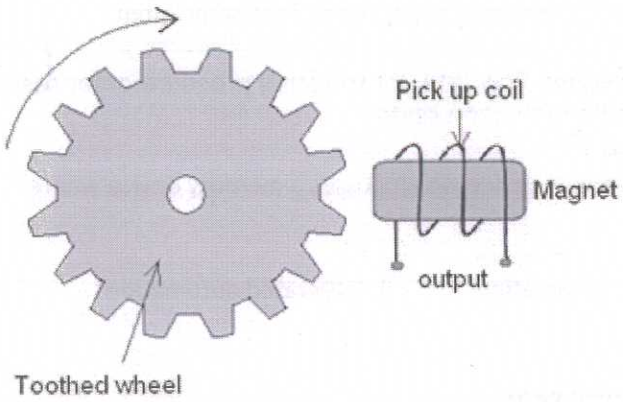
Qn. No.	Scoring Indicators	Split score	to sc
	PART-A		
I	1. The process of enabling machines to follow a predetermined sequence of operations with little or no human intervention and using specialized equipment and devices that perform and control manufacturing processes and operations. 2.The ability of a sensor to give the same output for repeated application of the same input Value. 3. An **orifice plate** is a device used for measuring flow rate, for reducing pressure or for restricting flow (in the latter two cases it is often called a restriction **plate**). 4.Diods, Thyristors, Bipolar transistors, Solenoids 5.PLC,Programmable Logic Controller, is an electronic device which posses a memory device where programs can be stored .	1x5	5
II	**1.** 1.Fixed automation 2. Programmable automation 3. Integrated automation **1.Fixed Automation** • It is used to produce high volume of similar parts. • In this automation the machine has no capability to change the sequence of operations. • Continuous flow and Discrete mass production systems use this automation • Ex. Conveyors, Welding Robots, **2. Programmable Automation** • In this, equipment has the capability to change the sequence of operation to adopts different product configuration • By changing the program, the equipment can be programmed to perform a variety of tasks • It is suitable for Batch production **3.Integrated Automation** • It denotes complete automation of a manufacturing plant, with all processes functioning under computer control and under coordination through digital information processing It includes technologies such as Computer Aided Design and Manufacturing Computer Aided Process Planning, Automated material handling system etc. **2. ADVANTAGES OF MECHATRONICS SYSTEM** • Simplified mechanical design • Rapid machine set up • Products produced are cost effective and have very good quality • Shows good performance characteristics • High degree of flexibility • Great extent of machine utilization • Greater productivity • High life expected by proper maintenance	2x3 4 adv. 4 disadv.	6 6

DISADVANTAGES OF MECHATRONICS SYSTEM

- Different expertise required
- More complex safety issued
- Increase in component failure
- Increased power requirements
- High initial cost of the system
- Specific problem of various system will have to be addressed separately and properly
- It is expenses to incorporate mechatronics approaches to existing/old system

3.



- Tachogenerator is used to measure angular velocity
- It consists of a toothed ferromagnetic wheel connected to the shaft whose angular velocity is to be measured.
- A pick up coil wounded on a permanent is nearby placed.
- As the wheel rotates the air gap between the coil and the ferromagnetic material changes and thus produces an alternating emf In the coil.
- The maximum induced emf Is taken the angular velocity.

Fig-3 6
Theory-3

4. It is used to monitoring the level of liquid in a vessel by monitoring the movement of a float. According to the changes in the liquid level, the float also changes its position causes a lever arm to rotate and so move a slider across a potentiometer. The result is an output of a voltage , related to the height of the liquid.

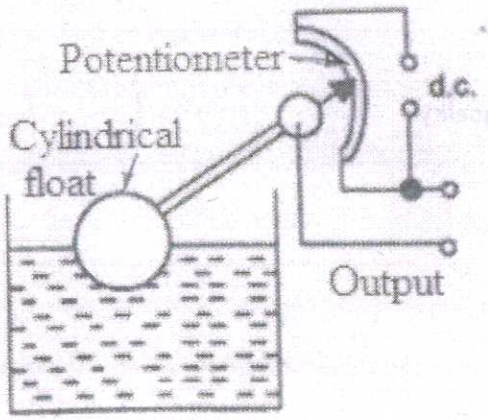


Fig. 3 6
Theory-3

5.

