	Vignan's Institute of Information Technology
	Department of Electrical & Electronics Engineering
POWER SEMI CONDUCTOR DRIVES SHORT TYPE Q & A	
Year : 3 EEE , II SEM	**Faculty: R.Ravi Shankar, K.S. Prakash**

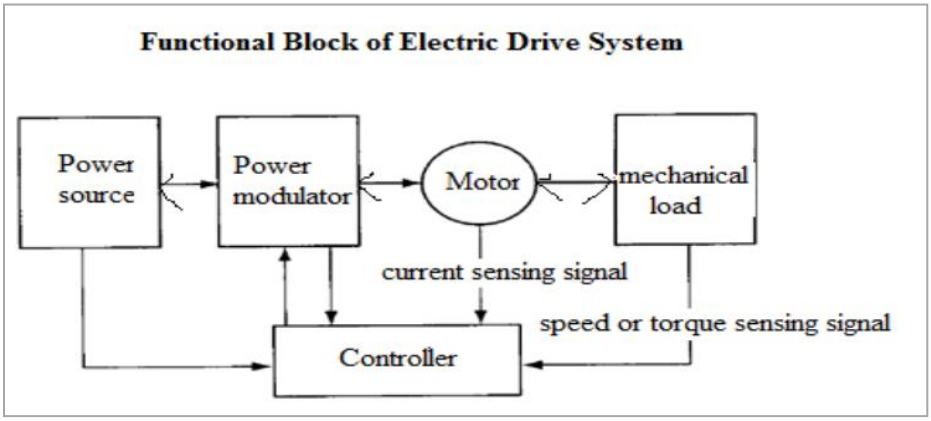
Unit-1

Fundamentals of Electric Drives

1. **What is the advantages of electrical drive?**

- Starting and braking is easy and simple
- Provides a wide range of torques over a wide range of speeds (both ac and dc motor)
- Availability of wide range of electric power
- Works to almost any type of environmental conditions
- No exhaust gases emitted
- Capable of operating in all 4 quadrants of torque –speed plane
- Can be started and accelerated at very short time

2. **Scetch the functional block diagram of electrical drive system?**



3. **Explain the different cases for the fundamental torque equation?**

i) $T_m > T_L$ *i.e.*

the drive will be accelerating, in particular, picking up speed to reach rated speed

ii) $T_m < T_L$ *i.e.* $\frac{dw_m}{dt} < 0$

the drive will be decelerating and particularly, coming to rest

iii) $T_m = T_L$ *i.e.* $\frac{dw_m}{dt} = 0$

the motor will continue to run the same speed, if it were running or will continue to be at rest, if it were not running.

4. Classify the different Load torques?:

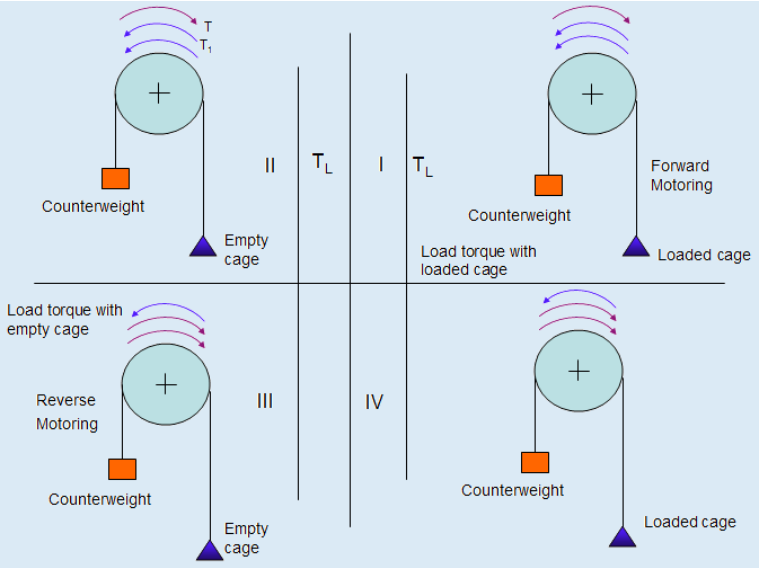
Various load torques are broadly classified into two categories.

