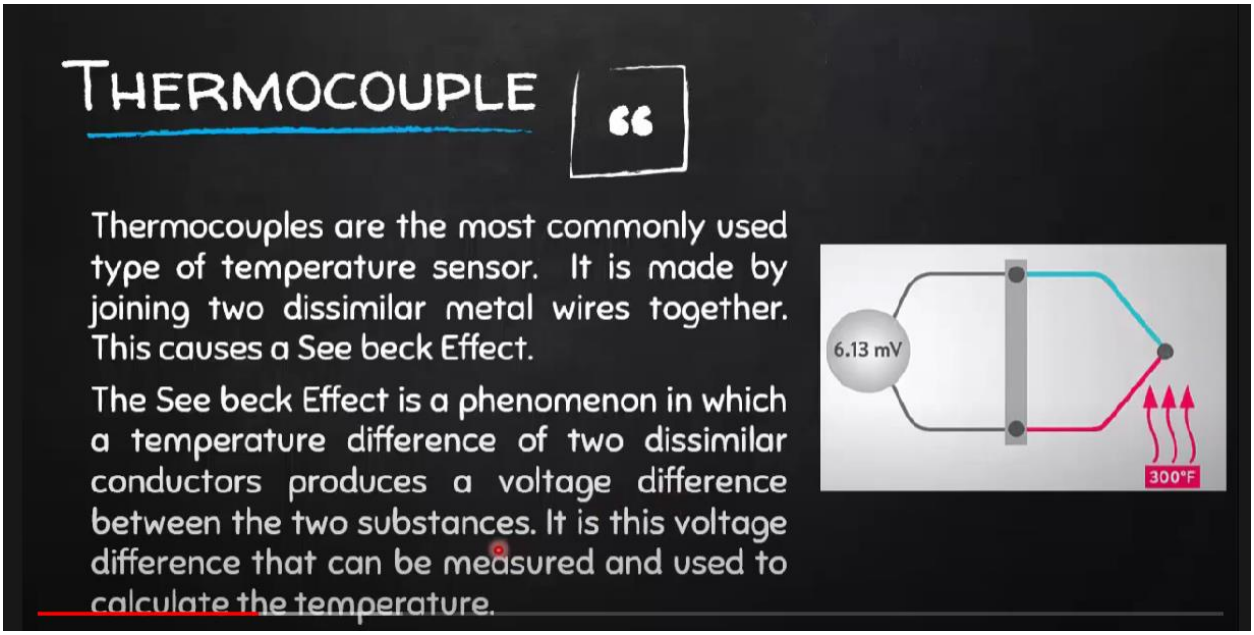
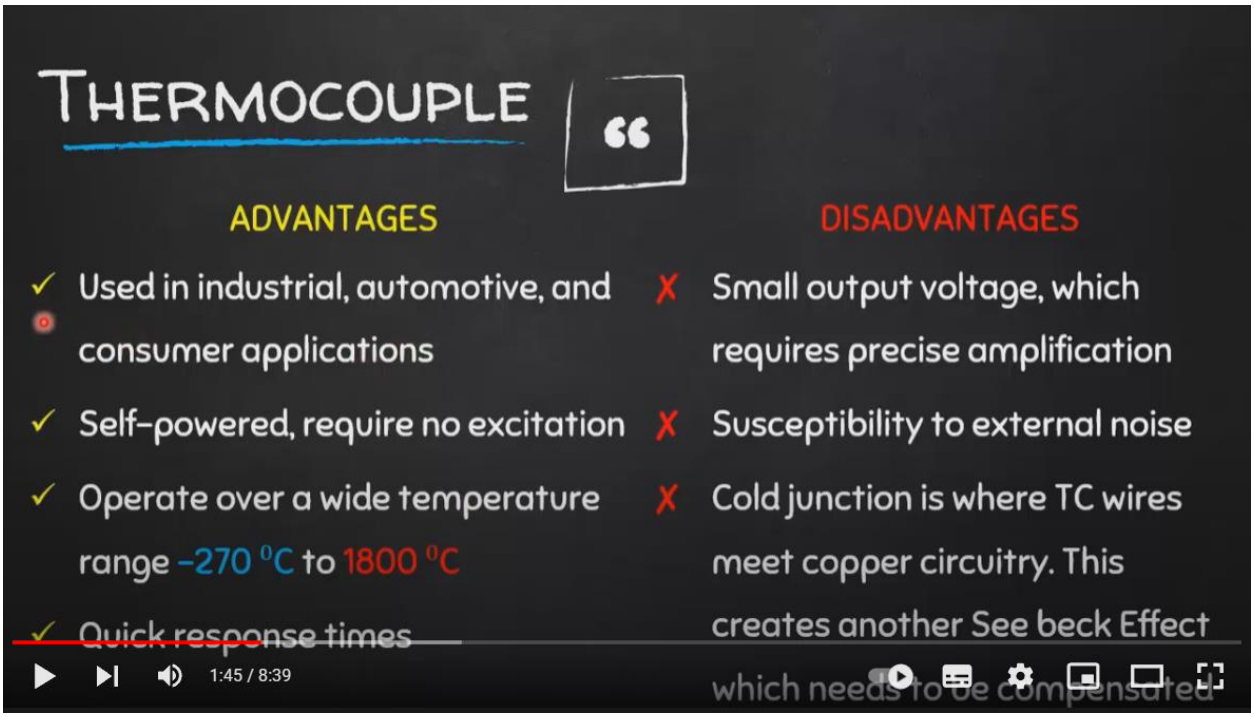
e] op scan :-