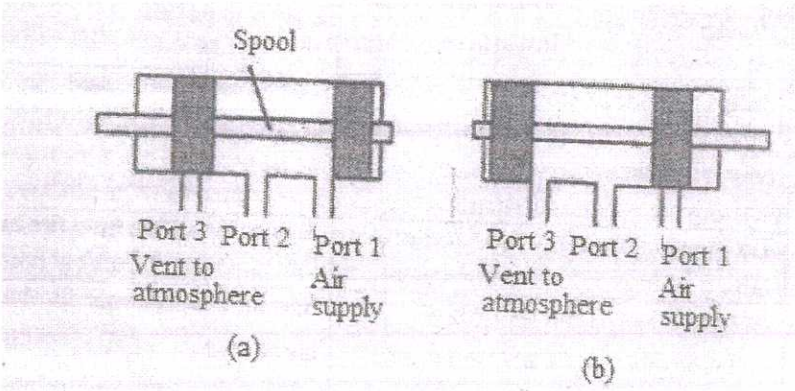


Fig 4.4 Spool valve

Fig 3½ 6
Theory 2½

It is a directional control valve . In this a spool moves horizontally within the valve body to control the flow. In fig. (a) spool moves to right side , port 1 opens and port 2 closes. Air enters into the cylinder through the port 1 and pressurize the device connected to the port 2.
When the spool moves to left side port 1 closes and port 3 opens. Air from the device vent to the atmosphere through port 3

6.

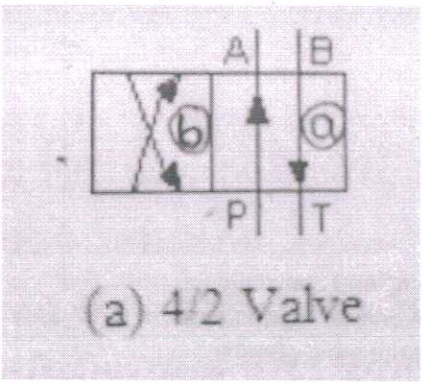
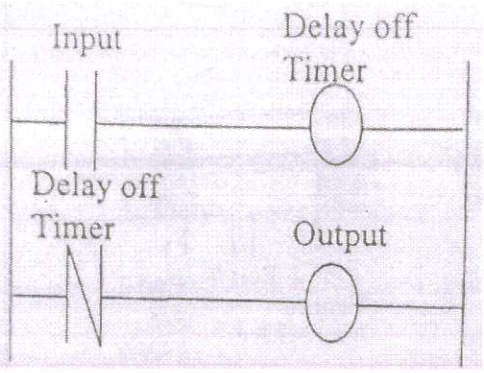


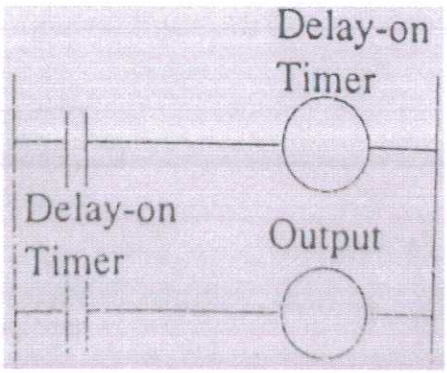
Fig 3
Theory-3 6

P -Pressure (Power)supply T- Exhaust/Return
A,B -Working lines

When the valve is in its normal state " a", fluid is delivered from port P to port A and returned from port B to port T. In state " b ", flow is reversed.

7.





A timer is specified by stating the interval to be timed and the conditions or events that are to start and/or to stop the timer.

When there is an input , the timer is energized and start timing . After some preset time the contact associated with the timer closed and output occur.

Two types of timers, 1. Delay-on timer and 2. Delay-off timer. The delay on timer closes the contact after a preset time where as the delay-off timer opens the contact after a preset time.

Fig 3 6
Theory-3

PART –C

UNIT-I

III. a

BASIC ELEMENTS IN AUTOMATED SYSTEM

Four Basic Elements

1. Actuator 2. Sensor 3. Controller 4. Mechanical System

1. **Actuator**

An actuator is a component of a machine that is responsible for moving and controlling a mechanism or system. They provide the movement to drive the system and can obtain that energy from different sources, with electricity, pneumatics or hydraulics being the most popular.

2. **Sensor**

Sensor is a device which detects or measures a physical property (light, temperature, stress etc) and records, indicates or otherwise responds to it.