A) Active Load Torque

B) Passive Load Torque

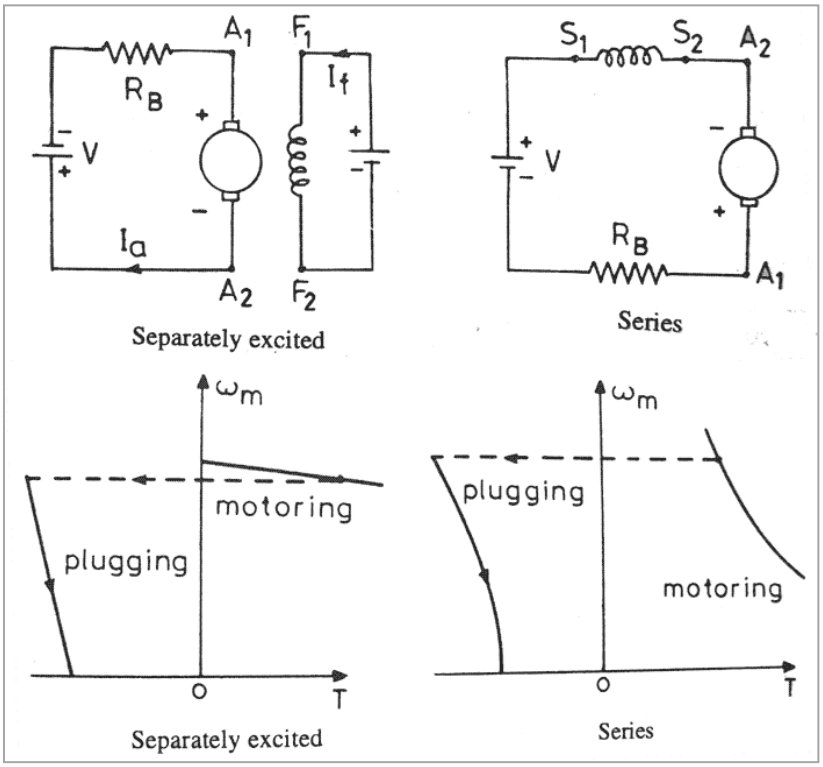
Load torques which have the potential to drive the motor under equilibrium conditions are called active load torques. Such load torques usually retains their sign when the direction of the drive rotation is changed. Torque due to the force of gravity, hoists, lifts or elevators and locomotive trains also torques due to tension, compression, and torsion undergone by an elastic body come under this category.

5. Scetch the four quadrant operation of drive using hoist load?



6. Explain the concept of plugging and its implementation?

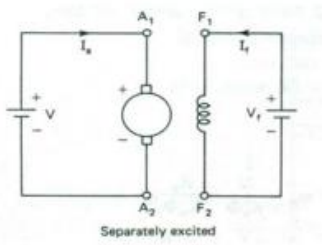
Another type of braking is **Plugging type braking**. In this method the terminals of supply are reversed, as a result the generator torque also reverses which resists the normal rotation of the motor and as a result the speed decreases. During plugging external resistance is also introduced into the circuit to limit the flowing current. The main disadvantage of this method is that here power is wasted.



Unit 2

Three phase converter controlled DC motors

1.Explain the basic equations of a DC motor?



Separately excited

The basic equations for DC motor are

$$E = K_e \phi w_m$$

$$V = E + I_a R_a$$

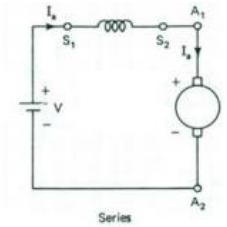
$$T = K_e \phi I_a$$

$$w_m = \frac{V}{K_e \phi} - \frac{I_a R_a}{K_e \phi}$$

$$w_m = \frac{V}{K_e \phi} - \frac{R_a T}{(K_e \phi)^2}$$

2. Sketch the torque speed characteristics of a DC series motor?

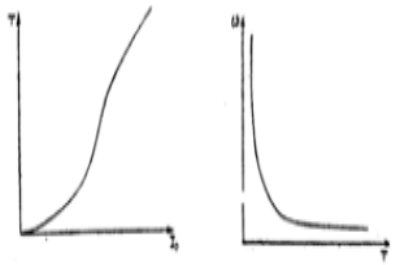
Dc Series Motor:



Series

From the basic equation the speed can be written as

$$w_m = \frac{V}{K_e \phi} - \frac{R_a T}{(K_e \phi)^2}$$

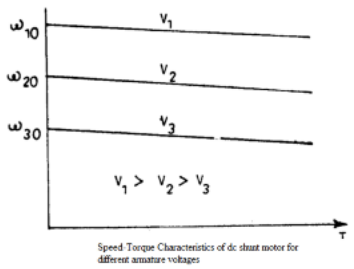


Torque vs. current of series motor.

Speed vs. torque of series motor.

3.Sketch the torque speed characteristics Armature voltage control method of DC shunt motor?

The no load speed is directly proportional to the supply voltages. Keeping the load torque as constant, the family of motor torque-speed characteristics can be drawn for a given load torque.

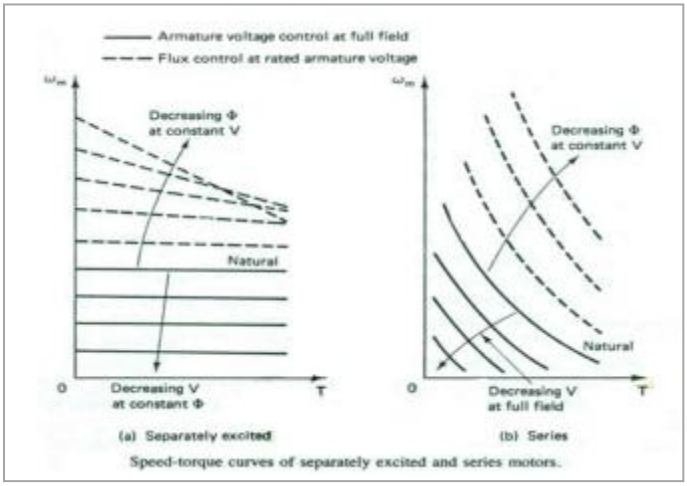


Speed-Torque Characteristics of dc shunt motor for different armature voltages

This method is only for below rated speed since the voltage magnitude should not be greater than the rated voltage. The variable voltages can be obtained by phase controlled rectifier and DC-DC Chopper

