CBCS SCHEME

USN | | | | | | | | | | | 17ME753

Seventh Semester B.E. Degree Examination, Jan./Feb. 2021
Mechatronics

Time: 3 hrs.   Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Why mechatronics is important to industrial automation? Explain the applications of mechatronics. (10 Marks)
   b. What are the merits and demerits of mechatronics? (10 Marks)

OR

2 a. Define transducer and sensor. List the difference between transducer and sensors. (08 Marks)
   b. Explain light sensors, proximity switch and hall effect sensors. (12 Marks)

Module-2

3 a. Define microprocessor and microcontrollers? With the help of sketch, explain the application of micro processor to automobile system (car). (10 Marks)
   b. What are the elements of control systems? Mention the difference between microcontroller and microprocessor. (10 Marks)

OR

4 a. With the help of block diagram, explain microprocessor. (08 Marks)
   b. Draw a neat sketch of 8085 microprocessor. Explain different types of registers used in this processor. (12 Marks)

Module-3

5 a. Explain principle operation of Programmable Logic Controller (PLC). How PLC is different from microprocessor in control system. (10 Marks)
   b. What do you mean by ladder diagram? Explain the same with the help of an example (10 Marks)

OR

6 a. Mention robot configuration. Explain yaw pitch and roll pertaining to robot, with the help of diagram. (10 Marks)
   b. Explain background of actuator in mechatronics system. Explain briefly typical hydraulic actuator and pneumatic actuator. (10 Marks)

Module-4

7 a. List the mechanical systems that transmits the power in different planes. (06 Marks)
   b. With the help of diagram, explain cams used in Internal Combustion (IC) engines. (10 Marks)
   c. List the mechanical aspects of motor selection. (04 Marks)

1 of 2

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OR

8 a. How relays are used in mechatronics application? Explain. Explain the working of solenoid switch. (08 Marks)
   b. With the help of sketch, explain synchronous DC motor and servomotor. (12 Marks)

Module-5

9 a. Classify the valves used in mechatronics systems. With the help of sketch, explain pressure reducing valve. (10 Marks)
   b. Explain cylinders types. Explain rotary actuator. (10 Marks)

OR

10 a. With the help of diagram and symbol, explain solenoid operated valve. (10 Marks)
    b. Briefly explain design and function of various units of hydraulic system. (10 Marks)

* * * * *

1a.   10M

→ Mechatronics based automated systems such as automatic inspection & quality assurance, automatic packaging, record making and automatic packaging, record making and automatic dispatch to help expedite the entire Manufacturing operation. These systems certainly ensure a supply better quality, well packed and reliable products in the Market.

→ It also looks for cross-functional issues that could crop up unless dealt with in the early stages Moreover, Mechatronics seeks to optimize high functionality & efficiency, two quality that promote Progress in Manufacturing.

Ans:

Applications of Mechatronics

→ Acctomative machines

→ FAX & photocopier mechanics

→ Dishwashes

→ Automatic washing M/c

→ Air Conditioner, elecveitor controls

→ Document scanner

→ IC Manufacturing system

→ Robotics employeed welding, nuclear inspection, painting etc.

1b.
Merits of Mechatronics

10m

→ The products produced & cost effective & good quality

→ high degree flexibility

→ Greater extent machine utilization

→ Greater productivity

→ high life expected by proper maintainance

Demerits of mechatronics

→ higher intial cost

→ Imperative to have knowledge of different engineering fields for design & implementation.

→ It is expenses to incorporate Mechatronic approach to existing system

✗ → specific problem various system will have to be addressed Seperately & properly.
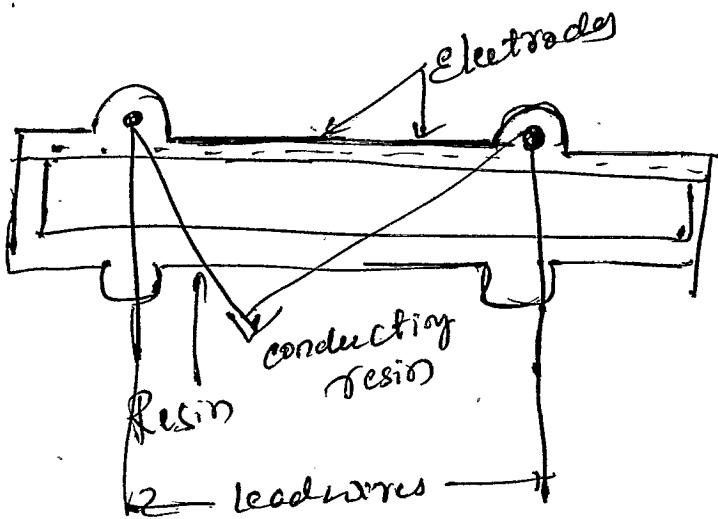
2a. - Transducer is a device which transforms one form of physical phenomenon or energy to another form for various purposes including measurement, control and information transfer.

- Sensor is defined as an element or device which can respond directly to different physical attributes such as heat, force related quantities.

→ Sensor is simple device, transducer is complicated electrical circuit used for energy conversion.