a) When the ladder scan completes, the op are updated using the temporary values in memory

b) The PLC updates the status the of the ops based on which ips were ON during the first step & the results of executing a program during the 2nd step. The PLC now restarts the process by starting a self-check for faults.

9. List any four logical and arithmetic instructions in PLC
10. Draw ladder dia. For all gates
11. Mechatronics is a synergy of several engineering disciplines”- explain with example
12. Provide an overview of two types of temperature sensors that could be used in mechatronic systems, identifying the advantages and disadvantages of each and the temperature range that it can measure





Advantages:

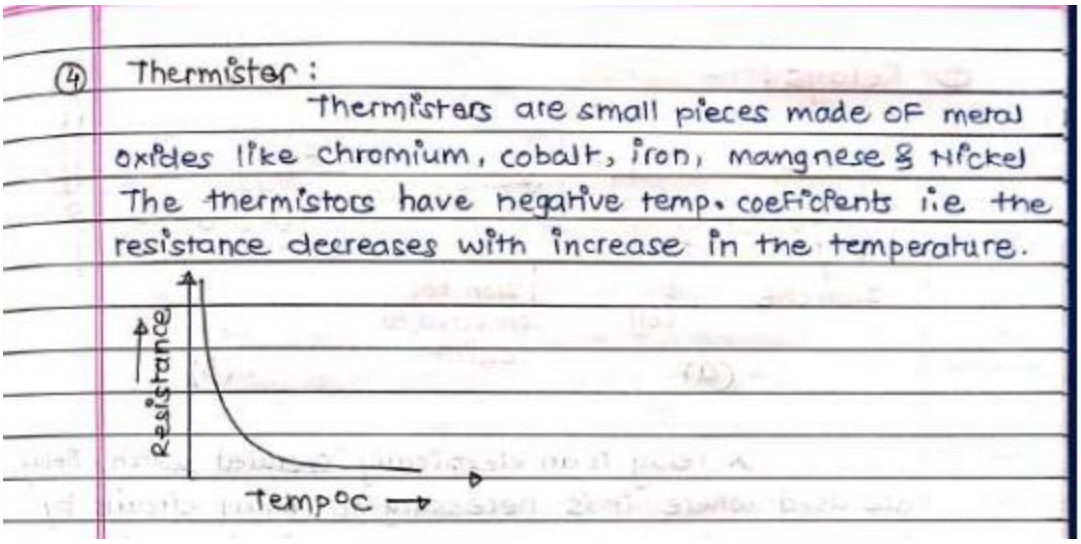
There are some advantages of thermocouple which are given below.

- The thermocouple is less expensive than RTD.
- It has wide temperature ranges.
- It has good reproducibility.
- The temperature range is 270 to 2700 degree Celsius.
- It has rugged construction.
- It does not required bridge circuit.
- It has good accuracy.
- It has high speed of response.

Disadvantages:

There are some disadvantages of thermocouple which are given below.

- The stray voltage pick up is possible.
- As output voltage is very small, it needs amplification.
- The cold junction and lead compensation is essential.
- It shows non linearity.



