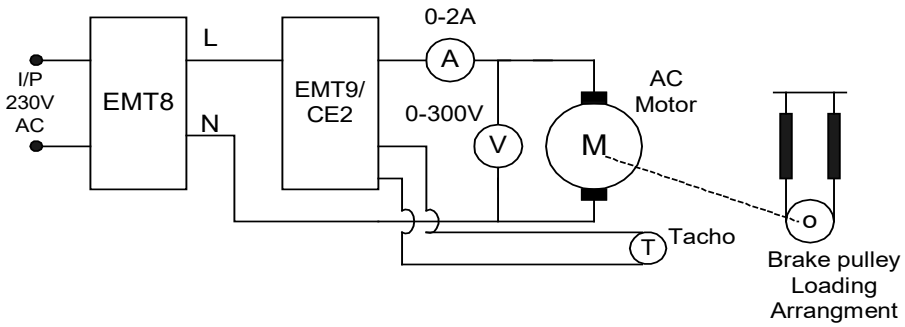
Experiment No.4 l

Objective: To determine the speed-torque characteristics of single-phase AC motor using thyristorised AC voltage controller with open loop and closed loop control.

Appratus Required : EMT8, EMT9/CE2, EMT6, 1phase AC machine

1. Study of Speed-torque characteristics of AC motor using open loop controller.

Block diagram of study of Speed-torque characteristics of AC motor using open loop system.



Wiring schedule

S	From	To	S	From	To
Field connections					
1	EMT8(L2)12	EMT9/CE2(9)	2	EMT9/CE2(7)	EMT6(5)
3	EMT6(2)	EMT6(6)	4	EMT8(N2)13	EMT6(3)
5	EMT6(4)	AC motor I/P	6	EMT6(1)	AC motor I/P
Tacho connections					
1	EMT9/CE2(14)	EMT8(6 or 8)	2	EMT9/CE2(15 or 19)	EMT8(7 or 9)

Note: Connect 6 pin audio connector from speed sensor assembly on motor, to 6 pin audio connector on EMT9/CE2 using 6 core back to back cable.

Procedure:

Thyristor Actuator panel EMT9/CE2 is used to control AC power and same is supplied to AC motor.

1) Make the connections as per the wiring schedule given above.
2) Donot connect motor terminals to respective sockets.
3) Use 230V/100W lamp load, to check proper voltage variation of the bridge. Output voltage variation achieved using SP pot on. EMT9/CE2 card should be around 0-

230V(+/-5%) AC for a nominal input of 230V AC. If you are not getting proper control(smooth variation), interchange L& N(i.e. L2 and N2).

4) Now set pot(SP) on CE2 at min. position. Keep the switch feedback at open position, and P,PI selector on open position.
5) Put off the supply, remove the lamp load and make respective connections for motor.
6) Ensure break pulley and loading belt are properly engaged. Also adjust belt tension to some intermediate value.
7) Put ON the switch SW1. This will provide DC power to EMT9 card. Now switch ON SW2. Slowly rotate the pot (SP) on CE2 in clockwise direction. The motor will start rotating. The motor supplied with the trainer is rated for 220/230V AC, 1phase, 50Hz AC/DC, /0.85Amp.
8) Adjust loading belt tension by keeping one wing nut at constant position and adjusting the other so that I(current) increases. Adjust bridge O/P and loading belt tension such that the motor draws its max. rated current at the speed of 1500RPM (Observe on EMT8 DPM). Correct P1 on CE2 panel to adjust O/P voltage at current of 1.4A/0.85A (such a correction is required because the CE2 panel bridge is used for many applications in the trainer and as such the O/P is not properly filtered for this particular application. Further motor load is a back emf type load as such SCR fires only when supply voltage is more than back emf.
9) Take down this readings as per following table by gradually decreasing the load and observing the speed of motor on EMT8 DPM. Decrease the load for various values of T1 and T2 untill EMT8 reads max. RPM=4000(max. RPM capacity of motor).

In our case the diameter of pulley is 81.6mm i.e. R-4.08cm = 0.04m (For 1/12 HP AC motor dia of pulley is 25mm = 0.025m).

Torque is given by,

Torque = Lkg*9.81*R in meter where Lkg=T1-T2

Torque(NM) = Lkg*9.81*0.0408, so Torque constant is 0.4

Torque(NM) = (T1-T2) *0.4

A) For ¼ HP AC motor:

Speed Torque characteristics of AC motor using open loop system

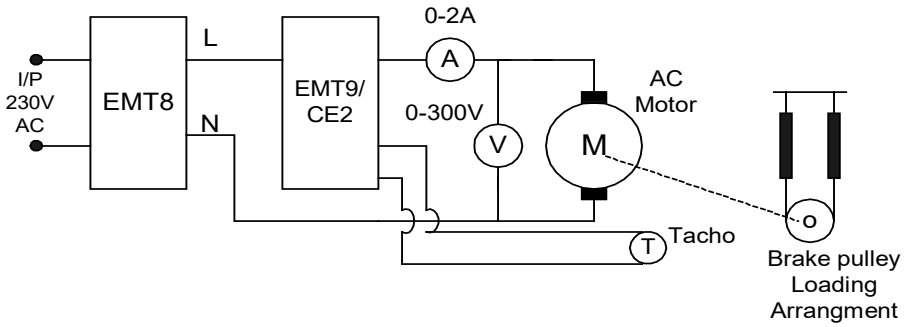
Sr.	Vin(AC Volts)	I Amp	T1 kg	T2 kg	Torque Nm	Speed RPM(N)
1		1.4				
2		1.3				
3		1.2				
4		1.1				
5		1.0				
6		0.9				

B) For 1/12 HP AC motor:

Sr.	Vin(AC Volts)	I Amp	T1 kg	T2 kg	Torque Nm	Speed RPM(N)
1		0.85				
2		0.75				
3		0.65				
4		0.55				

2. Study of Speed-torque characteristics of AC motor using closed loop (PI) controller.

Block diagram of study of Speed-torque characteristics of AC motor using closed loop (PI) controller.



Wiring schedule

S	From	To	S	From	To
Field connections					
1	EMT8(L2)12	EMT9/CE2(9)	2	EMT9/CE2(7)	EMT6(5)
3	EMT6(2)	EMT6(6)	4	EMT8(N2)13	EMT6(3)
5	EMT6(4)	AC motor I/P	6	EMT6(1)	AC motor I/P
Tacho connections					
1	EMT9/CE2(14)	EMT9/CE2(28)	2	EMT9/CE2(14)	EMT8(6 or 8)
3	EMT9/CE2(15 or 19)	EMT8(7 or 9)			

Note: Connect 6 pin audio connector from speed sensor assembly on motor, to 6 pin audio connector on EMT9/CE2 using 6 core back to back cable.

Procedure:

Thyristor Actuator panel EMT9/CE2 is used to control AC power and same is supplied to AC motor.

1) Make the connections as per the wiring schedule given above.
2) Donot connect motor terminals to respective sockets.
3) Use 230V/100W lamp load, to check proper voltage variation of the bridge. Output voltage variation achieved using SP pot on. EMT9/CE2 card should be around 0-230V(+/-5%) AC for a nominal input of 230V AC. If you are not getting proper control(smooth variation), interchange L& N(i.e. L2 and N2).
4) Now set pot(SP) on CE2 at min. position. Keep the feedback switch at close position, and P,PI selector on PI position.(i.e. proportional + integral action).
5) Put off the supply, remove the lamp load and make respective connections for motor.
6) Ensure break pulley and loading belt are properly engaged. Also adjust belt tension to some intermediate value.
7) Put ON the switch SW1. This will provide DC power to EMT9 card. Now switch ON SW2. Slowly rotate the pot (SP) on CE2 in clockwise direction. The motor will start rotating. The motor supplied with the trainer is rated for 220/230V AC, 1phase, 50Hz AC/DC, /0.85Amp.
8) Adjust loading belt tension by keeping one wing nut at constant position and adjusting the other so that I(current) increases. Adjust bridge O/P and loading belt tension such that the motor draws its max. rated current (for $1/4^{th}$ HP motor Max. current is 1.4A and for $1/12^{th}$ HP motor it is 0.85A) at the speed of 2500RPM (observe on EMT8 DPM). Hence here the speed will be the set point. You may set it to 1500 rpm, 2000rpm etc. Correct P1 on CE2 panel to adjust O/P voltage at current of 1.4A/0.85A(such a correction is required because the CE2 panel bridge is used for many applications in the trainer and as such the O/P is not properly filtered for this particular application. Further motor load is a back emf type load as such SCR fires only when supply voltage is more than back emf.
9) Take down the readings as per following table.
   In our case the diameter of pulley is 81.6mm i.e. R-4.08cm = 0.04m (For 1/12 HP AC motor dia of pulley is 25mm = 0.025m).

   Torque is given by,

   Torque = Lkg*9.81*R in meter where Lkg=T1-T2

   Torque(NM) = Lkg*9.81*0.0408, so Torque constant is 0.4

   Torque(NM) = (T1-T2) *0.4

A) For ¼ HP AC motor:

Study of Speed-Torque characteristics of AC motor using closed loop (PI) controller system

Sr.	Vin(AC Volts)	I Amp	T1 kg	T2 kg	Torque Nm	Speed RPM(N)
1		1.4				
2		1.3				
3		1.2				
4		1.1				
5		1.0				
6		0.9				

B) For 1/12 HP AC motor:

Sr.	Vin(AC Volts)	I Amp	T1 kg	T2 kg	Torque Nm	Speed RPM(N)
1		0.85				
2		0.75				
3		0.65				
4		0.55				