Ex of sensors are thermocouple, thermometer light sensor etc.

Example of transducers thermistor, potentiometer piezoelectric transducers.

2b   Light sensors: 12M

Light sensor is device that is used to detect light. there are different types of light sensors such as photocell / photo resistor & photo diodes being used ✓ in manufacturing & other industrial applications.

fig. shows the construction of photo resistor or the CdS resistor coil is mounted on a ceramic substrate this assembly is encapsulated by resin material the sensitive coil electrodes are connected to control system through lead wires.

on incidence of high intensity light on the electrodes, the resistance of resistor coil decreases which will be used further to generate appropriate signal by microprocessor via lead wires.

26.
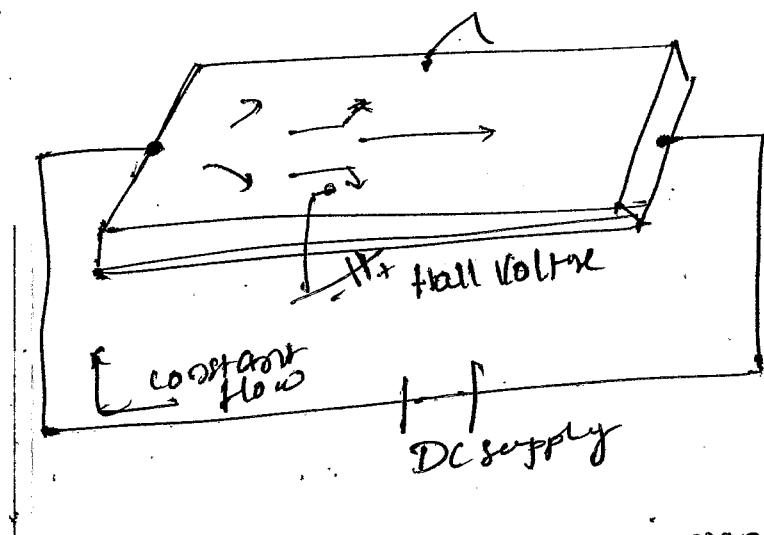
Hall effect Sensor:

Hall effect Sensors work on the principle that when a beam of charge particles passes through a magnetic field, forces act on the particles & current beam is deflected from ff st line path. Thus one side of the disc will become negatively charged & ther sidewill be +ve charge. this charge seperation generates a potential difference, which is the measure distance of majentic field from the disc carrying current.

The typical applications of hall effect sensor is measurement of fluid level in a container. The conta-iner comprises of d float with permanent majent attached at ft's" top.

Ans

3a.
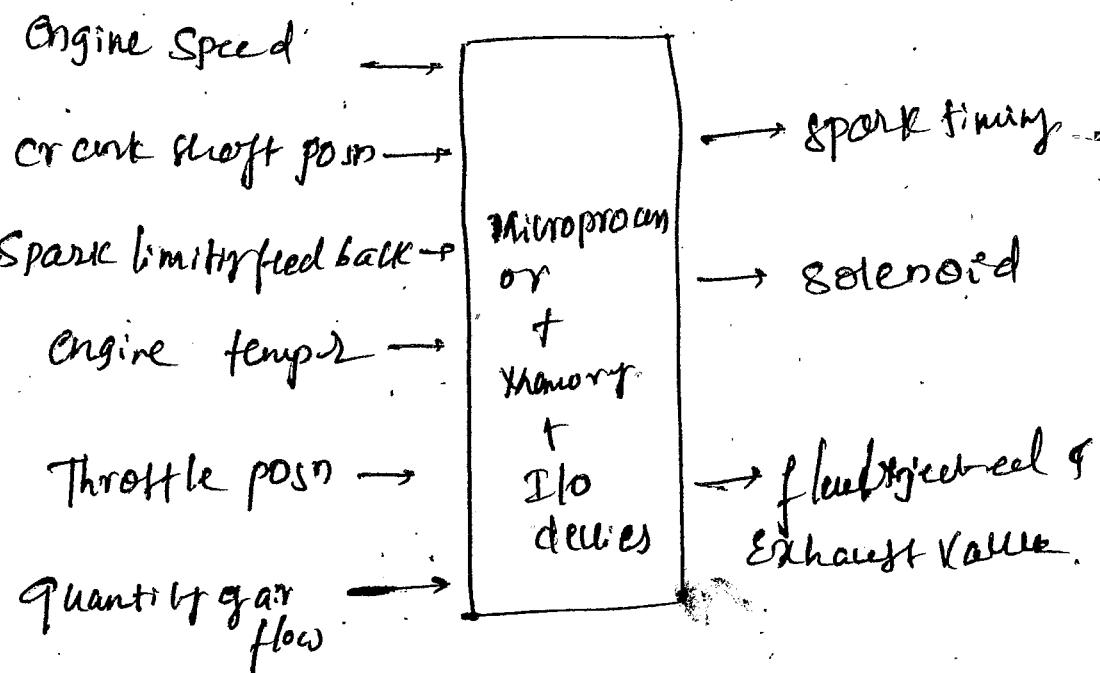
Microprocessor : It is a digital integrated circuit which carries out necessary digital functions to process the information obtained from measurement system.