Switches and transducers are another name of sensors.

3. **Controller**

It controls the motion and operation of the system components based on inputs from sensors and the internal programmed instructions. It is the brain of the system.

4. **Mechanical System**

It consists of other hardware included in the automation system. These Mechanisms or components are used with actuators.

4 Elements 9

b

MECHATRONICS PRODUCTS

In the late 1970s, the Japan Society for the promotion of Machine Industry classified mechatronics products into four categories as follows

1. **Class-I(Primary Level):** Primary mechanical products with electronics incorporated to enhance functionally
   Ex. Electrically controlled fluid valve relay

2. **Class-II(Secondary Level):** In the level microelectronics integrated with electrically controlled devices
   Ex. Casset Player

3. **Class-III(Third Level):** This level incorporate advanced feed back function into control strategy.
   Ex. Automatic washing machine, Hard disk

4. **Class-IV(Fourth Level):** This level incorporate intelligent control, fault detection etc.
   Ex. SMPS(Switch Mode Power Supply), Automatic Ovens

4 classify & -each 6

OR

IV a

1.**The need**-from a customer or a client-identified by market research
2.**Analysis of the problem-** Developing a design is to find out the true nature of the problem
3.**Prparation of specification**-Following the analysis a specification of the requirement can be prepared
4.**Generaton of possible solutions**-Solutions are prepared which are worked out in sufficient detail to indicate the required functions such as sizes, shapes, materials and costs.
5.**Selection of suitable solution**-A most suitable solution is selected by evaluating above solutions.
6.**Production of a detailed design** –The detail of the selected design has to be worked out.
7.**Production of working drawing**-The selected design is then translated into working drawings, circuit diagrams etc.

7 steps 9

b

Sr. No.	Open loop system	Close loop system
1.	Any change in output has no effect on the input i.e. feedback does not exist.	Changes in output affects the input implemented by use of feedback.
2.	So long as the calibration is good, the performance of the system is accurate.	Due to feedback the performance of closed-loop system is accurate.
3.	Operation is normally stable.	Stability is major consideration while designing.
4.	Simple construction and operation.	Complicated design and operation.
5.	Highly affected by non-linearities.	Reduced effect of non-linearities.

4 points 6

UNIT-II

V a

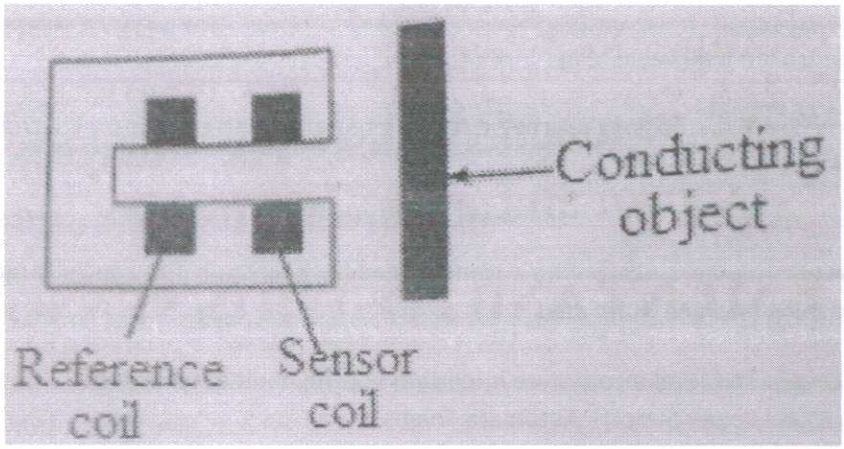


Fig 3
Theory 6 9

It consist of two coils, one is reference coil and other is sensor coil
It is used for the detection of non-magnetic conductive material
When an alternating current is supplied to the coil ,an alternating magnetic field is produced. If there is a metal object in close proximity of this alternating magnetic field, the eddy current is induced in it .
This eddy current themselves produced a magnetic field and the impedance of the coil changes the amplitude of the alternating current. This changes can be used to trigger a switch.