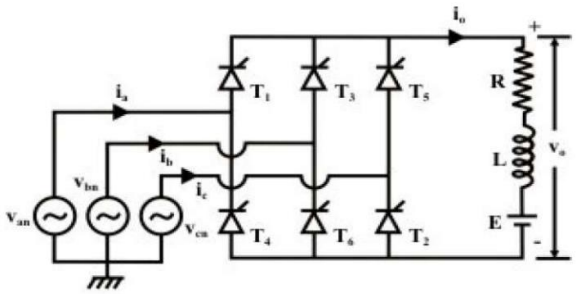
4.Sketch the torque speed characteristics Field flux control method of DC shunt motor and series motor?

If the field of a separately or series excited motor running at a speed is weakened, its induced emf decreases. Because of low armature resistance, the current increases by an amount much larger than the decrease in the field flux. As a result, in spite of the weakened field, the torque is increased by a large amount, considerably exceeding the load torque. The surplus torque thus available causes the motor to accelerate and the back emf to rise. The motor will finally settle down to a new speed, higher than the previous one, at which the motor torque with the weakened field becomes equal to the load torque. Any attempt to weaken the field by a large amount will cause a dangerous inrush of current. Care should therefore be taken to weaken the field only slowly and gradually.



Speed-torque curves of separately excited and series motors.

5. Derive the average voltage for the 3-phase full controlled converter fed shunt machine?



The average output voltage is found from

$$V_{dc} = \frac{3}{\pi}\int_{\pi/6+\alpha}^{\pi/2+\alpha} v_{ab}\, d(\omega t) = \frac{3}{\pi}\int_{\pi/6+\alpha}^{\pi/2+\alpha} \sqrt{3}\, V_m \sin\left(\omega t + \frac{\pi}{6}\right) d(\omega t)$$

$$= \frac{3\sqrt{3}\, V_m}{\pi}\cos\alpha$$

The maximum average output voltage for delay angle, $\alpha = 0$, is

$$V_{dm} = \frac{3\sqrt{3}\, V_m}{\pi}$$

6.Explain the circulating current operation of the dual converter?

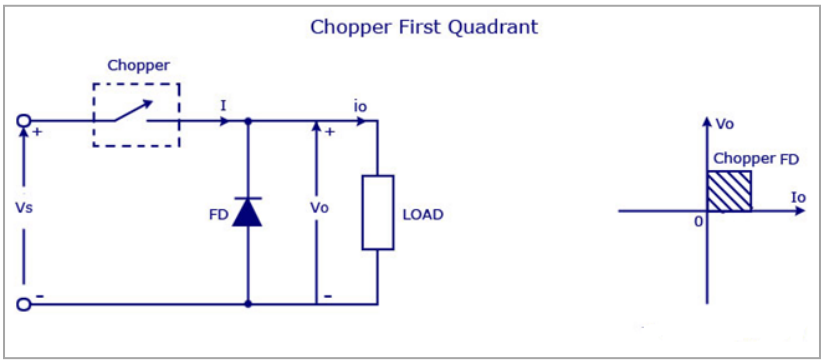
In this mode both the converters are operated simultaneously since their instantaneous output voltage are out of phase, a circuit current flows. The circulating current does not contribute to load current but flows through the converters. Therefore, it should be reduced as much as possible. In this mode a reactor is inserted between converter-1 and converter-2. This reactor limits the magnitude of circulating current to a reasonable value. The circulating current can be found by the integration of the instantaneous voltage V_{01} + V_{02}. It may be added that the average output voltages of the two converters during the interval ($\Pi+\alpha_1$) and ($2\Pi+\alpha_1$) are equal and opposite and their instantaneous circulating

UNIT-3

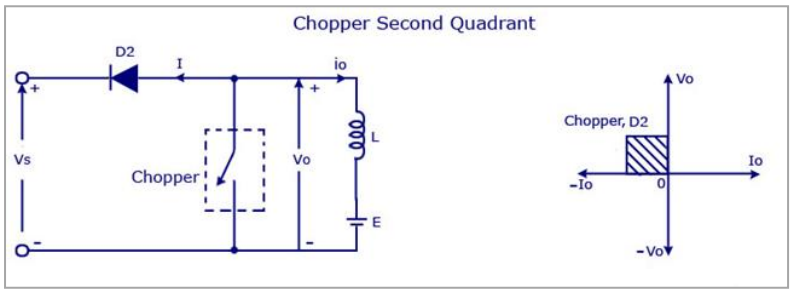
Control of DC motors by DC–DC converters (Type C & Type D)

1. Explain Type A Chopper with quadrant of operation ?

This type of chopper is shown in the figure. It is known as first-quadrant chopper or type A chopper. When the chopper is on, $v_0 = V_S$ as a result and the current flows in the direction of the load. But when the chopper is off v_0 is zero but I_0 continues to flow in the same direction through the freewheeling diode FD, thus average value of voltage and current say V_0 and I_0 will be always positive as shown in the graph.