Microcontroller ; microcontroller is microprocessor based system. It is data processing system that employs a microprocessor as central unit. Based input it takes decisions.

Engine management of system of car.

Engine Speed ⟶

crank shaft posn ⟶   Microprocessor   ⟶ spark timing
                             or
Spark limiting feed back ⟶   +   ⟶ solenoid
                            Memory
engine tempr ⟶   +
                            I/o   ⟶ fuel injection &
Throttle posn ⟶   devices   Exhaust valve.

Quantity of air
            flow ⟶

36.

| Microprocessor	Microcontroller
1. Intended to be a general purpose digital computer	→ Intended to be a special purpose digital controller
2. Contains a CPU, memory addressing circuits & interrupt handling circuit.	2. contains CPU memory adding circuit, interrupt handling circuit, as well as timers, & serial I/O, & internal RAM & ROM
3. Has many opcodes for moving data from external to CPU	3. has one or two opcodes
4. It is concerned with rapid movement of code & data from external address to the chip	4. concerned with rapid movement or bits within the chip
5. has one or two types of bit handling instructions	5. has many types of bit handling instructions.

Omx

4.

a.

ALU:→ ALU stands Arithmatical logic unit, As name indicates it has two parts - Airthmatic & logic unit

Register Array: are small storage devices that are available to cpu or processor.

Control; this part of cpu dedicated to coordinate data flow & signal flow through various buses

Memory: 2 different types of memory Segemented Rom which stands Read only memory & R/w - Read & write memory.

I/P devices: are used to enter input data to microprocessor from key board or from DDC.
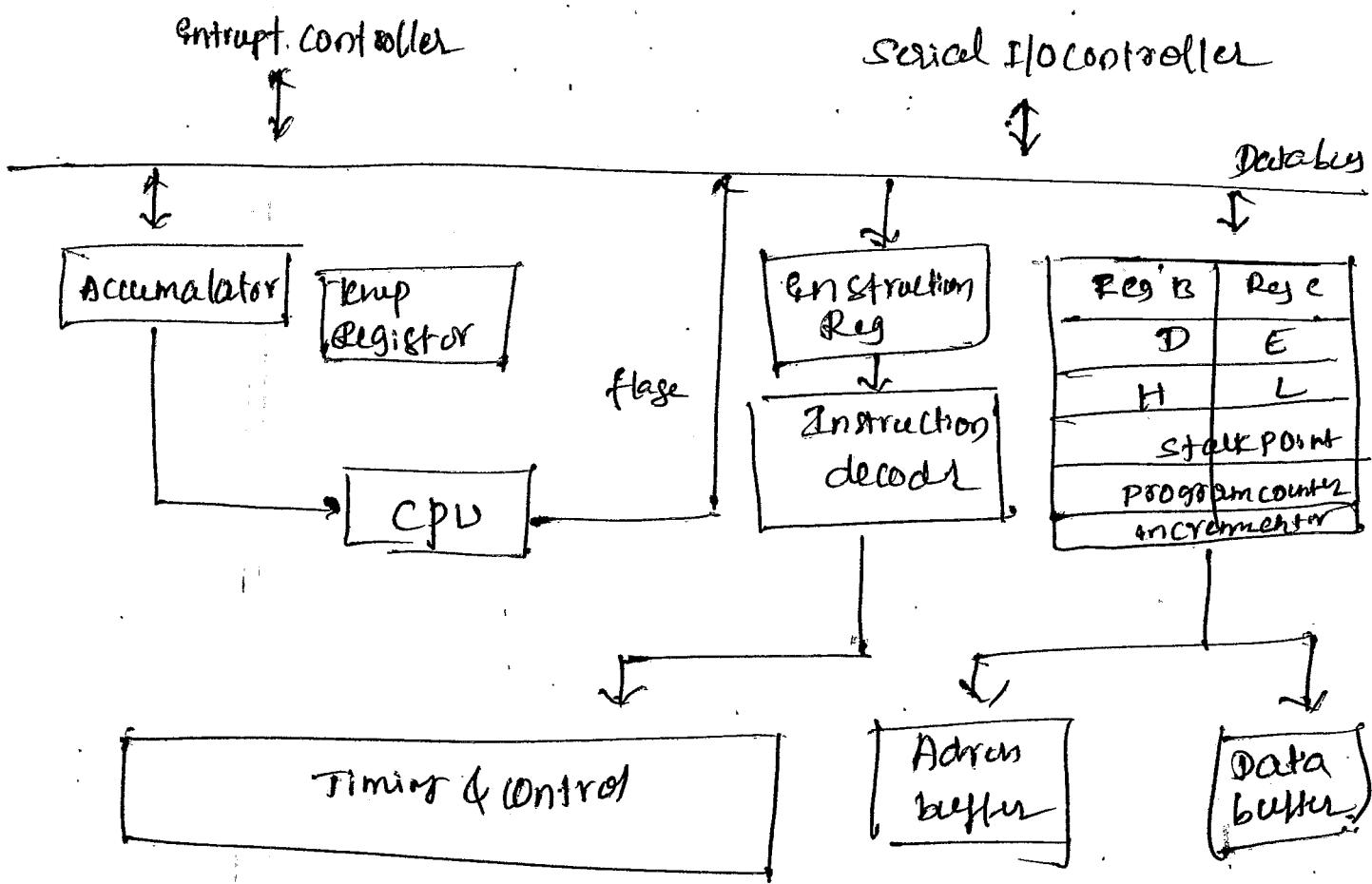
o/p device: These devices display the result / conclusion coming out from ALU.