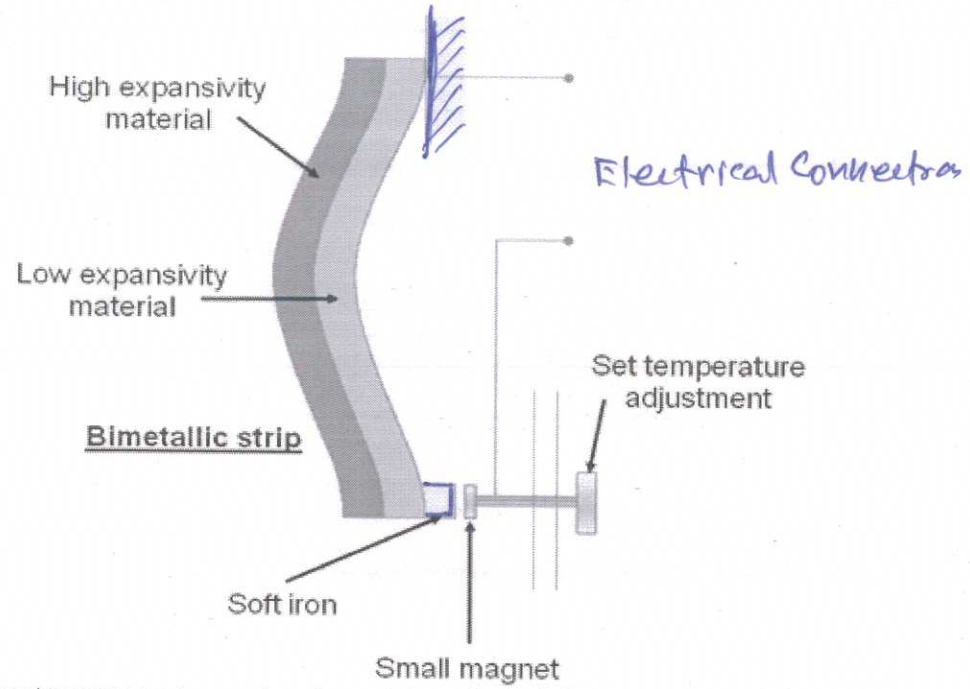
b

1.The size of displacement (mm, cm or meter)
2.Type of displacement-Linear or angular
3.The resolution required
4.The accuracy required
5.Material of the object
6.Cost of the sensor

6 points 6

OR

VI a



Electrical Connectors

Fig 5
Theory 4 9

A **bimetallic strip** is used to convert a temperature change into mechanical displacement.
This consist of two different thin metal strips bonded together . The metals have different coefficient of expansion. The higher coefficient of metal is outside on the bond . When the temperature changes the composite strips bends into a curved shape . This causes the circuit close and it is used to control a switch of the equipment.

b

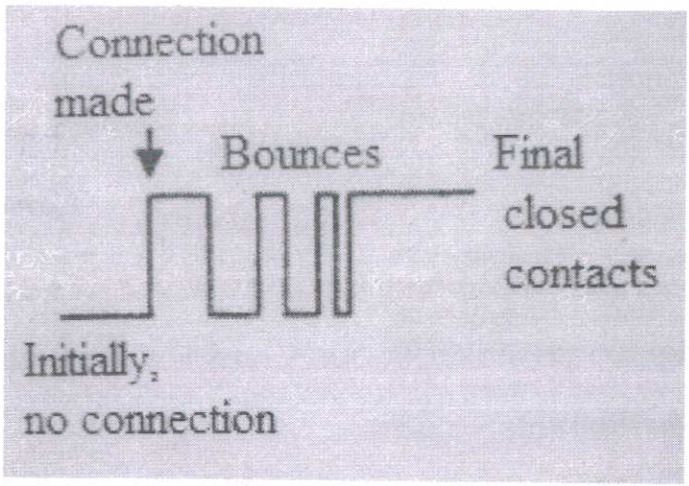


Fig 3
Theory 3 6

Bouncing is a problem that occurs in mechanical switches. When the switch is switched to close contacts, one hits other because the contacting elements are elastic. It may bounce a number of times before finally settling. Each of the contact during its bouncing time can consider as a separate contact.
This is known as bouncing .Bouncing problem in mechanical switches can overcome by the use of a hardware or software. This process is known as debouncing