Advantages of thermistor:

- It is a small size
- Highly sensitive allows them to work well over a small temperature range
- They are more sensitive than other temperature sensors
- Easy to use
- They are fast in operation
- It has good sensitivity in NTC region
- Fast response over the narrow temperature range
- Cost is low
- Very responsive to changes in temperature
- High accurate
- Repeatable
- It does not require contact and leads resistance problem not occurred due to large resistance
- Options for customization
- Easily interfaced to electronics instrumentation
- it requires a standard two-wire connection system means they are compatible with many devices

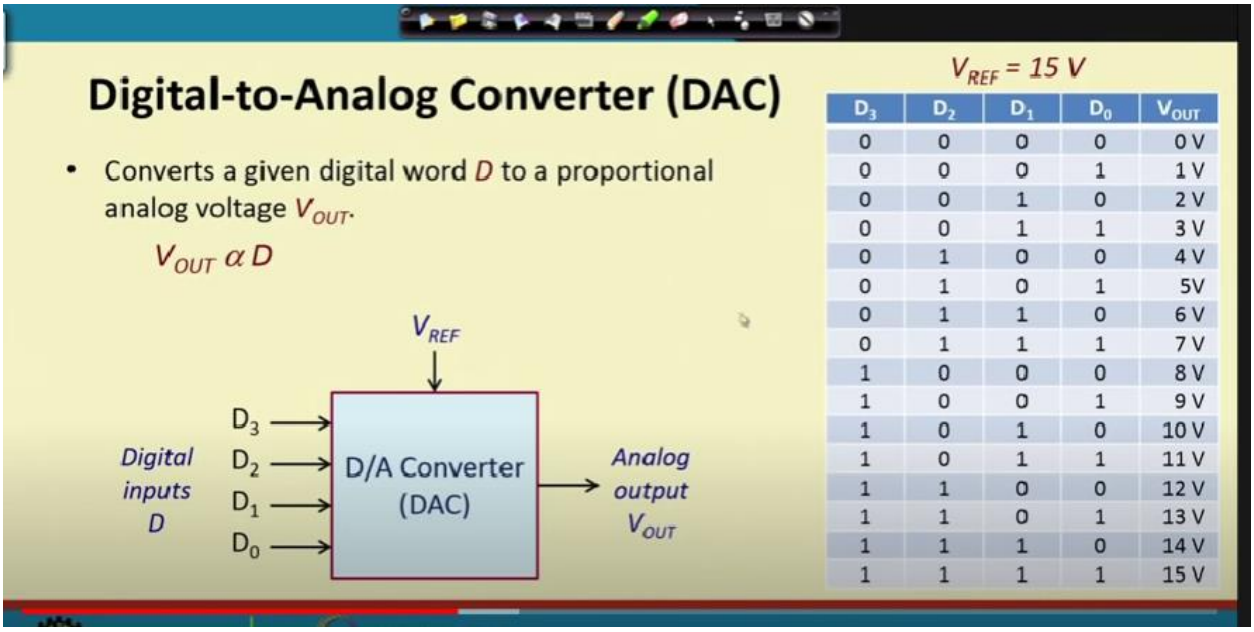
Disadvantages of thermistor:

- Thermistor need for shielding power lines

- Extremely non-linear
- Passive
- The thermistor is not suitable for a large temperature range
- The resistance temperature characteristics are nonlinear
- Narrow working temperature range compared to other sensors such as RTD and thermocouple
- More fragile as they are semiconductor devices
- Susceptible to self-heating errors
- The excitation for large temperature range

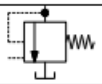
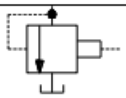
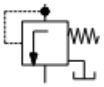
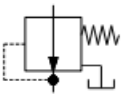
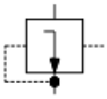
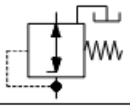
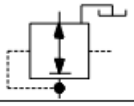
most thermistors work best in the range **between -55°C and +114°C.**

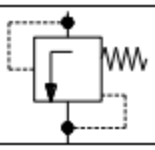
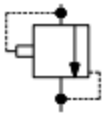
13. Explain working of DAC with suitable block diagram & truth table.

