Accelerometer →

It is a transducer that produce a signal ∝ to acceleration used in high speed aircraft space vehicle.

At high freq. accelerometer is used for mean of displacement but at low freq. it is used for mean of acceleration.

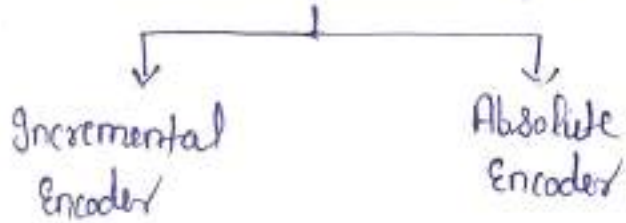
#potentiometer →

In an electromechanical transducer which converts mech. energy into electrical energy. Here i/p is mech. displacement which may be linear or rotational.

In this case o/p is ∝ to displacement either linearly or some non-linear relation. In d.c control system potential are used for position feedback.

En-coder →

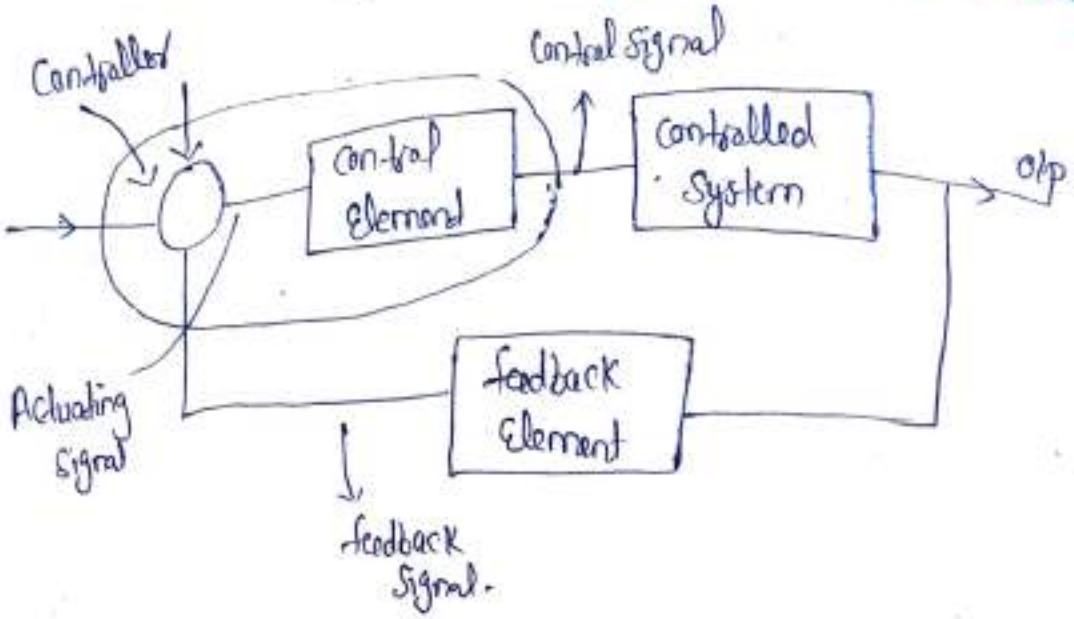
It is of two type




Encoder convert linear or rotatory displacement into digital code or pulse signal.

Absolute Encoder provides o/p as a distinct digital code but incremental provide a pulse for each increment.

# Block diagram of closed loop control system →




Controller consist of Error detector & control element. this Error detector compare feedback signal obtained from plant o/p with I/p signal and determines Error known as actuating signal, this signal is of low power & after manupilating with control element produces control signal. this manipulation may be amplification of diff. power stages.

# Servo - motors

- DC Servo Motors
- AC Servo Motor

D.C Servo Motor →

1) Linear characteristic
2) Easier to control position & velocity
3) Prbm of commutation
4) Expensive

A.C. Servo Motor →
1) Non Linear charac.
2.) Diff. to control.
3) No. prob of commu.
4) cheaper

D.C. Motor

field control
I/p is applied to field winding & armature current is kept const. In this case I/p is d.c. voltage & o/p is angular displacement.

Armature control
Here I/p is applied in armature winding & field vol. is kept const. In this case also I/p is d.c. voltage & o/p is angular displacement.

AC. Servo motor →

It is a like two phase induction motor. Becoz there r two winding, ref. & control winding.

Ref. winding is supplied with a cond. voltage source while control winding is supplied with a variable voltage of same freq. In this case voltage in both windings are equal in magnitude but are quadrature in phase.

# Diff. b/w 2-phase AC servo motor & normal Ac motor →
2) In A.C. Servomotor rotor is squirrel cage or drag-cup.
3) There is no binding inside the rotor.

## Torque Speed characteristic of 2 phase Induction motor / A.C. servomotor

$X \rightarrow$ Rotor reactance

$R \rightarrow$ Rotor resistance

In case of A.C. servomotor of 2$\phi$ I.M. value of $\frac{X}{R}$ is very small & due to that property torque speed characteristic is highly linear.

$$\frac{X}{R} << 1 \rightarrow \text{A.C. servomotor.}$$

But if $\frac{X}{R}$ ratio is high then torque speed characteristic will become non-linear & servomotor will become unstable.

$$G_m(s) = \frac{K \rightarrow \text{Motor Gain const.}}{s(1+\tau_m s)} \quad \tau_m \rightarrow \text{Motor Time const.}$$

$\downarrow$

T.F of AC Servomotor.

In A.C. Servo one cannot use normal g.m. because due to non-linear characteristic system may go towards -ve damping.