VII a

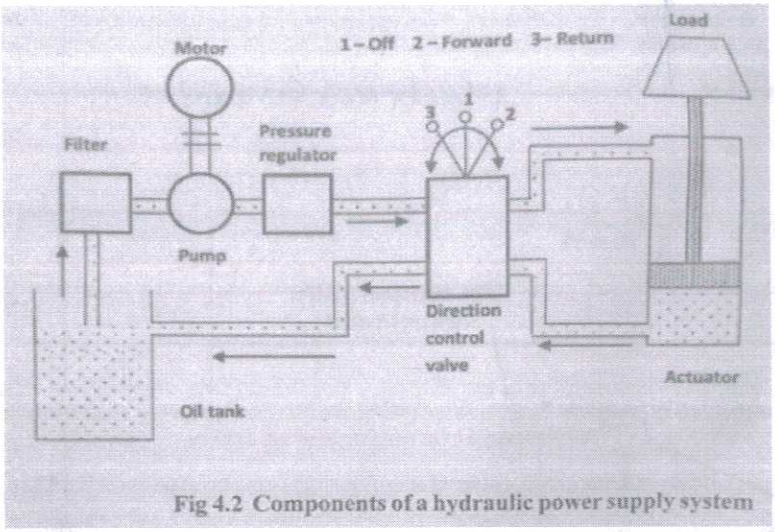


Fig 4.2 Components of a hydraulic power supply system

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

The piping shown in Fig. 4.2 is of closed-loop type with fluid transferred from the storage tank to one side of the piston and returned back from the other side of the piston to the tank. Fluid is drawn from the tank by a pump that produces fluid flow at the required level of pressure. If the fluid pressure exceeds the required level, then the excess fluid returns back to the reservoir and remains there until the pressure acquires the required level.

Cylinder movement is controlled by a three-position change over a control valve.

Fig. 5
Theory-4

9

b

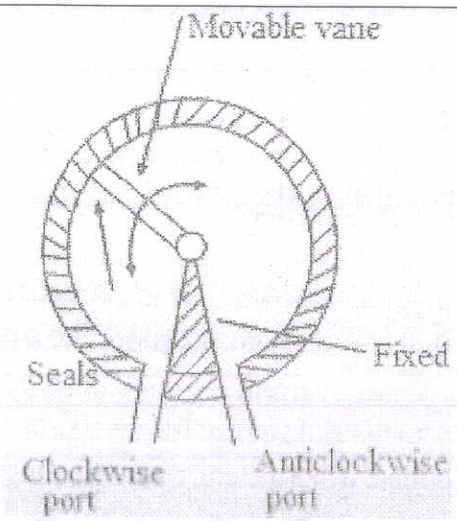


Fig-3 Theory-3 b

Rotary actuators with limited travels are needed to actuate dampers or control large valves. These are used to convert the fluid pressure into torque which in turns through an angle limited by the design of the actuator . In single vane actuator the vane is coupled to the output shaft which rotates when hydraulic pressure is applied to one side of the vane.

OR

VIIIa

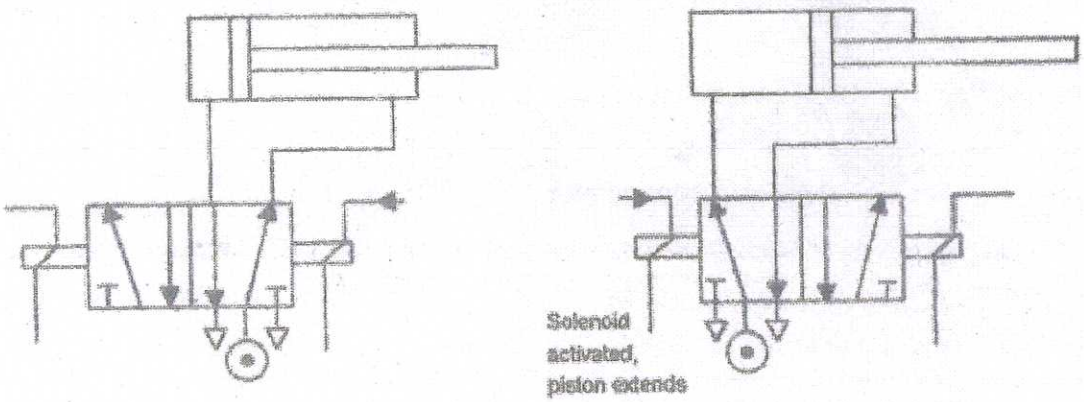


Fig-5 Theory-4 9

In double acting cylinder the fluid pressure is applied and delivered on both sides of the piston.
In fig. (a) the current passes through the right solenoid ,the valve switches positions and the pressure is entered to the right side of the cylinder and piston moved to left side. The pressure in the cylinder delivered through the left port.
In fig. (b) when the current passes through the left solenoid ,the pressure is entered to the left side of the cylinder and piston moved to right side .the pressure in the cylinder delivered through the right side.

b

A machine that converts DC electrical power into mechanical power is known as a Direct Current motor.
DC motor working is based on the principle that when a current carrying conductor is placed in a magnetic field, the conductor experiences a mechanical force.