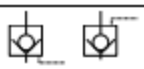
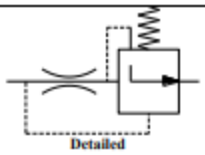
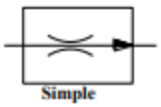
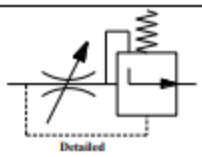
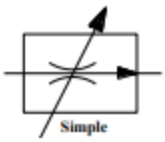


D_3	D_2	D_1	D_0	V_{OUT}
0	0	0	0	0 V
0	0	0	1	1 V
0	0	1	0	2 V
0	0	1	1	3 V
0	1	0	0	4 V
0	1	0	1	5V
0	1	1	0	6 V
0	1	1	1	7 V
1	0	0	0	8 V
1	0	0	1	9 V
1	0	1	0	10 V
1	0	1	1	11 V
1	1	0	0	12 V
1	1	0	1	13 V
1	1	1	0	14 V
1	1	1	1	15 V

14. Give full classification of control valves used in fluid system

Pressure Control Valves				
Throttling orifice (normally closed)		Throttling orifice (normally closed)		
Pressure relief valves	Inlet pressure control			
	Inlet pressure or remote pilot control			
Proportional pressure relief valves	Inlet pressure limited to a value proportional to pilot pressure			
Sequence				
Pressure regulator or reducing valve	Without relief port 		Without relief port with remote control 	
	With relief port 		With relief port with remote control 	

Differential pressure regulator (outlet pressure is reduced by a fixed amount with respect to the inlet pressure)	
Proportional pressure regulator (outlet pressure is reduced by a fixed ratio with respect to the inlet pressure)	

Flow Control Valves		
Shut-off valve		
Non-return valve (also called check valve)		
Non-return valve, spring-loaded		
Non-return valve, pilot-operated		
Non-return valve, with restriction		
Flow control valve, with fixed output		
Flow control valve, with variable output		

15. Prepare a ladder diagram for automatic mixing process in industry from the description given below:

Material A and Material B are collected in a tank. These materials are mixed for a while. Mixed product is then drained out through Outlet valve. Implement this in PLC using Ladder Logic programming language.

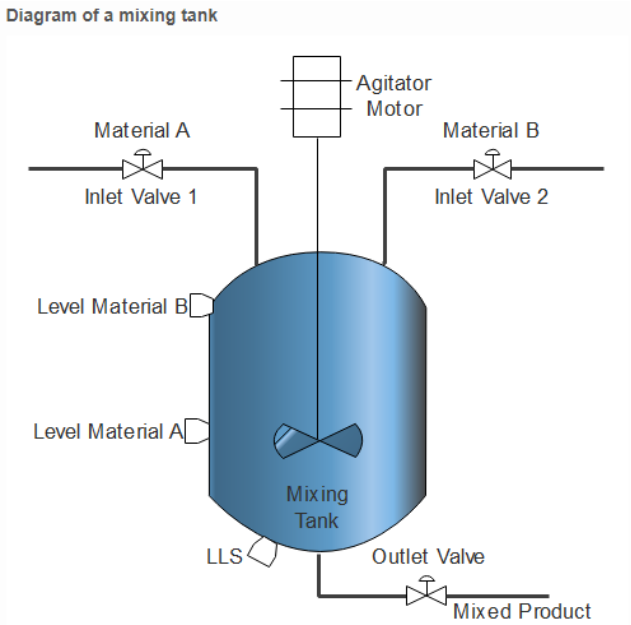


Figure:4

Problem Description

i. To detect level of Material A and Material B, two separate level switches are used. To detect low level, one more level switch is used at the bottom of the tank.
ii. These give output in digital terms that is when corresponding levels are detected.
iii. To control level of this system, Single Acting Piston valve can be used which has two states, either fully open or fully close.
iv. To control mixing, agitator is used which is connected with Motor shaft.
v. Particular time delay is generate to mix the materials for a definite time.
vi. Control inlet valves on the basis of Level Material switches A and B.
vii. Outlet valve is then operated to drain the mixed product.