4 b.   8085 microprocessor

12M

- Instruction Register : Before execution of instruction is sent to Register, instruction stores current instruction of any program.

- Adress Register: MAR holds the adress of next instruction to be executed

- General purpose of Register used to store additional data during a program.

5a.

Principle of operation of PLC:

PLCs are programmed through concept of ladder logic. In general there exist a graphical user Interface to program a plc that makes it different from other processers.

Ladder comprises of two columns shows i/p put devices like switches, sensors while i/p o/p columns is at right side which shows actuators like cylinders & motors.

So any computer having i/p & o/p inter -face can be used to control external devices however most of computer not industrially hardned. plc are digital electronic device that uses a programable memory to store instructions.

5.

b. Ladder diagram are specialised schematics commonly used to document industrial control logic systems.
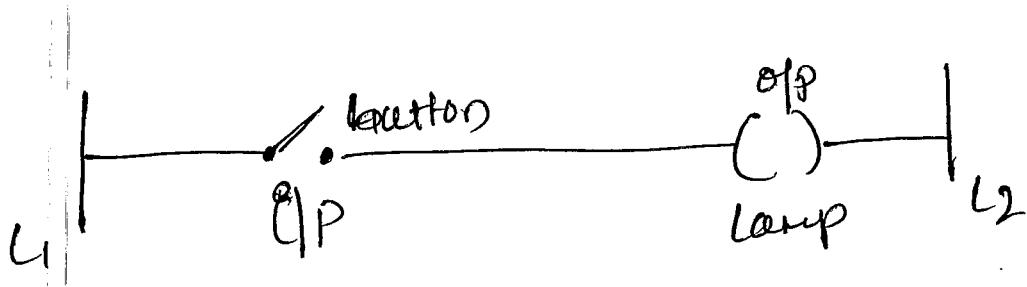
or

is a graphical programing language that you use to develop software for plc.

Ex:

If we wanted to draw simple ladder diagram showing a lamp that controlled by hand scoitch

The L's are designation refer to the two poles of power supply one i/P & one output input is button on o/p lamp will glow. if get off lamp get off.

6

a.

Robot configurations
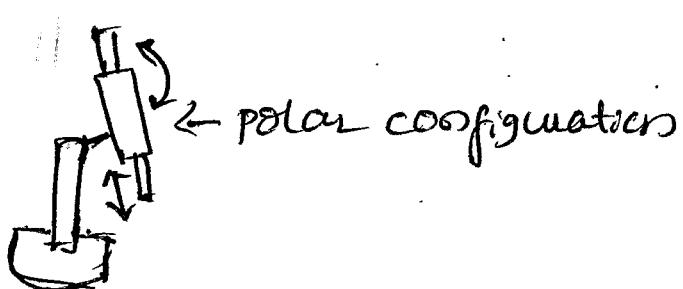
1. polar configuration
   - cylindrical configuration
   - cartesian
2. jointed arm Robot
3. SCARA

• Polar configuration of sliding L-joint, actuated relative to body, which Rotates around both vertical axis (T-joint) & horizontal axis (R-joint)

← polar configuration
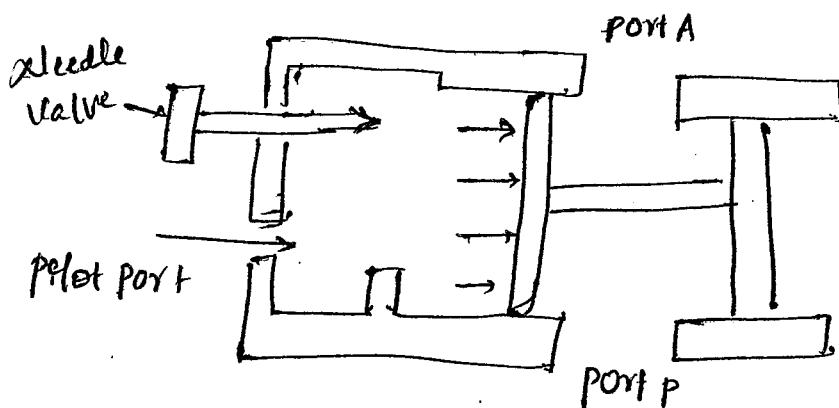
• jointed arm robot configuration similar to human arm. It consist of vertical column that scoivels about the base using T-joint. shoulder joint (R-joint) is located at the top of the column.

Hydraulic actuation.