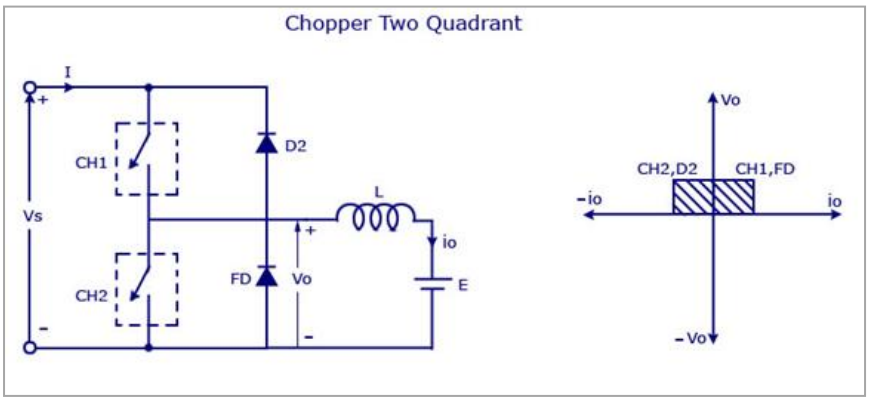
2. Sketch Type B Chopper with quadrant of operation ?



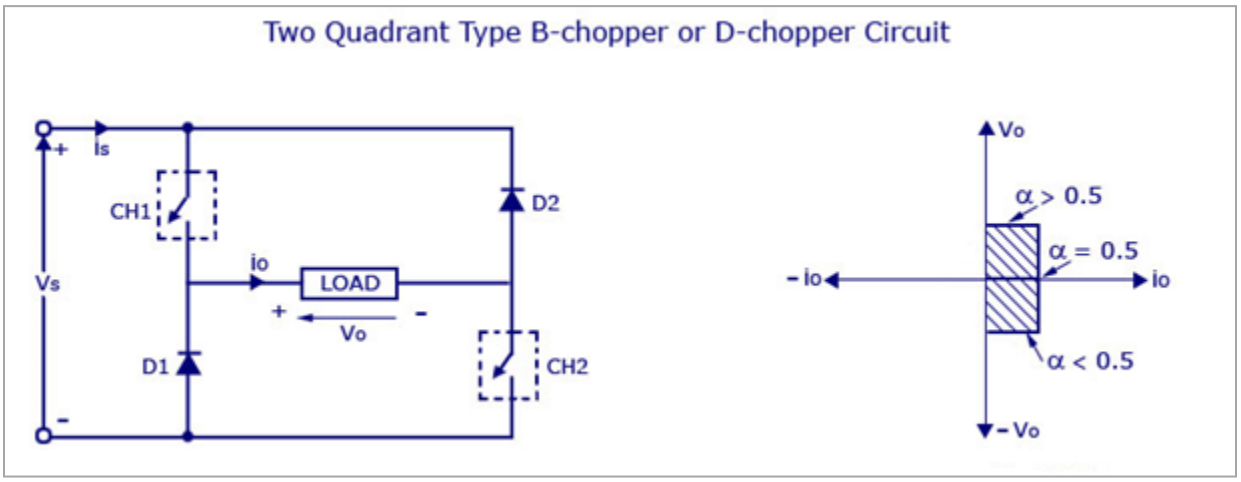
3. Explain Type C Chopper with quadrant of operation ?

Type C chopper is obtained by connecting type –A and type –B choppers in parallel. We will always get a positive output voltage V_0 as the freewheeling diode FD is present across the load. When the chopper is on the freewheeling diode starts conducting and the output voltage v_0 will be equal to V_s . The direction of the load current i_0 will be reversed. The current i_0 will be flowing towards the source and it will be positive regardless the chopper is on or the FD conducts. The load current will be negative if the chopper is or the diode D2 conducts.

We can say the chopper and FD operate together as type-A chopper in first quadrant. In the second quadrant, the chopper and D2 will operate together as type –B chopper.