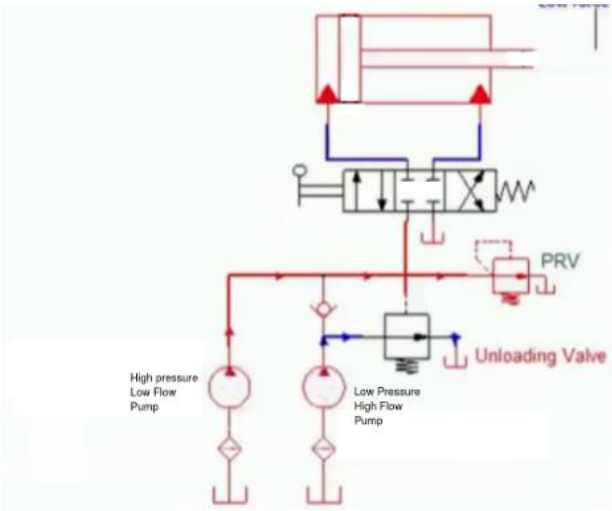
Draw PLC ladder logic diagram to control mixing in the tank.

16. Output 100 is to be ON only when either input 7 or 8 are ON or if input 17and input 18 are ON. Output 100 can be ON when all four inputs are ON. Draw ladder relay and PLC logic.

17. Explain the instruction TON and TOFF.
18. Find the response of first order system subjected to unit step and unit ramp input.
19. Draw circuit of voltage follower & derive equation.
20. Draw and explain two pump unloading circuit

Q.5. Explain with sketch two pump unloading circuit .

A two pump unloading circuit is used in situation where some part of the piston travel is required at high speed and low pressure and some small part is required at High pressure and low speed. For such purpose it is uneconomical to use a very high pressure and high volume pump. Instead the unloading circuit is used which uses two pumps for two purposes. When the motion is required with less force(pressure) both of the pumps discharge in the cylinder, and when the motion is required with high force(pressure) only the high pressure pump discharges to the cylinder and low pressure pump returns back oil to tank through unloading valve. Application: This circuit finds application in machine tools like punching machine and other cutting machines.



21. Draw and explain following ckts
    Meter in CKT
    Meter out CKT
    Bleed off CKT

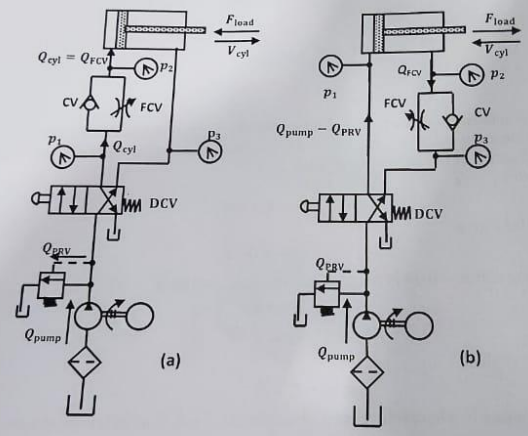


Figure 1.11 Speed control of cylinders:(a) Meter in and (b)meter out.

Now, Eq. (1.2) + Eq. (1.3) gives

$$p_1 A_{p1} = F_1 + F_2 \qquad (1.4)$$

If Eqs. (1.1) and (1.4) are met in a hydraulic circuit, the cylinders hooked in series operate in synchronization.

1.12 Speed Control of a Hydraulic Cylinder

The speed control of a hydraulic cylinder circuit can be done during the extension stroke using a flow-control valve (FCV). This is done on a meter-in circuit and meter-out circuit as shown in Fig. 1.11. Refer to Fig. 1.11(a). When the DCV is actuated, oil flows through the FCV to extend the cylinder. The extending speed of the cylinder depends on the FCV setting. When the DCV is deactivated, the cylinder retracts as oil from the cylinder passes through the check valve. Thus, the retraction speed of a cylinder is not controlled. Figure 1.11(b) shows meter-out circuit; when DCV is actuated, oil flows through the rod end to retract the cylinder.

Bleed-Off Circuit

Compared to meter-in and meter-out circuits, a bleed-off circuit is less commonly used. Figure 1.10 shows a bleed-off circuit with extend stroke control. In this type of flow control, an additional line is run through a flow-control valve back to the tank. To slow down the actuator, some of the flow is bledoff through the flow-control valve into the tank before it reaches the actuator. This reduces the flow into the actuator, thereby reducing the speed of the extend stroke.

The main difference between a bleed-off circuit and a meter-in/meter-out circuit is that in a bleed-off circuit, opening the flow-control valve decreases the speed of the actuator, whereas in the case of a meter-in/meter-out circuit, it is the other way around.