This type of actuation usually known as pilot actuated valve. In this type of actuation hydraulic pressure is directly applied on the spool. The pilot port is located on one end of the valve. fluid entering from pilot port operates against piston & force to move forward.

Pneumatic Actuation :

DCV can also be operated by applying compressed air against the piston at either end of the valve spool.

The construction of system similar to hydraulic system.

The only difference would be the actuation medium

The actuation medium is the compressed air in pneumatic actuation system.
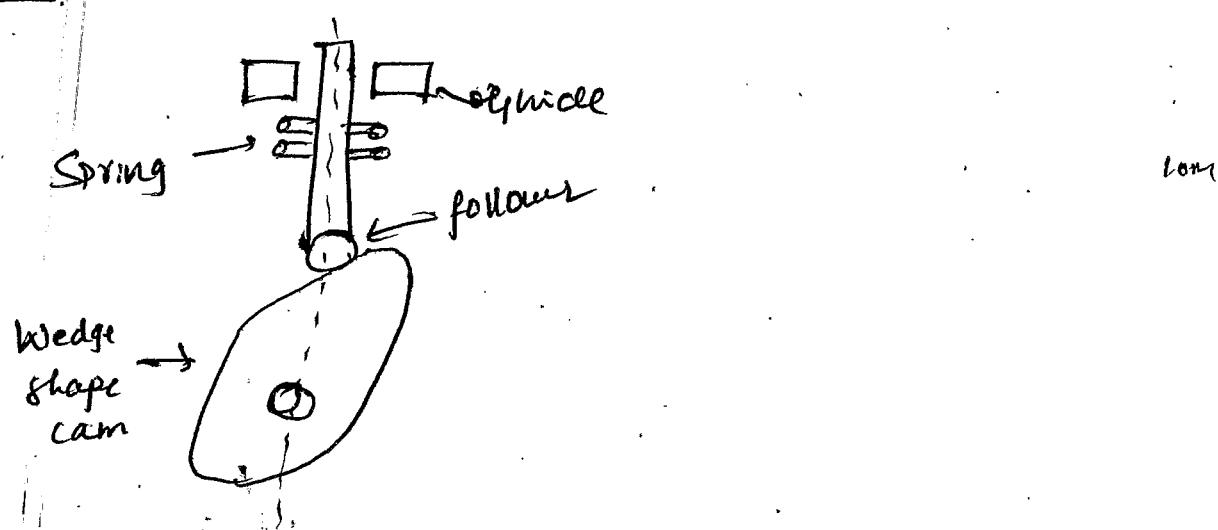
7a. Mechanical systems that transmits power in different planes

→ Transform linear motion into rotation

→ Rotation into linear motion

→ linear into rotary motion

→ rotary into linear motion

→ linear reciprocating to rotary motion

→ Rotary to linear reciprocating.

Eg: cams, gear, Rack-and-pinion, belt drives etc.

7b. **Cams**

Spring →

→ guide

→ follower

Wedge shape cam →

10m

Cams are mechanical devices which are used to generate curvilinear or irregular motion of mechanical elements. They are used to convert rotary motion to oscillatory motion or oscillatory motion to rotary motion.

Cams are widely used in internal combustion engines machine tools, printing control mechanisms.

- driver member known as cam
- driven " " follower.

7c. Mechanical aspects of motor selection.

4M

- Motor speed
- power rating & duty cycle
- Motor load torque
- The motor & environment
- Machine efficiency
- hysteresis
- Current ring theory & mechanism.

a.

Relay is the device that open or closes the contact to cause the operation of their electric control

It detects the undesirable condition with an assigned area and gives the commond to circuit breaker to disconnect the offected area.

Solenoids : are actuators capable of linear motion they can be electromechanical (AC/DC), hydraulic or pneumatic driven-all operating on the same basic principle i.e given energy to it will produce linear force

