Government of Rajasthan

GOVERNMENT POLYTECHNIC COLLEGE, PALI

Year: 2nd yr **Branch: Electronics** **Session: 2017-18**

EL-203: Electronic Measurement & Instrumentation

III MID TERM TEST

Duration: 1 Hr. **Max. Marks: 15**

Q.1 Compare open loop & closed loop control system.

ओपन लूप एवं क्लोज्ड लूप कण्ट्रोल सिस्टम म अंतर बताइये !

Ans. Comparison between Open Loop and Closed Loop Control Systems is as follows:

Feature	**Open Loop Control System**	**Closed Loop Control System**
Effect of Output on Input	No effect on input	The input signal affects the controller output into the system
Stability	Very Stable	The response changes as the input signal changes.
Response to external disturbances	No reaction to disturbances. The Open Loop control works on fixed output	The output of the controller adjusts itself in response to the input signal
Ease of Construction	The controller is easy to construct	Controller is difficult to construct as it is complex
Cost	Cheap	Expensive
Bandwidth	Small Bandwidth	Large Bandwidth
Maintenance	Low Maintenance	More Maintenance is required.
Feedback	There is no Feedback	Feedback is always present.

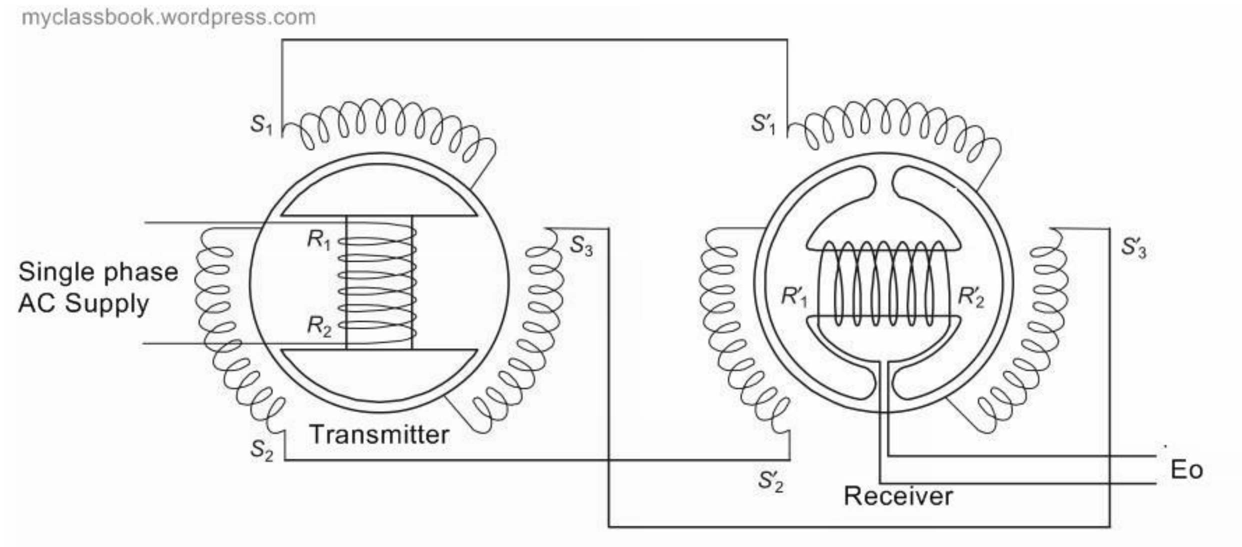
Q.2 Explain synchro control transformer as error detector.

सिंक्रो कण्ट्रोल ट्रांसफामर को त्रुटा संसूचक के रूप म समझाइये !

Ans) We can also use the pair of Synchro pair as an error detector. Here error means the output voltage which depends upon the difference between the angular positions of two rotors of synchro pair.

As the name indicates, it uses two synchros. First synchro is called as synchro generator (or transmitter) and second synchro is called as control transformer (or receiver).

Synchro generator has dumb-bell shaped (salient pole) rotor whereas control transformer contains umbrella shaped rotor. For ease of understanding consider that initially two rotors as perpendicular to each other.