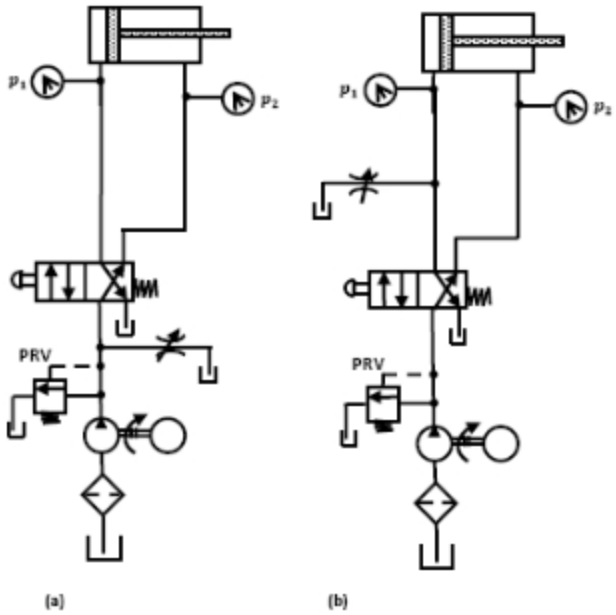
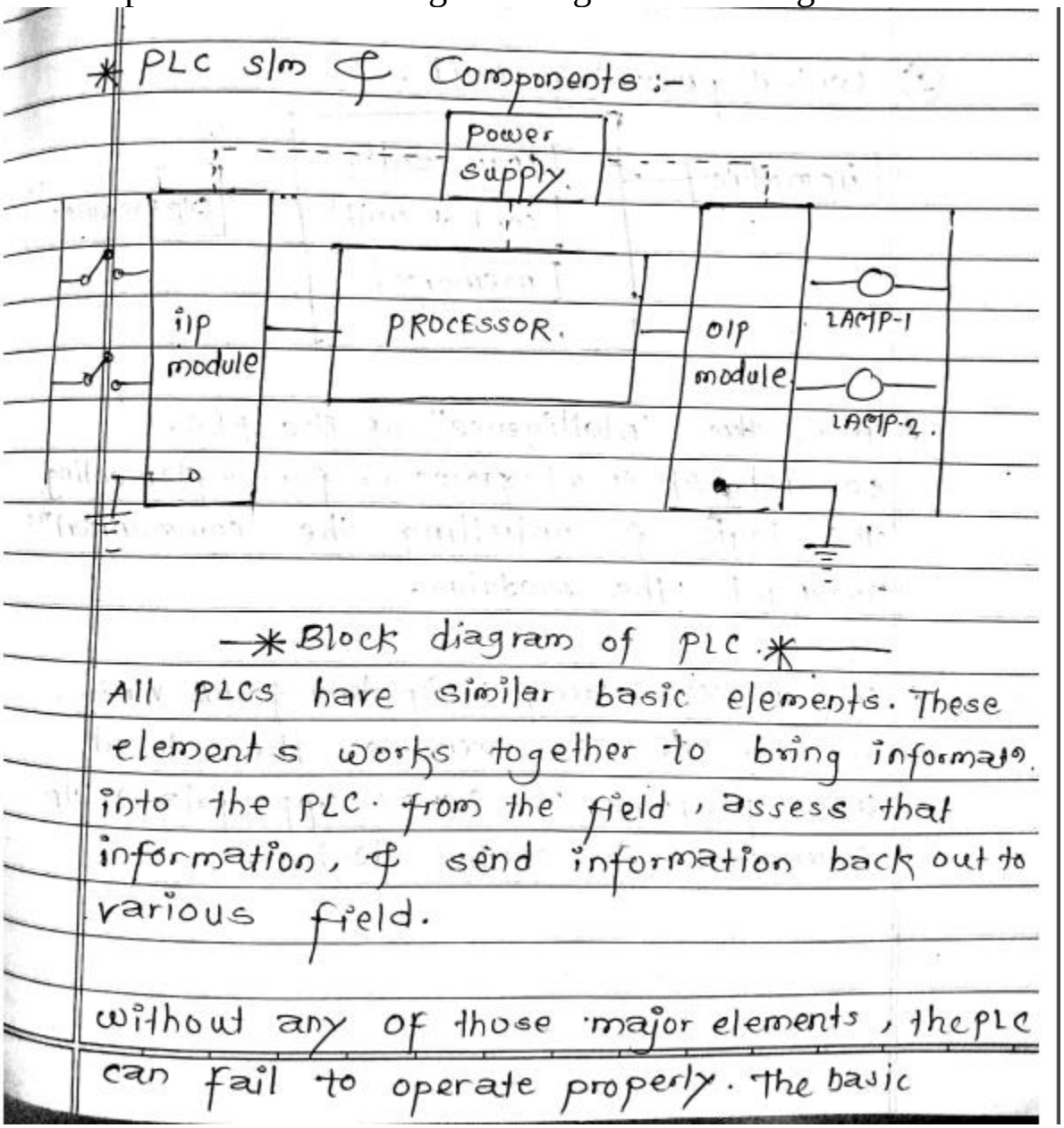