A brush type d.c. motor is essentially a coil of wire which is free to rotate, and so termed the rotor, in the field of a permanent magnet or an electromagnet. The magnet being termed as the stator since it is stationary(Fig 4.31) . When a current is passed through the coil, the resulting forces acting on its sides at right angles to the field cause forces to act on those sides to give rotation. However, for the rotation to continue, when the coil passes through the vertical position the current direction through the coil has to be reversed and this is achieved by the use of brushes making contact with a split-ring-commutator, the commutator rotating with the coil.

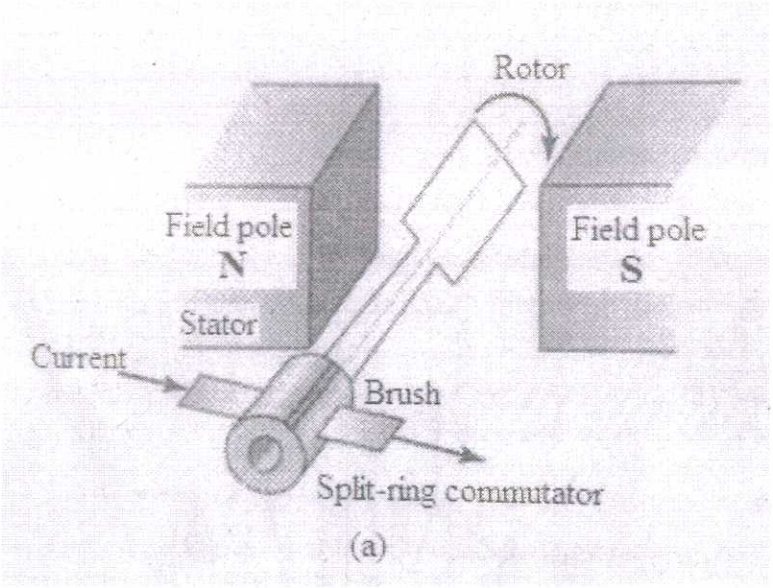
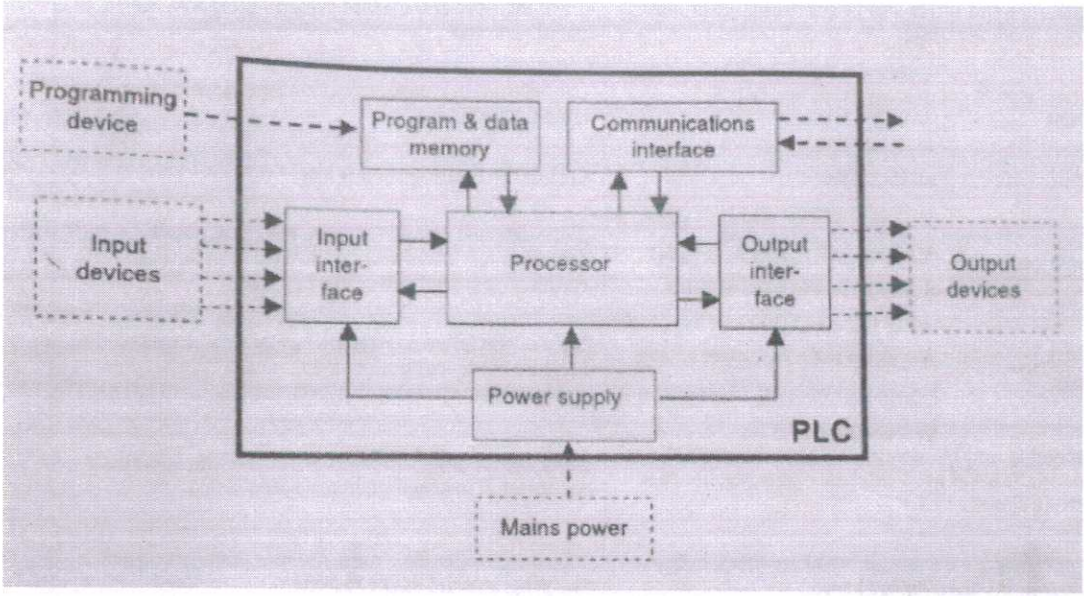


Fig-3 6
Theory-3

IX a

UNIT-IV



A PLC system has the basic functional components of processor unit, power supply unit, the programming device, memory, , input/output interface section, communication interface and.