← movable core

← coil

← spring

← stationary core
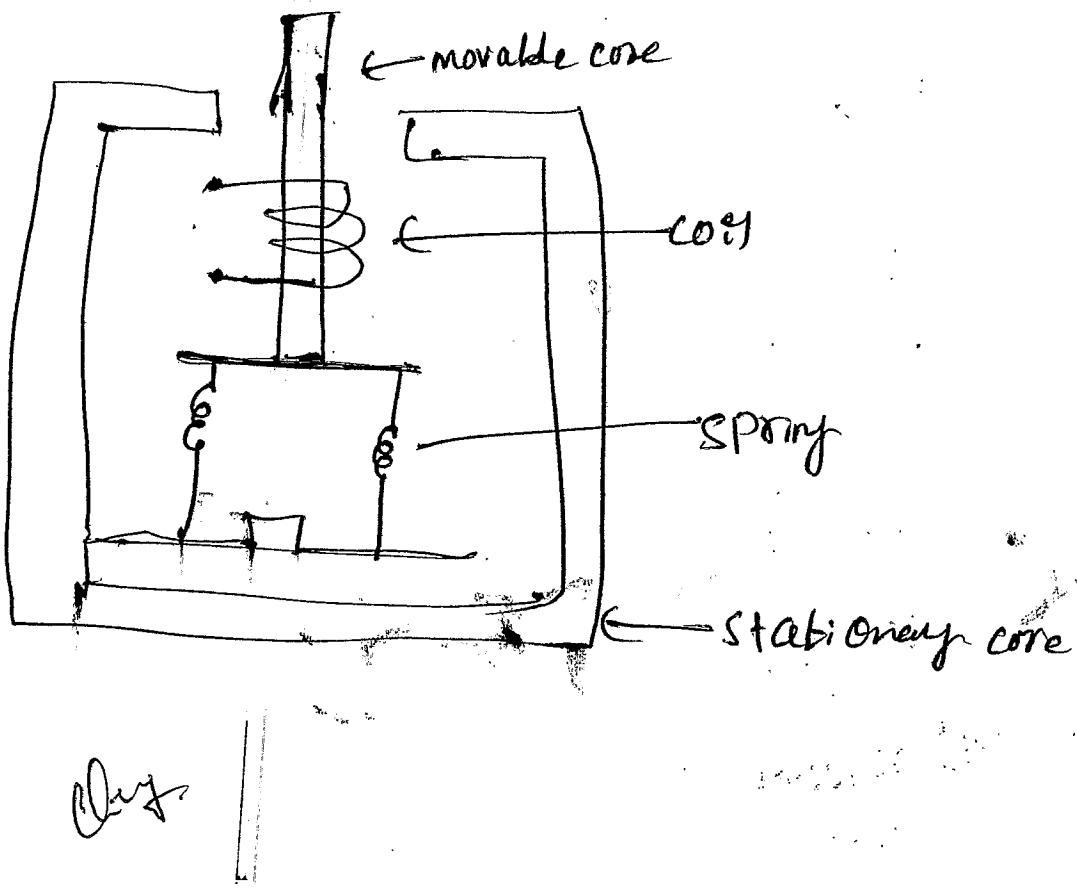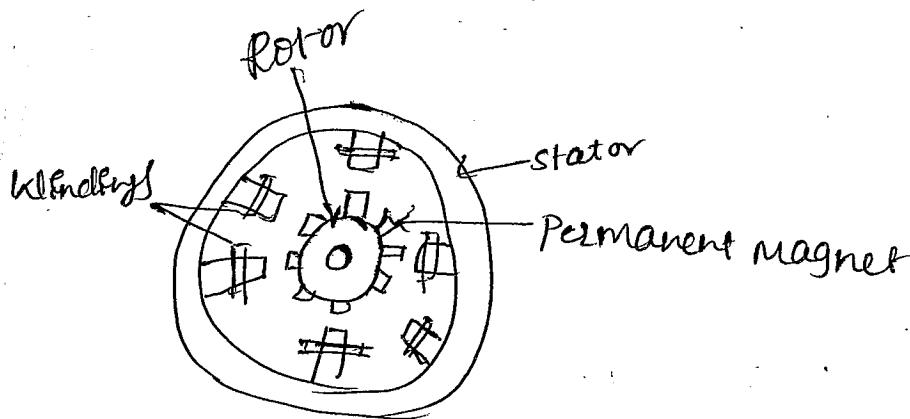
figure shows pull type solenoid the plunger is normally outside solenoid coil for short length called stroke length due to the spring.

when coil is energized, the magnetic field produced in the coil pulls the plunger inside the solenoid & when the coil are de energized, the spring pushes the plunger outside the solenoid.

86.

Synchronous motor

→ A synchronous motor which runs at constant speed fixed by frequency of the system. It requires DC for excitation & has low starting torque, & hence situated for applications that start with low load.

→ As shown in figure, the stator consist of group of individual wounded electromagnets arranged such way that they form a hollow cylinder. The Rotor is Rotating electrical component.

→ It also consist of group of permanent magnet arrange around cylinder, with the poles facing toward the stator pole.

sychronous speed of an AC motor is determined by following formula

$$Ns = \frac{120f}{P}$$

Ns — synchronous speed (RPM)
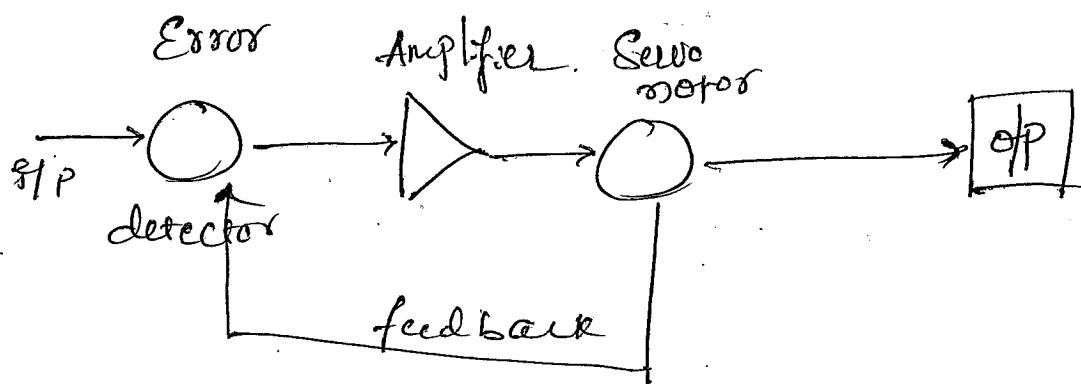
f — frequency (Hz)

P — No. of poles.