Figure 1.10 Bleed-off circuits:(a) Bleed-off for both directions and (b) bleed-off for inlet to the cylinder or motor.

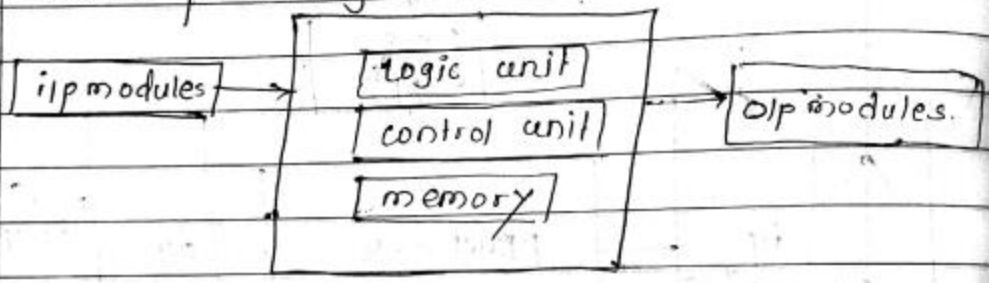
22. Explain with block diagram-Programmable Logic Controller.



Date

elements embrace a power supply, central pro
① central processing unit (CPU)
② i/p & o/p section
③ power supply
④ Programming device.

① Central processing unit :-



⊙ It is ~~those~~ "intelligence" of the PLC. consist of a microprocessor for implementing the logic & controlling the communicat^ns amongst the modulus.

⊙ The processor accepts i/p data forms various sensing devices, executes the stored user program & sends appropriate o/p commands to control devices.