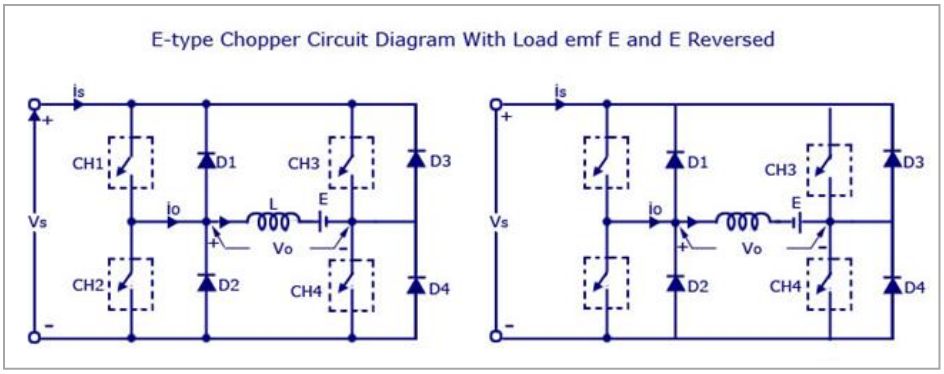


4. Sketch Type D Chopper with quadrant of operation ?

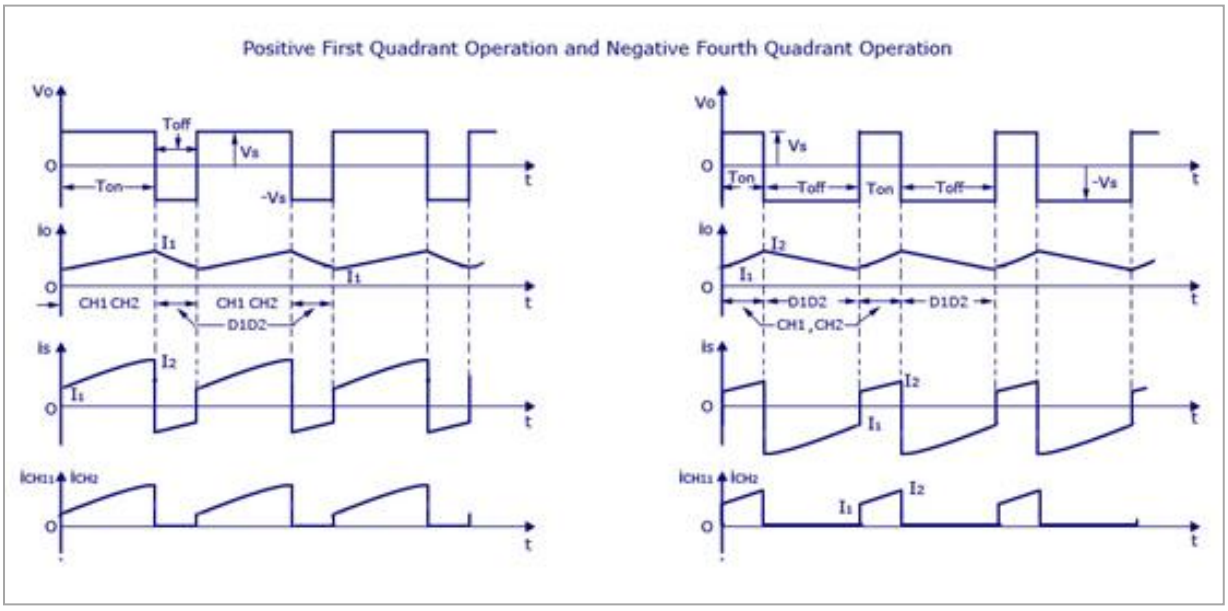


5.Explain Type E Chopper with quadrant of operation ?

Type E or the fourth quadrant chopper consists of four semiconductor switches and four diodes arranged in antiparallel. The 4 choppers are numbered according to which quadrant they belong. Their operation will be in each quadrant and the corresponding chopper only be active in its quadrant.



6. Sketch the waveforms for Type D Chopper for different quadrant of operation ?

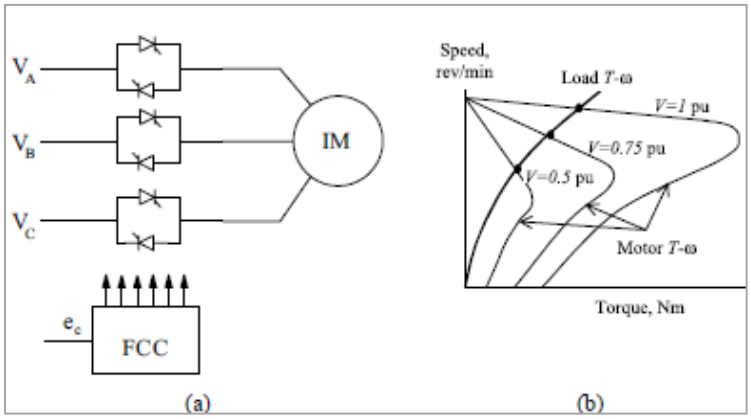


Unit -4

Induction motor control – Stator side

1.Explain why Stator Voltage Control is suitable for speed control of induction motors in fan and pump drive?

In this method of control, back-to-back thyristors are used to supply the motor with variable ac voltage. The analysis implies that the developed torque varies inversely as the square of the input RMS voltage to the motor. This makes such a drive suitable for fan- and impeller-type loads for which torque demand rises faster with speed. For other types of loads, the suitable speed range is very limited. Motors with high rotor resistance may offer an extended speed range. It should be noted that this type of drive with back-to-back thyristors with firing-angle control suffers from poor power and harmonic distortion factors when operated at low speed.



