Objective: Speed Torque Characteristic of AC Servo Motor

Apparatus Used:

Name of the apparatus	Range/Rating	Quantity
1. AC Servo Motor System		1

Theory

An AC servo motor is basically a two phase induction motor except for certain special design features. A two phase induction motor consisting of two stator windings oriented 90 degrees electrically apart in space and excited by ac voltage which differ in time phase by 90 degrees. Generally voltages of equal magnitude and 90 degrees phase difference are applied to the two stator phases thus making their respective fields 90 degrees apart in both time and space, at synchronous speed. As the field sweeps over the rotor, voltages are induced in it producing current in the short circuited rotor. The rotating magnetic field interacts with these currents producing a torque on the rotor in the direction of field orientation.

The shape of the characteristics depends upon ratio of the rotor reactance (X) to the rotor resistance (R). In normal induction motors X/R ratio is generally kept high so as to obtain the maximum torque close to the operating region which is usually around 5% slip.

A two phase servo motor differs in two ways from normal induction motor.

1. The rotor of the servo motor is built with high resistance so that its X/R ratio is small and the torque speed characteristics are as shown in fig 1.

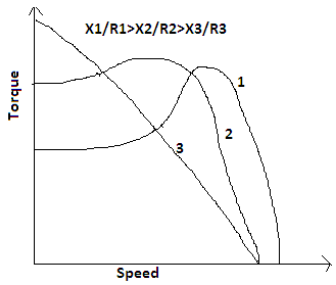

Fig1. Torque-Speed Characteristics of IM

2. In servo applications, the voltage applied to the two stator windings are seldom balanced one. One of phase is known as reference phase is excited by constant voltage and the other known as the control phase w.r.t. the voltage supplied to the reference winding and it has a variable magnitude and polarity. The control winding is supplied from a servo amplifier. Fig 2.

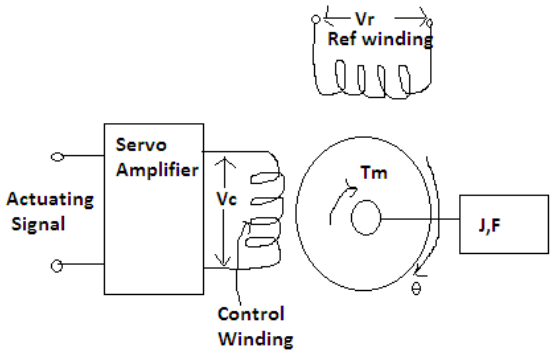

Fig2. Schematic Diagram of Two phase motor

Circuit Diagram-

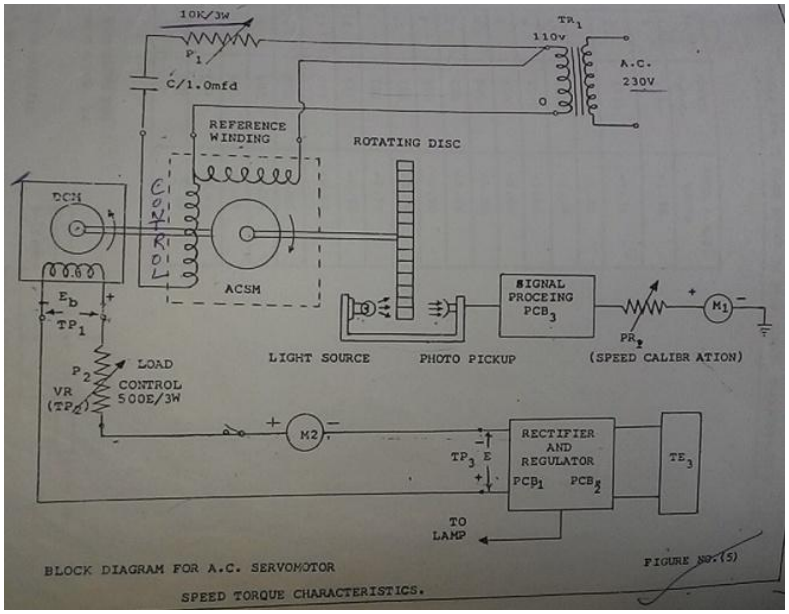

Fig 1. Circuit diagram of AC Servo Motor System.

PROCEDURE:

Study all the controls carefully on control panel.

a) Keep the switch SW3 in upward position, indicating that the armature circuit of DC machine is not connected to auxiliary power supply (12 V), switch SW2 should also be in OFF position.

b) Ensure P1 and P2 are in fully anticlockwise position

c) Now switch on SW1 and also switch SW2. You can observe that AC servomotor will start rotating and the speed will be indicated by the meter M1 on the front panel.

d) With SW3 in OFF position, vary the speed of the AC servomotor by moving P1 in clockwise direction and note the emf generated by the dc machine (Now working as dc generator or tacho). Enter the results in Table No. 1. (Use a dc voltmeter in the range 0 to 2 volts or so).

Observation Table1: (Table indicates only procedure)

S. No.	RPM	Eb(Volts)
1.	150	
2.	300	
3.	450	

e) Now switch SW3 in OFF condition, switch ON SW2 and keep the pot P1 in minimum position. You can observe that the ac servo motor starts moving with speed being indicated by the RPM indicator. You can measure the ref winding voltage (about 100 volts ac) and control winding voltage (which is variable by P1). Note the speed of ac servomotor. Now switch on SW3 and starts loading ac servo motor by controlling pot P2 in a slow fashion. Note down corresponding values on Ia and N. Enter these values in Table 2.

Table No.2 (Speed- Torque Characteristics)

S.No.	Ia (mA)	N (RPM)	E(Table 1) Volts	P(mW)	$T = \frac{P*1.019*10^4*60}{2*pi*N}$ gm-cm
1	0 mA				
2	50 mA				
3	100 mA				
4	150 mA				
5	200 mA				
6	250 mA				
7	300 mA				

CALCULATION:

The torque formula is given by $T = \frac{P*1.019*10^4*60}{2*pi*N}$ gm-cm

And $P = E_b * I_a$, where E_b back emf and I_a armature current.

RESULT: Plot torque –speed characteristics.

Precaution:

i. Before switch on P1 and P2 should be always brought to most anticlockwise position.

ii. Controls P1 and P2 should be operated in a gentle fashion.