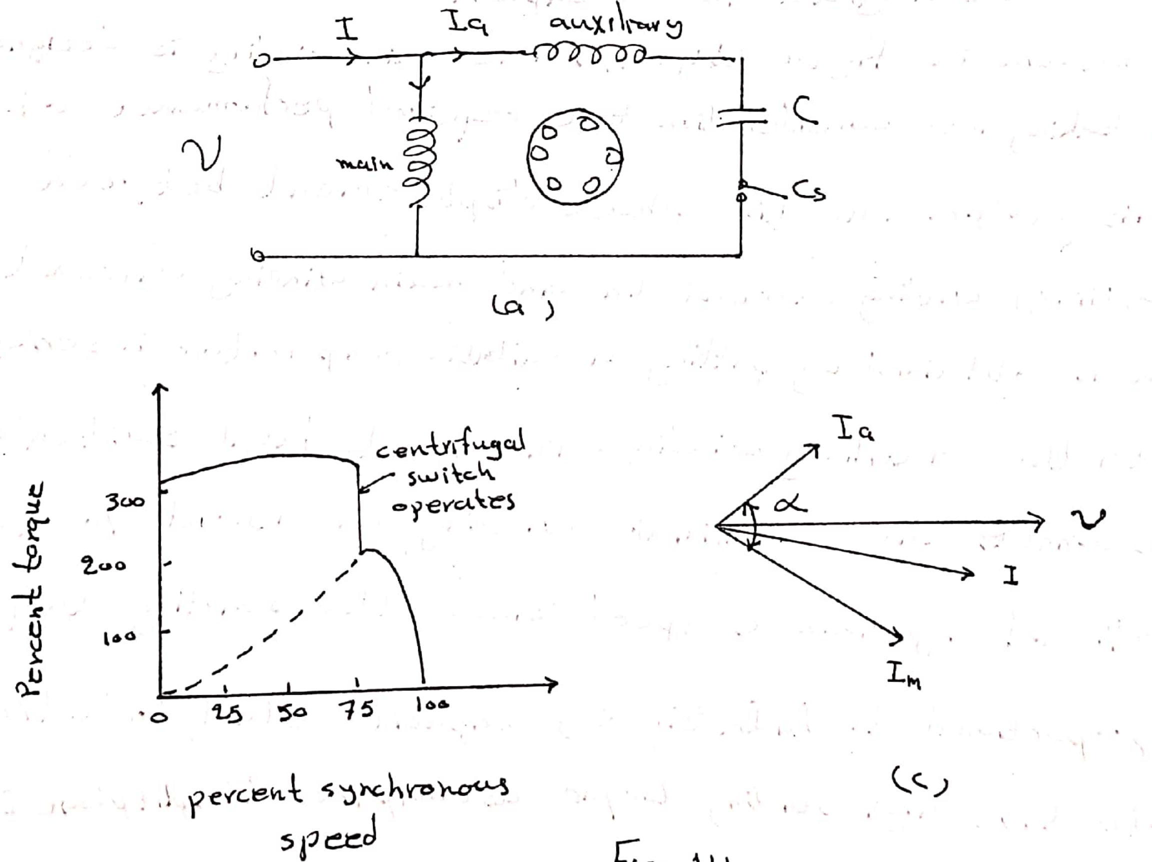
If the centrifugal switch fails to operate, auxiliary winding will remain in circuit and noisy performance is observed. Since the auxiliary winding is short time rated, it may become overheated and burn out.

The typical torque-speed characteristics of this motor is shown in figure 13.c. This motor has low to moderate starting torque, which depends on the two currents and the phase angle between them. The starting torque can be increased by inserting a series resistance in the auxiliary winding.

2- Capacitor-Start induction motor

The circuit diagram for a capacitor start induction motor is shown in figure (14.a). The main winding is designed by taking into consideration the required performance of this motor. The time phase displacement between auxiliary winding current I_a and main winding current I_m is obtained by putting a suitable capacitor in series with the auxiliary winding. The centrifugal switch CS disconnects the auxiliary winding at about 70 to 80% of synchronous speed. Since the starting torque is proportional to $I_a I_m \sin\alpha$, capacitor start induction motor have high starting torque as compared to split phase I/M for the same line current. By using a suitable starting capacitor, angle α can be made 90° at standstill and this results in the highest possible starting torque. But size and hence cost of the starting capacitor; then would be quite high. In view of this, it is usual to make angle α slightly less than 90° so as to obtain a best compromise between the starting torque, starting current and the cost. A typical capacitor value for a 0.5 hp motor is 300 μf. Because the capacitor is in the circuit only during the starting period, it can be an inexpensive ac electrolytic type.



(b)

Fig. 14

3- Capacitor-Run induction motors

The capacitor is kept permanently in series with auxilrary winding as shown in figure(15). There is, therefore no need of centrifugal switch. At a particular desired load, the capacitor and auxilrary winding can be so designed as to result in 90° time-phase displacement between the two winding currents. In such a case, the motor would operate as a balanced two phase induction motor, backward rotating flux would, therefore, be absent and the motor would have improved efficiency and better operating power factor. Since backward rotating field can be reduced to zero, the pulsating torque due to interaction between forward and backward rotating fields is absent and this results in a quiet motor. These motors are used where quiet operation is essential, as in offices, class rooms, theaters etc. The ceiling fans are invariably of capacitor run I/M, in which the value of capacitance varies from 2 to 3 μf. The capacitor type is an ac paper oil. The capacitor is a compromise between the best starting and running values and therefore starting torque is sacrified.

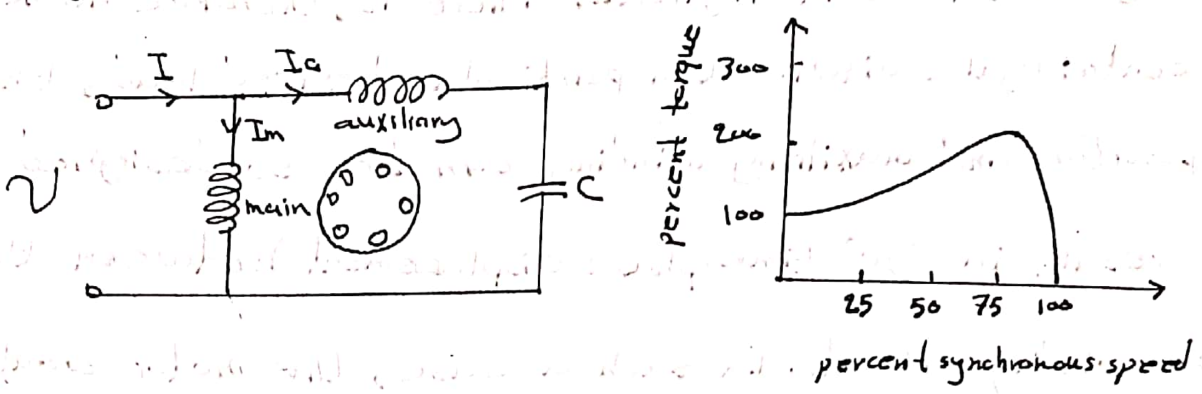


Figure (15)

4- Capacitor-start Capacitor-run induction motor

Figure (16a) illustrate the circuit diagram. A large capacitor Cs is connected in parallel with Capacitor Cr at the time of starting only. The centrifugal switch disconnect Cs automatically at about 75% of synchronous speed; leaving behind Cr a small capacitance in series with the auxiliary winding. Thus, best starting with high capacitance, and best running performance with a low capacitance, are obtained with this type of motors. Since Cr and auxiliary winding are permanently in circuit