2. Discuss their relative merits and demerits stator voltage control?

Advantages with stator voltage control

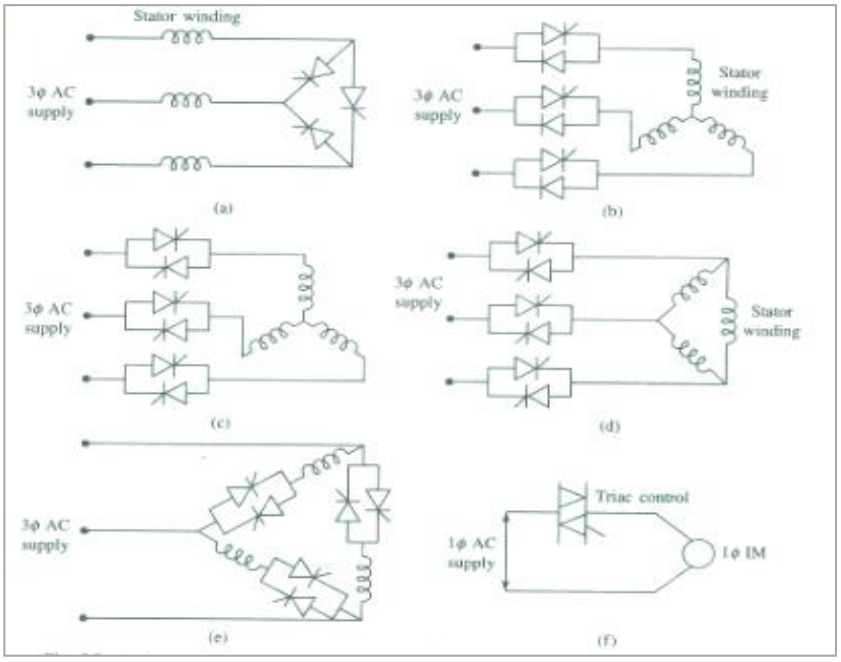
- These are:
- The control circuit required is very simple
- The equipment is more compact in size and less in weight
- Very quick response is possible
- It is a more economical method, since considerable savings in energy is possible.

Disadvantages with stator voltage control

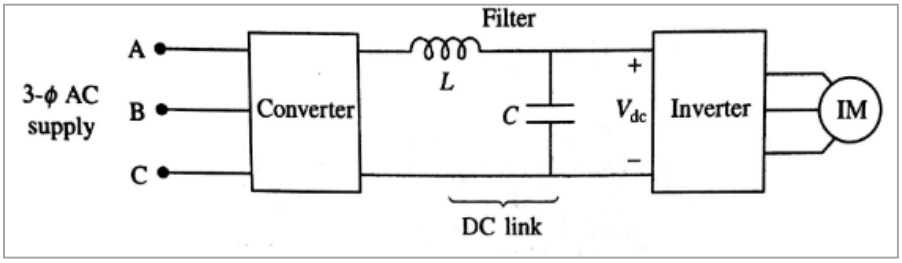
- The input power factor is poor

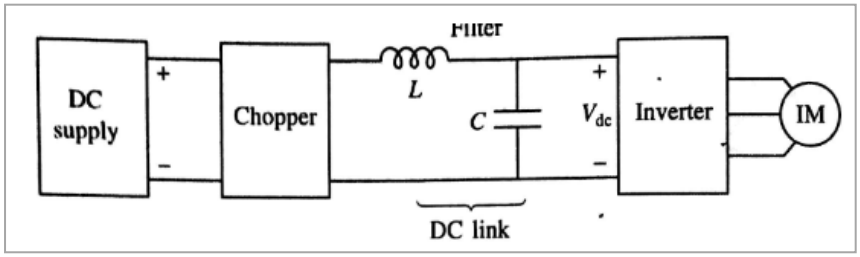
- Performance is poor under low speed running condition
- Operating efficiency is low as ohmic losses are high
- As the stator voltage decreases, maximum available torque from the motor decreases.

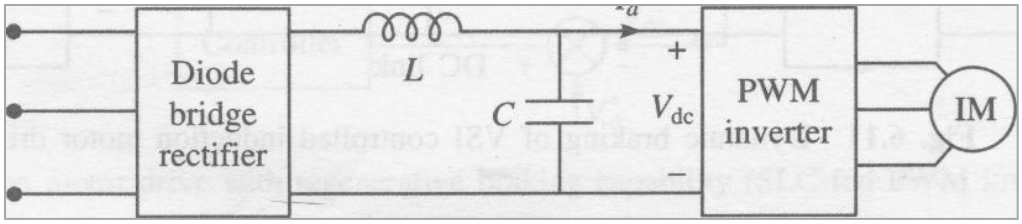
3.Sketch different 3-phase AC voltage controller circuits available for stator voltage control of Induction motor?



4. Scetch the different configurations of inverter control induction machines?

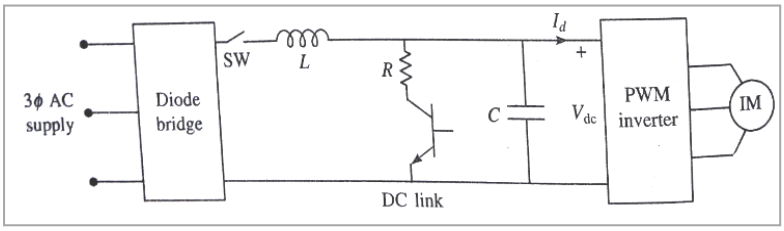






5. Explain dynamic braking implemented for induction machine?

.For dynamic braking, a switch SW and a self-commutated switch (here transistor) in series with braking resistance RB are added to the drive circuit of Fig. and the connections are shown in Fig. The switch SW is opened when the motor operation is shifted from motoring to braking. The capacitor C with the generated energy flows into the dc link and the capacitor voltage rises. When this voltage crosses a set value, switch SW is closed; thereby resistance is connected across the link. The generator power and a part of the energy which is stored in the capacitor flows through the resistance, and dc link voltage is reduced.