Synchro Pair as an Error Detector

When single phase AC supply is applied to the rotor of synchro generator an alternating flux is generated in the rotor and the empty space between rotor and stator. The stator has three windings, one end of each winding is connected in the star connection and ends are connected to the three ends of the stator of control transformer. Remaining three ends of the control transformer are also connected in star fashion.

As alternating flux is generated in the rotor of generator it produces statically induced emf in the stator windings. As these windings are connected to the three windings of the stator of the control transformer same current flows through it.

Initially, the flux axis of both the rotors are perpendicular so that the output voltage (E0) will be zero because it depends upon cos (θ-a). Where θ is angular position of first rotor and a is angular position of the second rotor.

As the angle between two rotor changes output voltage also changes which is given by,

$E0 = Eom \cos(\theta - a) \sin(wt - ß)$

Where

- θ = angular position of the rotor of the generator,
- a = angular position of the rotor of the control transformer,
- ß = phase lag due to resistances and inductances of the windings,

let us define a new angle for ease of calculations as , d = a + 90, a = d – 90

so the output voltage becomes,

Eo = Eom cos[θ-(d-90)] sin (wt-ß)

Eo = Eom cos[90+(θ-d)] sin (wt-ß)

Eo = Eom [-sin(θ-d)] sin (wt-ß)   (since cos(90+A) = -sin(A))

Eo= Eom sin (d-θ) sin (wt-ß)

For small value of (d-θ), sin (d-θ) ≈ (d-θ)

Therefore

E = Eom (d-θ) sin (wt-ß)

Above equation gives the value of error voltage. Thus the synchro pair can be used as an error detector.

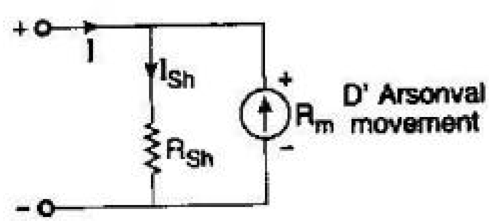
Q.3 How range of ammeter is extended by resistance. Derive the formula

धारामापी का प्रतिरोध के द्वारा परास म वृधि किस प्रकार करते ह1 सूत्र का व्युत्पत्ति काजिये

Ans) Range of an ammeter can be extended by connecting a shunt resistance parallel to the meter. Current division enables ammeter to measure only a fixed and known part of the current.

Shunts are used for the extension of range of Ammeters. So a good shunt should have the following properties:-

1- The temperature coefficient of shunt should be low
2- Resistance of shunt should not vary with time
3- They should carry current without excessive temperature rise
4- They should have thermal electromotive force with copper
* ‘Manganin’ is used for DC shunt and ‘Constantan’ as AC shunt.



Ammeter:- PMMC is used as indicating device. The current capacity of PMMC is small. It is impractical to construct a PMMC coil, which can carry a current greater than 100 mA. Therefore a shunt is required for measurement of large currents.
Let,

Rm = Internal resistance of movement (coil) in Ω
Rsh = Resistance of shunt in Ω
Im = Ifs = Full scale deflection current of movement in Amperes
Ish = Shunt current in Amperes
I = Current to be measured in Amperes

Since the shunt resistance is in parallel with the meter movement, the voltage drop across shunt and movement must be same.

$$I_{sh}R_{sh} = I_m R_m$$

$$R_{sh} = {I_m R_m}/{I_{sh}}$$

$$I_{sh} = I - I_m$$

$$\therefore \text{ We can write } R_{sh} = {I_m R_m}/{(I - I_m)}$$

$$\frac{I}{I_m} - 1 = \frac{R_m}{R_{sh}}$$

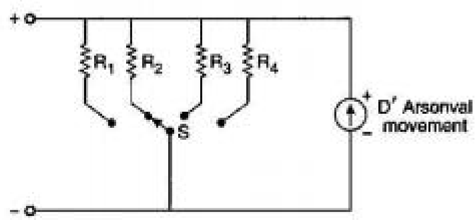
$$\frac{I}{I_m} = 1 + \frac{R_m}{R_{sh}}$$