8b   Servo motor

Servomotor are special electro mechanical devices that produce precise degree of rotation. A servomotor is DC or AC or brushless DC motor combined with position sensing device.

The servomotors are used in closed-loop servo system as shown in figure. A reference i/p is sent to servo amplifier, which controls the speed of servomotor.

A feed back device mounted on a machine which is either an encoder or resolver. The device changes mechanical motion into electrical signal and used as feedback. This feed back sent to error detector, which compares actual operation with that reference input. servo motors provide accurate speed, torque, and have ability of direction control.

9.a. Classification of valves

1. Type of construction
   - poppet valve
   - spool "
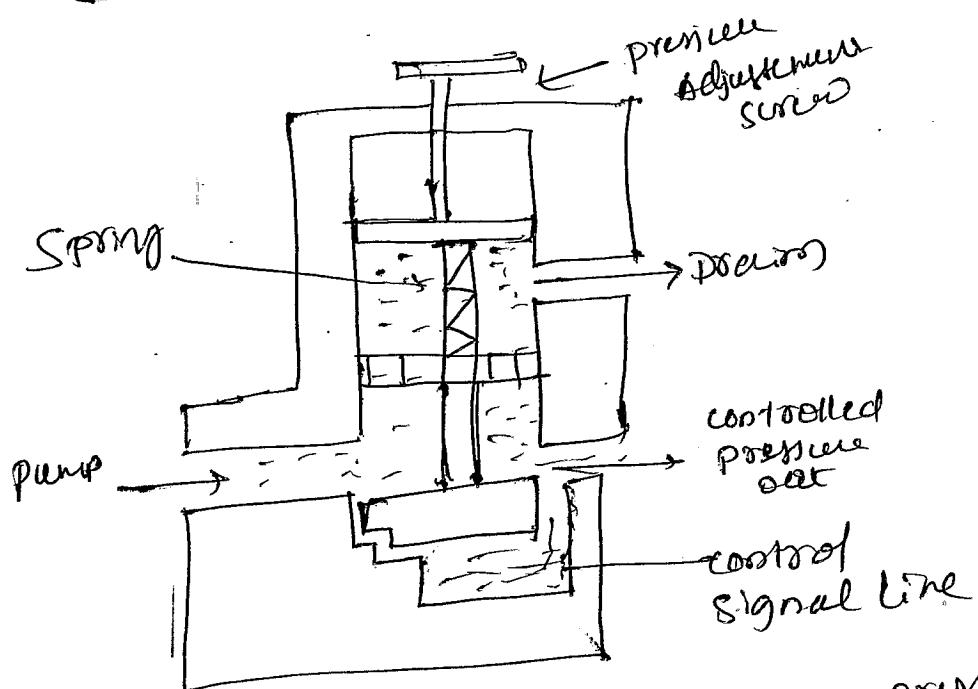
2. No. of ports
   - Two-way valve
   - Three - " "
   - four - way "

3. No. of switching positions
   - Two-position
   - Three-position

Pressure Reducing Valve

part of system may need a lower pressure. this can be made possible by using pressure reducing valve shown in diagram.

9a cont/.

→ These valve are used to limit the outlet pressure.

→ Generally, they are used for the operation of branch circuits where the pressure may vary from the main hydraulic pressure lines.

→ These are open type valve & have spring chamber with adjustable spring, a movable spool as shown in figure. A drain is provided to return a leaked fluid in the spring, a movable spool as chamber. A spool valve with adjustable spring chamber as shown in figure.

→ When pressure in Reduced pressure line exceeds the valve setting the spool valve moves to reduce flow passage area by compressing spring. It can be seen from fig. that if the spring force is more, the valve opens wider & if the controlled pressure has greater force, the valves moves towards the spring & throttles the flow.

9b. Cylinder types

- Single acting cylinder
- Double acting cylinder
- Cylinder end cushions

Rotary actuators
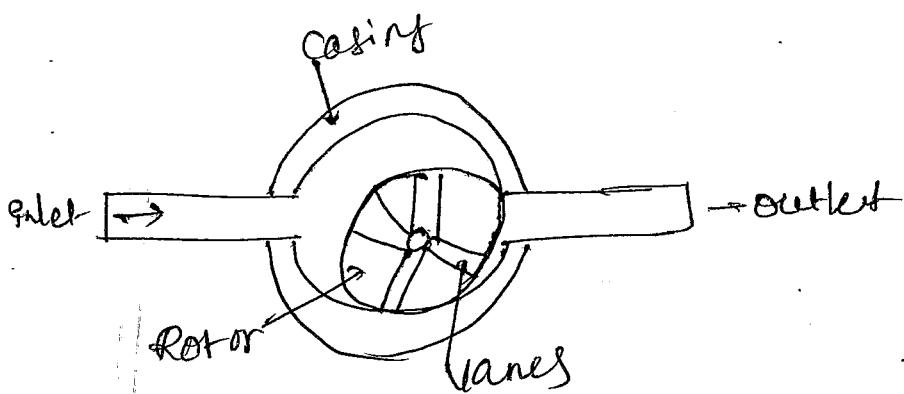
1. Gear motor; rotary actuator
2. Vane motor;
3. limited rotation actuators

Vane motor; Rotary actuator

Rotary vane motor consist of a rotor with sliding vanes in a slots. provided on the Rotor. The Rotor is placed eccentrically with housing. Air enters from i/c port, rotates the Rotor and thus torque is produced. Air is then Released from exhaust port (o/c).