6. Draw the block diagram of closed loop operation of induction motor drives?

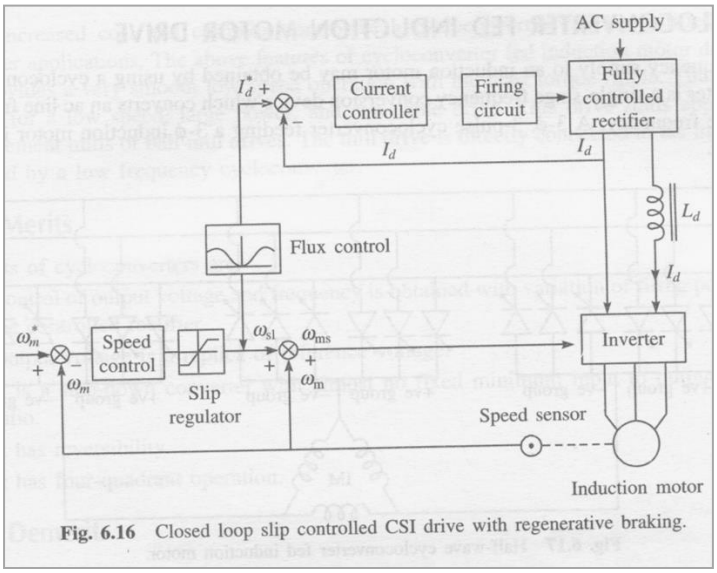
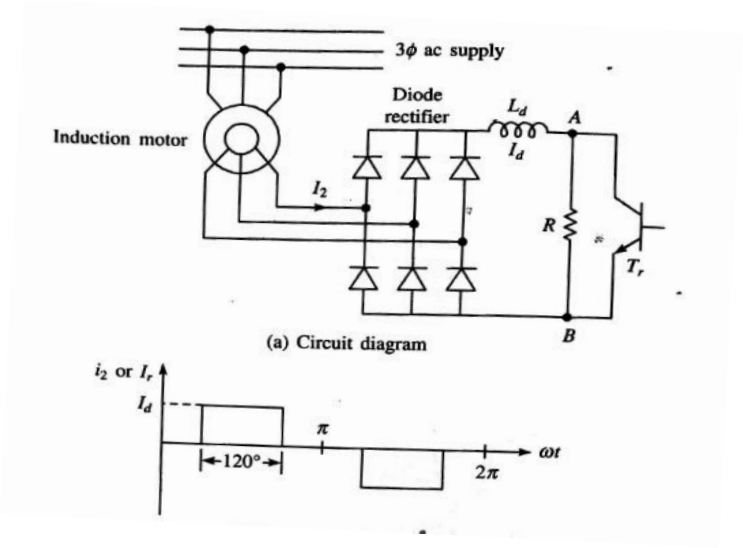


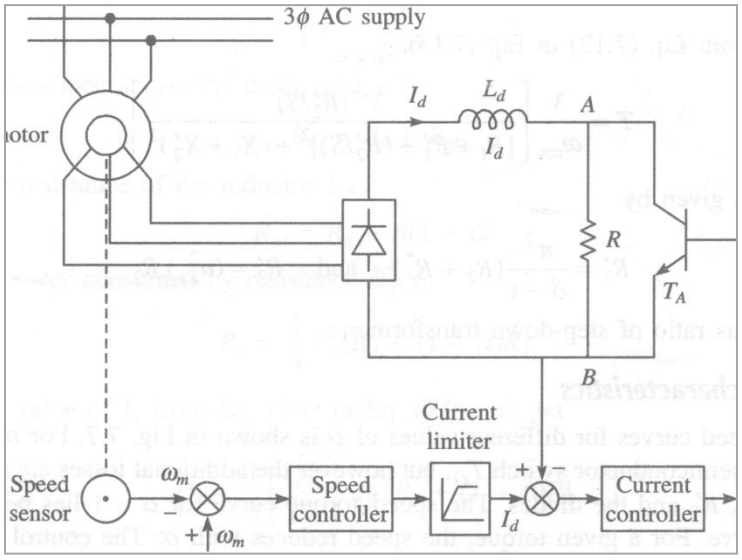
Fig. 6.16 Closed loop slip controlled CSI drive with regenerative braking.

Unit -5
Control of Induction motor – Rotor side

1.Draw the circuit diagram and block diagram of rotor- resistance control using chopper (Static Rotor Resistance Control)?



2.Draw the closed loop block diagram of rotor- resistance control using chopper (Static Rotor Resistance Control)?