$$\frac{I}{I_m} = m \quad \text{is known as 'multiplying power'}$$

of shunt

$$\text{Resistance of shunt } R_{sh} = {R_m}/{(m-1)}$$

$$\text{Or } R_{sh} = {R_m}/{\left(\frac{I}{I_m} - 1\right)}$$

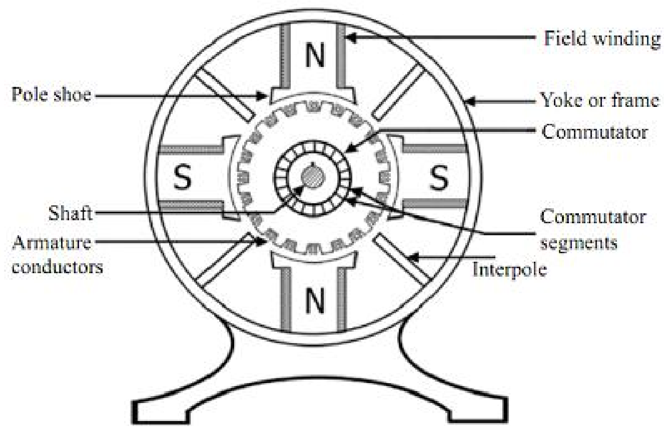


Q.4 Write short note on DC motor.

DC मोटर पर लघु टिपण्णी लिखिए:

Ans.) The main parts of DC Machine (motor or generator) are as follows:

1. Yoke
2. Pole core and Winding
3. Armature core & Winding
4. Commutator
5. Brushes



Yoke

The magnetic frame or the **yoke of DC motor** made up of cast iron or steel and forms an integral part of the stator or the static part of the motor. Its main function is to form a protective covering over the inner sophisticated parts of the motor and provide support to the armature. It also supports the field system by housing the magnetic poles and field winding of the DC motor.

Pole core & pole winding

The magnetic **poles of DC motor** are structures fitted onto the inner wall of the yoke with screws. The construction of magnetic poles basically comprises of two parts namely, the pole core and the pole shoe stacked together under hydraulic pressure and then attached to the yoke. These two structures are assigned for different purposes, the pole core is of small cross sectional area and its function is to just hold the pole shoe over the yoke, whereas the pole shoe having a relatively larger cross-sectional area spreads the flux produced over the air gap between the stator and rotor to reduce the loss due to reluctance. The pole shoe also carries slots for the field windings that produce the field flux.

The **field winding of DC motor** are made with field coils (copper wire) wound over the slots of the pole shoes in such a manner that when field current flows through it, then adjacent poles have opposite polarity are produced. The field winding basically form an electromagnet, that produces field flux within which the rotor armature of the DC motor rotates, and results in the effective flux cutting.

Armature core & Winding

The **armature winding of DC motor** is attached to the rotor, or the rotating part of the machine, and as a result is subjected to altering magnetic field in the path of its rotation which directly results in magnetic losses. For this reason the rotor is made of armature core, that's made with several low-hysteresis silicon steel lamination, to reduce the magnetic losses like hysteresis and eddy current loss respectively. These laminated steel sheets are stacked together to form the cylindrical structure of the armature core.

The armature core are provided with slots made of the same material as the core to which the armature winding made with several turns of copper wire distributed uniformly over the entire periphery of the core. The slot openings a shut with fibrous wedges to prevent the conductor from plying out due to the high centrifugal force produced during the rotation of the armature, in presence of supply current and field.

Commutator

The **commutator of DC motor** is a cylindrical structure made up of copper segments stacked together, but insulated from each other by mica. Its main function as far as the DC motor is concerned is to commute or relay the supply current from the mains to the armature winding housed over a rotating structure through the **brushes of DC motor**.

Brushes

The **brushes of DC motor** are made with carbon or graphite structures, making sliding contact over the rotating commutator. The brushes are used to relay the current from external circuit to the rotating commutator form where it flows into the armature winding. So, the commutator and brush unit of the DC motor is concerned with transmitting the power from the static electrical circuit to the mechanically rotating region or the rotor.

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