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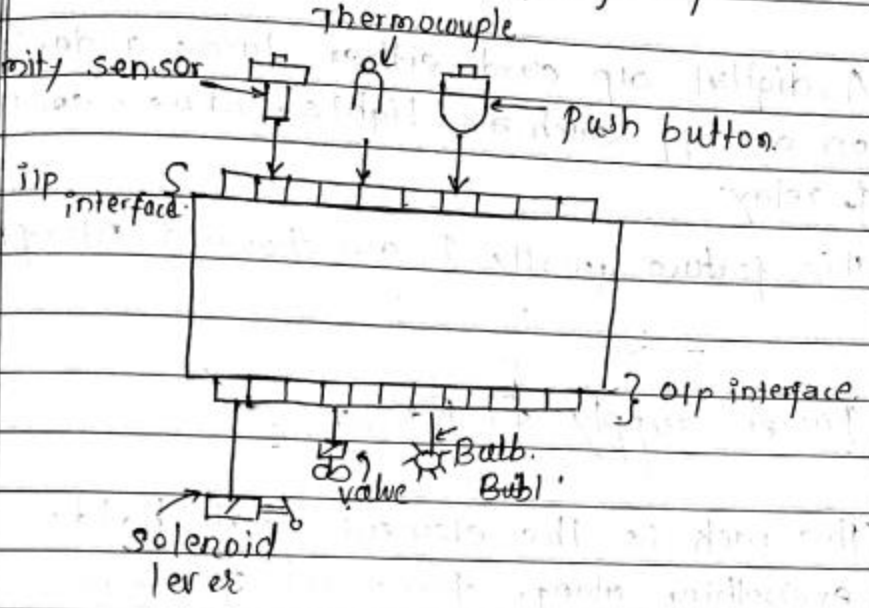
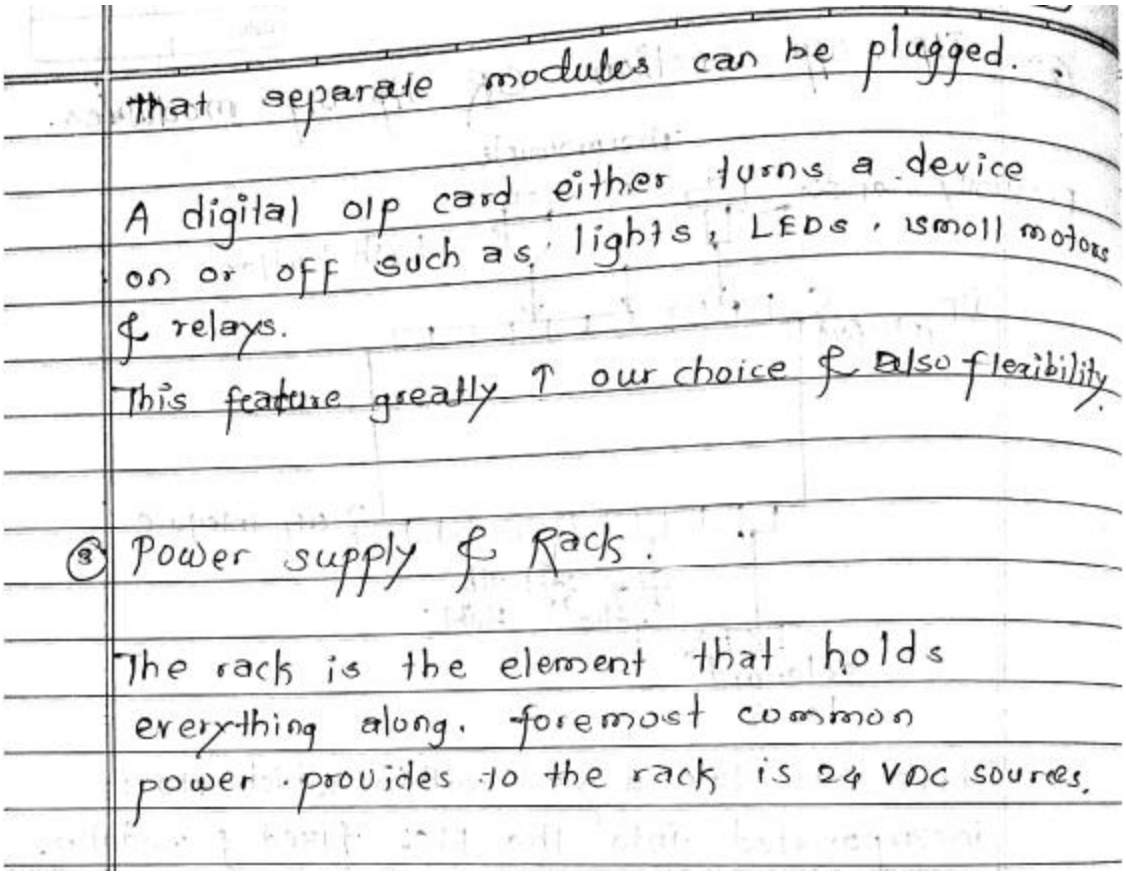
(2) I/p . O/p section OR i/p - o/p modules.



There are two ways within which I/O is incarporated into the PLC: fixed & modular. fixed is usual of small PLCs that are available in one package with no separate removable units.

The processor & I/O are ~~pad~~ prepackaged along & the I/O terminals are available but can't be changed. The most advantage of this type of packaging is lower price. Modular I/O is split by & compartments into that can be understood by the CPU.



23. Explain symbols used in Programmable Logic Controller.
24. Explain how holding registers are used in timers.

https://www.electronics-tutorials.ws/waveforms/555_timer.html

25. Mention differences between hydraulic & pneumatic systems
26. State any four types of accessories used in pneumatic system along with their function.
https://jhfoster.com/automation-blogs/pneumatic-system-components/

27. Explain timers ,counters
https://www.tutorialspoint.com/embedded_systems/es_timer_counter.htm

28. There are three mixing devices on processing line (A, B and C)
When start is pressed mixer A goes on after 5 second delay
Next B is to start 10 seconds after A
Mixer C starts 12 seconds after B
All remains on until master switch is OFF. Develop a ladder logic.

29. Give comparison between computer-controlled systems & PLC controlled systems.

30. Draw a ladder diagram for 3 motor operation for following condition: i) Start push button starts motor M1. After 15 seconds M2 and M3 starts ii) Stop push button stops M3 and after 15 seconds motor M2 and M1