1. Processor unit or CPU –containing the microprocessor-interprets the input signals and carries out the control actions according to the program stored in the memory.
2. Power supply unit-Convert the mains AC voltage to the low DC voltage for the processor and other components
3. The programming device is used to enter the required program into the processor
4. Memory-Hold the program instructions and data.
5. The input and output sections-The processor receives information from external devices and communicates to external devices.
6. Communication interface-used to receive and transmit data on communication networks.

Fig-5 9

b

Microprocessor	Micro Controller
Microprocessor is heart of Computer system.	Micro Controller is a heart of embedded system.
It is just a processor. Memory and I/O components have to be connected externally	Micro controller has external processor along with internal memory and i/O components
Since memory and I/O has to be connected externally, the circuit becomes large.	Since memory and I/O are present internally, the circuit is small.
Cannot be used in compact systems and hence inefficient	Can be used in compact systems and hence it is an efficient technique
Cost of the entire system increases	Cost of the entire system is low
Due to external components, the entire power consumption is high. Hence it is not suitable to used with devices running on stored power like batteries.	Since external components are low, total power consumption is less and can be used with devices running on stored power like batteries.
Most of the microprocessors do not have power saving features.	Most of the micro controllers have power saving modes like idle mode and power saving mode. This helps to reduce power consumption even further.
Since memory and I/O components are all external, each instruction will need external operation, hence it is relatively slower.	Since components are internal, most of the operations are internal instruction, hence speed is fast.
Microprocessor have less number of registers, hence more operations are memory based.	Micro controller have more number of registers, hence the programs are easier to write.
Microprocessors are based on von Neumann model/architecture where program and data are stored in same memory module	Micro controllers are based on Harvard architecture where program memory and Data memory are separate
Mainly used in personal computers	Used mainly in washing machine, MP3 players

4 points 6

X a

OR

1.Replication checks—This involves duplicating or replicating an activity and comparing the results. In the Absence of faults it is assumed that the results should be the same.

2.Expected value checks—Software errors are commonly detected by checking whether an expected value Is obtained when a specific numerical input is used. If the expected value is not obtained then there is a fault.

3.Timing checks—This involves the use of timing checks that some functions has been carried out within a specified time. These checks are commonly referred to as watchdog timers.

4.Reversal checks—Where there is a direct relationship between input and output values, the value of the output can be taken and the input which should have caused it computed. This can be compared with the actual input.

5.Parity and Error coding checks—Commonly used for detecting memory and data transmission errors. Communication channels are frequently subjected to interference which can affect data being transmitted. To detect whether data has been corrupted ,a parity bit is added to the transmitted data word.

6.Diagnostic checks—Used to test the behavior of components in a system. Inputs are applied to a component

And the outputs compared with those which should occurs.

6x1½ 9.

b

Mechatronics design solutions can be implemented for system to carryout a task simple.
When cam rotate at constant rate and the cam follower used to actuate a switch, length of the time for which the switch is closed depending on the shape of the cam. This problem can be solved by PLC arrangement(timed switch) as shown in figure

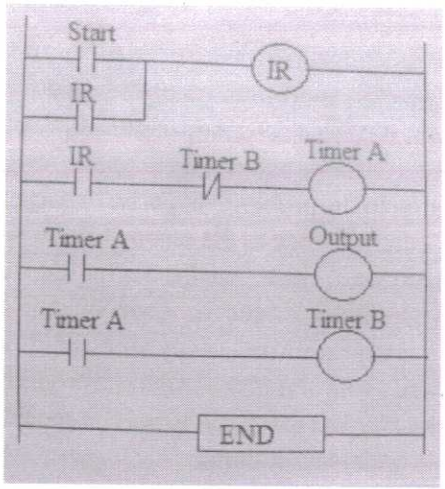


Fig:3
Theory-3 b