Oay
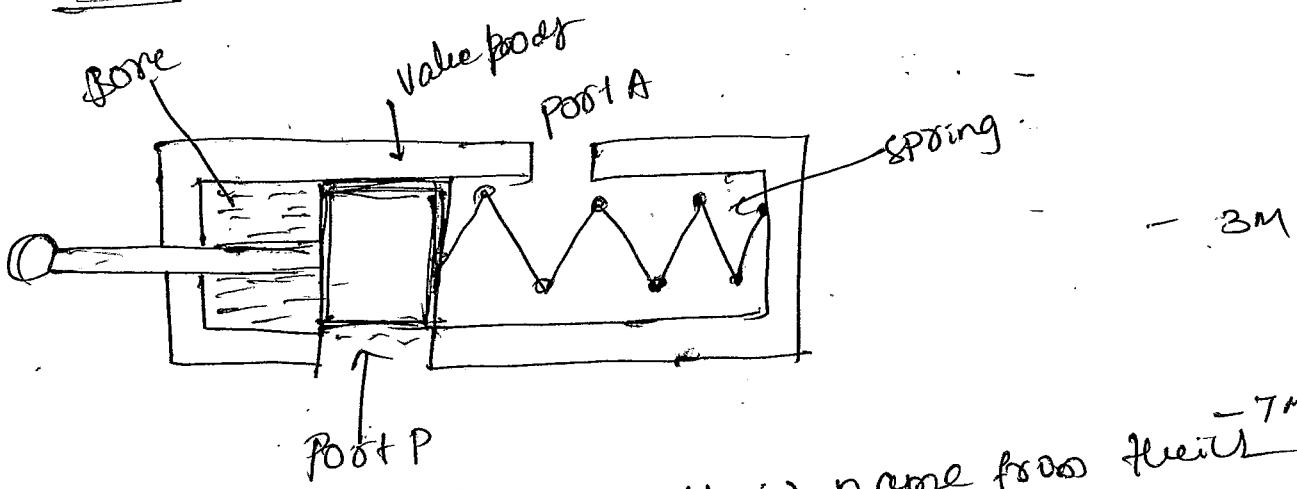
10Q)
a.   Solenoid operated valve.

- 3M

- 7M

→ The spool valves derive their name from their appearance. It consist of shaft sliding in a bore which has large groove around circumference.

→ This type of construction make it look like spool. The spool is sealed along the clearance b/w moving spool & housing. The quality of seal or the amount of leakage depends on the amount of clearance viscosity of fluid and the level of pressure.

One simplest two way spool operated solenoid valve shown in figure. The standard terms are reffered as port 'P' pressure port, port T tank port and port A' which means valve operated actuation.
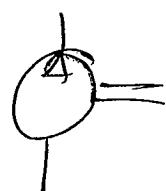
Design and functions of hydraulic system.

Symbol is used to represent individual element display for the following characteristic

- function
- Actuation & Return
- No. of connection
- no. of switching positions
- General operating principle
- simplified representation of flow path
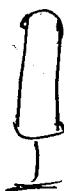
Symbol and designation of the designs

| Energy symbol	designation
	Air compressor
	Air reciever
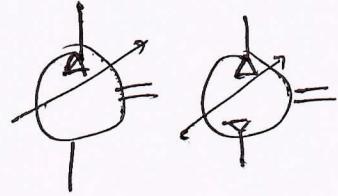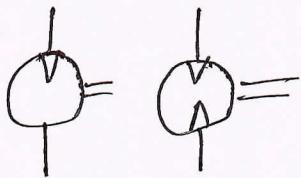
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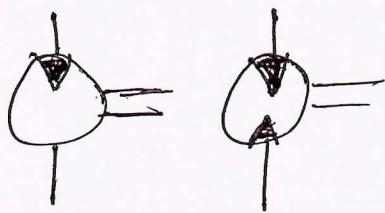
Hydraulic pump

Rotary actuators
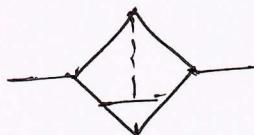

Pneumatic motor

Hydraulic motor
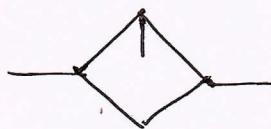
Service units

Air filter

Dryer

Lubricator

faculty incharge

Vineykumar Beclaji   21/03/22