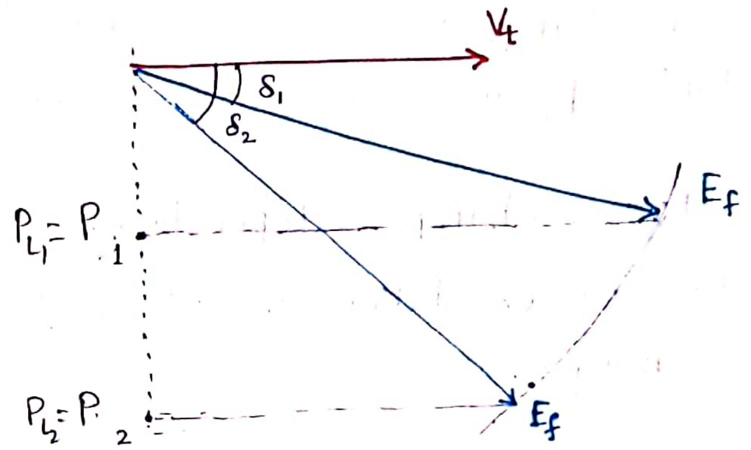
(ii) Varying load, keeping excitation constant.



- Excitation is kept constant, but load is increased, which changes both the active as well as reactive power requirement.

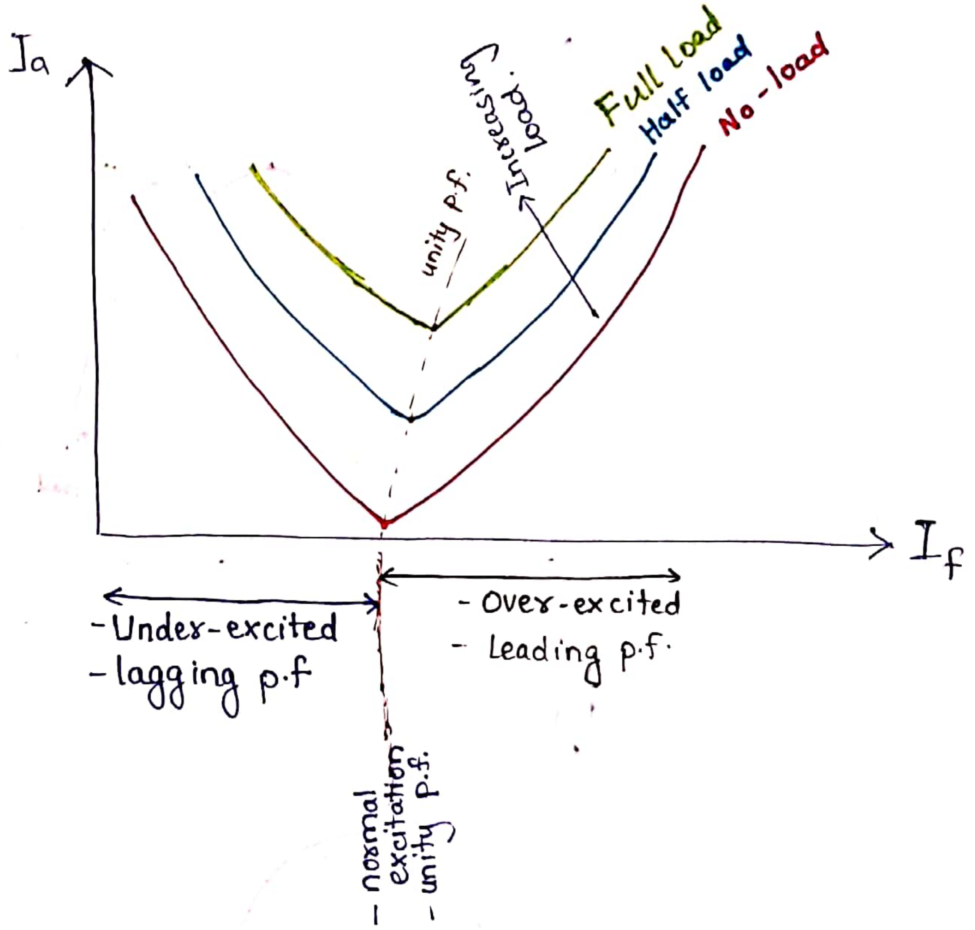
- Though the load on synchronous motor is increased, but it still runs at synchronous speed.

- Torque angle δ increases with increase in load.

- The armature current I_a, increases with increasing load.