IES 04

Q. Consider statement for a.c. series Motors

1) Rotor is designed so that R/X ratio is small.

2) $\frac{dT}{dw} < 0$, where T & w are torque & speed.

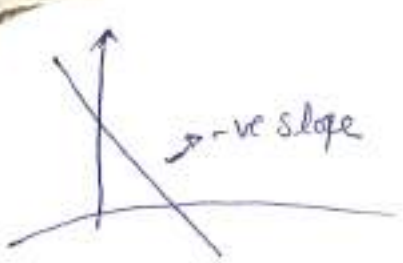
3) Rotor & control voltage should be in phase generator

a) 1/2

b) 2/3 ✓

c) 1/3

d) 1/23




# Synchros

Self Syn or Auto Syn.

It is an electromagnetic transducer which convert angular motion/position of shaft into elec. signal.

- Synchro Transmitter
- control transform

Thus Synchro transmitter & control. transf. act like Error detector.

# Tachometer →

It convert mech. energy into elect energy. In this case angular vel. of shaft is I/p & o/p is generally of d.c. type which is d.c. voltage.

In position control system T.m used to improve stability or damping of closed loop system while In speed control system it is used to have accuracy of the system.

IES 02

Q. A Tacometer feedback is used as inner loop in position control system. what is the Effect of feedback gain of subloop incorporating tachometer & on the Effec. time const. of the system

A) Both are reduced (✓)
B) G↓ but T is ↑
C) G↑ but T is ↓
D) Both are ↑

As gain ↓ becoz stability improved

$$T = \left(\frac{1}{\xi \omega_n}\right)$$

# What is the T.F of Tachometer?

A) $K_s$ (✓) B) $K/s$

C) $Ks^2$ D) $K$

$$v(t) \propto \frac{d\theta}{dt}$$

$$V(s) = K \cdot s\theta(s)$$

$$\frac{V(s)}{\theta(s)} = Ks$$

$\theta$ – unit of K

Vol. / rad / sec.

Comparison of A.C. & D.C Tachometer

| D.C. | A.C. |
|---|---|
| → Convert rotational speed into proportional d.c voltage | → Convert rot speed into ∝ a.c. voltage |
| → uses a permanent magnet for producing a magnetic field | → Work on the principle of induction generator |
| → Magnetic field is const. due to permanent magnet | → Ref. winding is supplied by a ref. vol. & o/p volt. is induced across o/p winding. |
| ∴ Induced voltage at terminal of armature is ∝ to shaft speed | |

# Stepper Motor –

Digital Device whose o/p is completely determined by No. of i/p pulses. Here o/p is any displacement

Two types variable reluctance motor.

Permanent Magnet Motor.

# Amplidyne → Nothing but an amplifier.

# Metadyne → It is a 2-stage cross field amp$^r$. In this case cross magnetizing flux of armature rea. is used for generation of Emf in sec. stage. Also used as Const. current source.

GATE

Q. In Synchro Error detector o/p vol. is proportional to $[\omega(t)]^n$. where $\omega(t)$ is rotor vel. & n equals to

A. 1 B- 1

C 2 D - 2

Voltage $\propto \omega(t)$

$\Rightarrow n = 1$

GATE

Q. A stepper motor is

A) 2 ϕ ∃ M

B) Rotating Amp$^r$.

c) Electromag. transducer

✓ d) Electromec. device

which actuate a train of step angular movements in response to a train of i/p pulses on one to one basis

Q. A) Servomotor
B) Amplidyne
C) Potentiometer
d) Flapper value

1) Error detector
2) Transducer
3) Actuator
4) Power Amp$^r$.

A-3, B-4, C-1, D-2

Q. Which of the following can work as an error detecting device

1. A pair of potentiometer
2. A pair of Synchros
3. Differential transformer
4. Metadyne
5. Control Xmer

A) 1,2,5 ✓
B) 2,3,4,5
C) 1,3,4,5
D) 1,2,3,4

Q. Matching

| List 1 (unit) | List 2 (Type of Rotor) |
|---|---|
| A) Synchro T/F | 1) Dumb-bell |
| B) Control T/M | 2) Drag cup |
| C) A.C. servometer | 3) cylindrical |
| D) stepper motor | 4) Twisted |

A-1, B-3, C-2, D-4

Book.
Q. For 2ϕ Servomotor which statement is not true?

A) A Rotor dia is small
B) Applied volt. are seldom balanced
C) Rotor resist. is low ✓
D) Torque speed charac. is linear.

$\frac{X}{R} << 1 \Rightarrow R$ is high

Q. Components

A) A.C servomotor
B) field controlled D.C. servomotor
C) Tachogenerator
D) Integrating Gyro

T/F's

1) $K/S(1+ST_m)$
2) $K/S(1+ST_c)(1+ST_m)$
3) $KS$
4) $K/1+ST$

A-3, B-2, C-3, D-4

Q. for 2ϕ A.C. servo motor, rotor resistance & reactance respectively R & X

If its length & diameter are L & D respectively then

A) X/R & L/D both are small

B) X/R is large & L/D is small

C) X/R is small & L/D is Large (✓)

D) Both Large

$$\frac{X}{R} << 1 \;,\; \frac{L}{D} >> 1$$

Q. Consider Statements

1) Squirrel-Cage or drage cup type rotor

2) Nearly linear torque-speed charac.

3) Low X/R ratio

which are passed by 2ϕ, ac. Servometer

1,2

2,3

1,3

1,2,3 (✓)

Q. the device which provides damping in servomechanism is

A) Servomotor

B) Amplidyne

C) Tachometer (✓)

D) None