V- curve

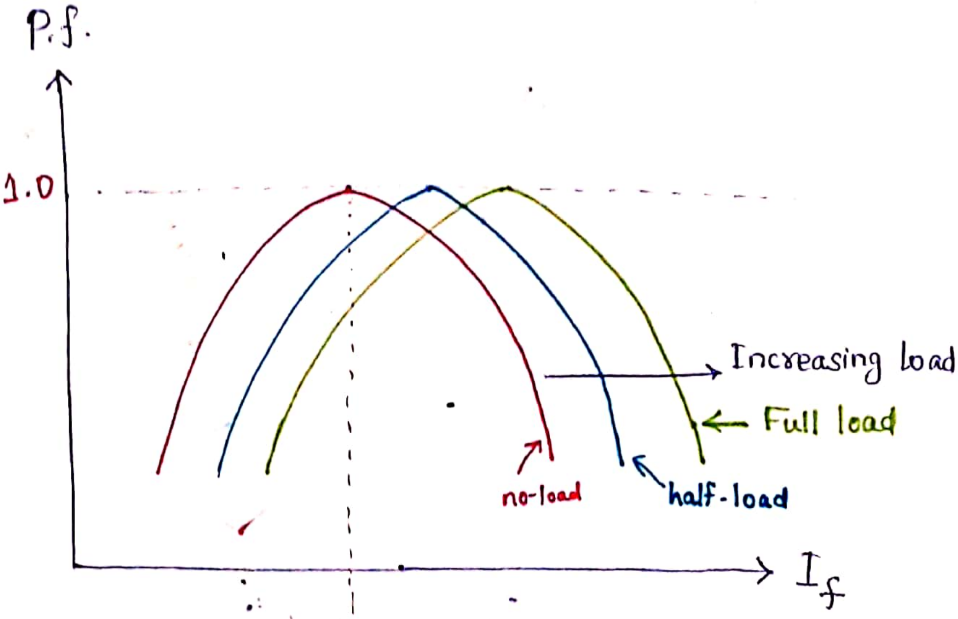
- The variation in armature current, I_a, with changing field current, I_f, keeping terminal voltage V_t and shaft load constant, is depicted in V-curves of synchronous motor.

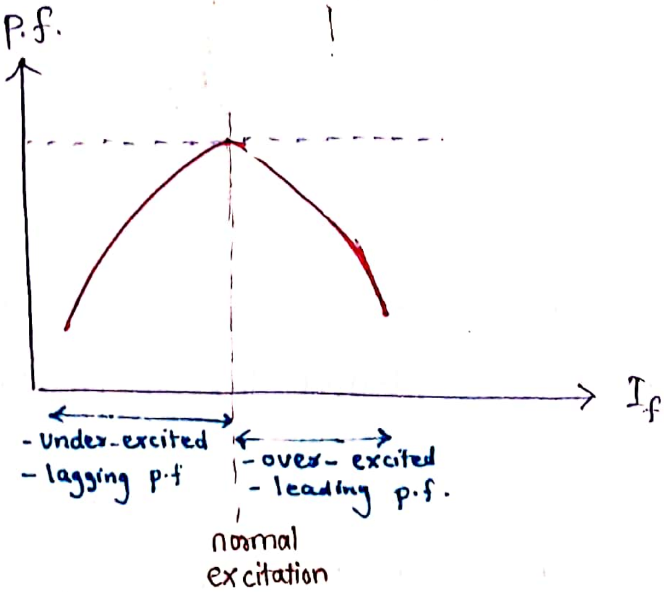


- V-curve can be obtained from the excitation curve.
- Each V-curve is plotted for a particular load on shaft.
- If load is increased, the plot shifts upwards, as the armature current increases, to ~~supply~~ consume more active power.
- At a constant load, with changing field current, the reactive power taken or supplied by the motor can be changed. Thus we get different values of I_a and also p.f. of operation can be adjusted.

Inverted-V curve.

- For a constant load, and constant terminal voltage, plot between power-factor and field current is depicted in the inverted-V curve.





- We can see from inverted-V curve, at constant load,

→ If the motor is initially under-excited, then with increasing field current p.f. improves first, reaches unity and then deteriorates on the leading side.

(c) having suitable stiffness coefficient of machine.

- By designing the machine to have suitable stiffness coefficient or synchronizing power coefficient, oscillations can be reduced.

- Stiffness coefficient has tendency to prevent machine from losing synchronism. So, when there are osciallations, suitable value of stiffness coefficient prevents this.

- We can also see that, with increasing load from no-load to full-load, field current required for same power factor operation increases.

  ↓ For example. Unity power factor operation at full load, requires more field-current than unity power factor operation on no-load.

- From powerfactor of operation of the synchronous motor, we can also get information regarding the reactive power absorbed or delivered by the machine.

  ↓ If at a certain load, I_f is known then we can get p.f. from the inverted-V curve.

  Synchronous Motor → From lagging p.f. operation, we can understand that machine is taking reactive power, while it is supplying reactive power at leading p.f.

Application of synchronous motors.

(i) Used as synchronous condensers to improve power factor of the system.

(ii). Used where load requires high power at low speed.
for example in rolling mills, crushers, compressors, etc.

↳ { Operating speed less than 500 rpm.
Power requirement range → 35 kW - 2500 kW }

↓

Synchronous motors are much better than induction motors, in terms of size, weight and cost.