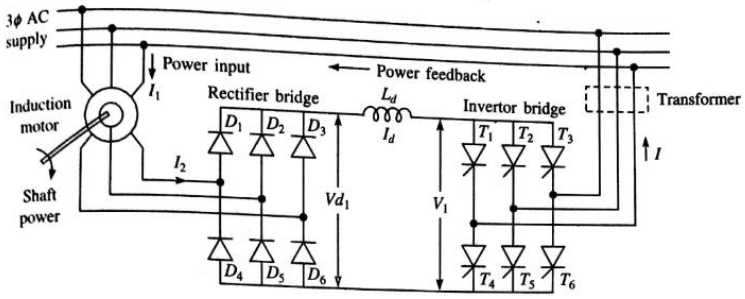
3.Explain The Basic Idea Of Slip Power Recovery Schemes?

This system is mainly used for speed control of slip ring induction motor. The foregoing discussion makes it is very clear that the methods of voltage control and rotor resistance control have poor efficiency, particularly at low speeds, and find limited application. The slip power is wasted due to rotor resistance, either inherent in the rotor or connected in the rotor circuit, instead of wasting the slip power in the rotor circuit resistance, it can be converted various schemes for the speed control of SRIM . The slip power recovery system can be classified into two types and they are:

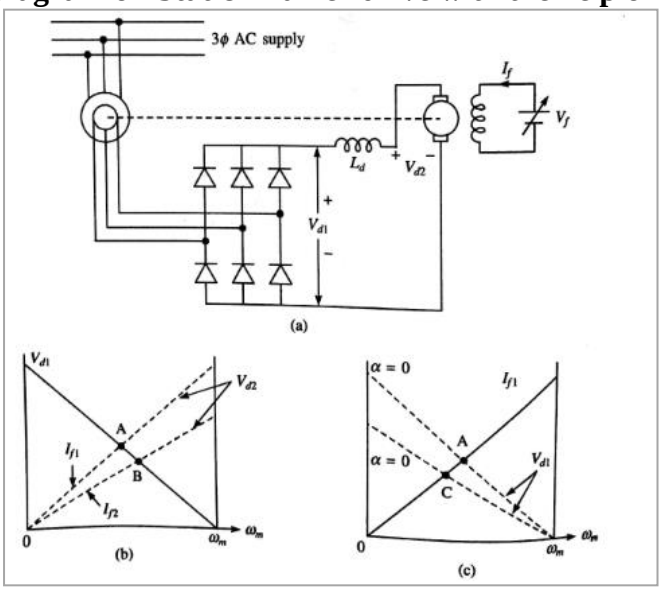
I. Scherbius system

2. Kramer system.

4.Draw the block diagram of Static Scherbius drive with the help of a neat schematic?



5.Draw the block diagram of Static Kramer drive with the help of a neat schematic?



6.Explain the Advantages and disadvantages of static rotar resistance control:

The advantages of this scheme are:

- Reduce the starting current
- Increase the starting torque
- Power factor of the line is improved
- There is no harmonics in the line current
- Speed control is smooth and of wide range.

Disadvantages of static rotar resistance control:

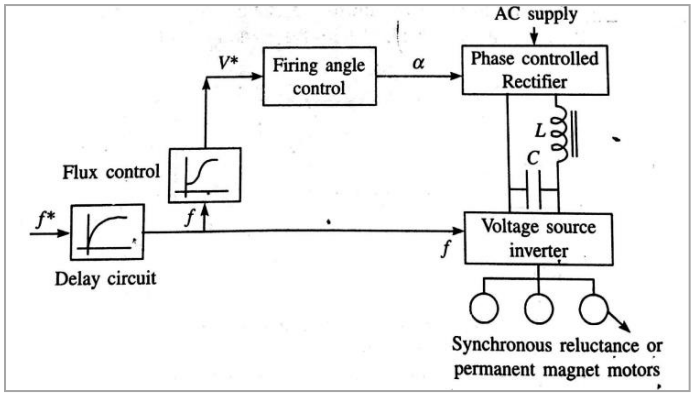
The disadvantages are:

- Efficiency is reduced due to wastage of slip energy in the rotor circuit.
- If rotor resistances are not equal, unbalance in currents and voltages.

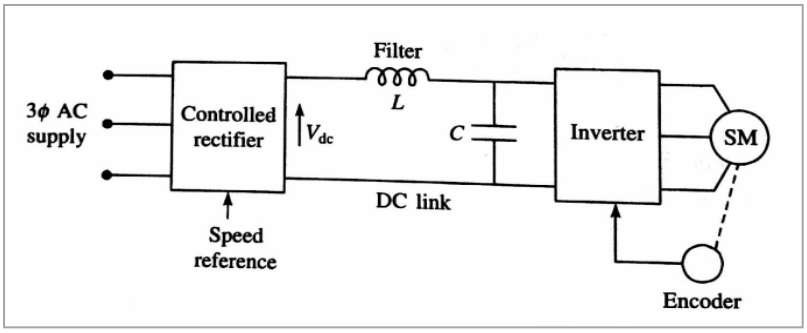
UNIT -6

Control of Synchronous Motors

1.Sketch the block diagram of True Synchronous Mode of Synchronous Motors



2.Sketch the block diagram Self-control of Synchronous Motors?

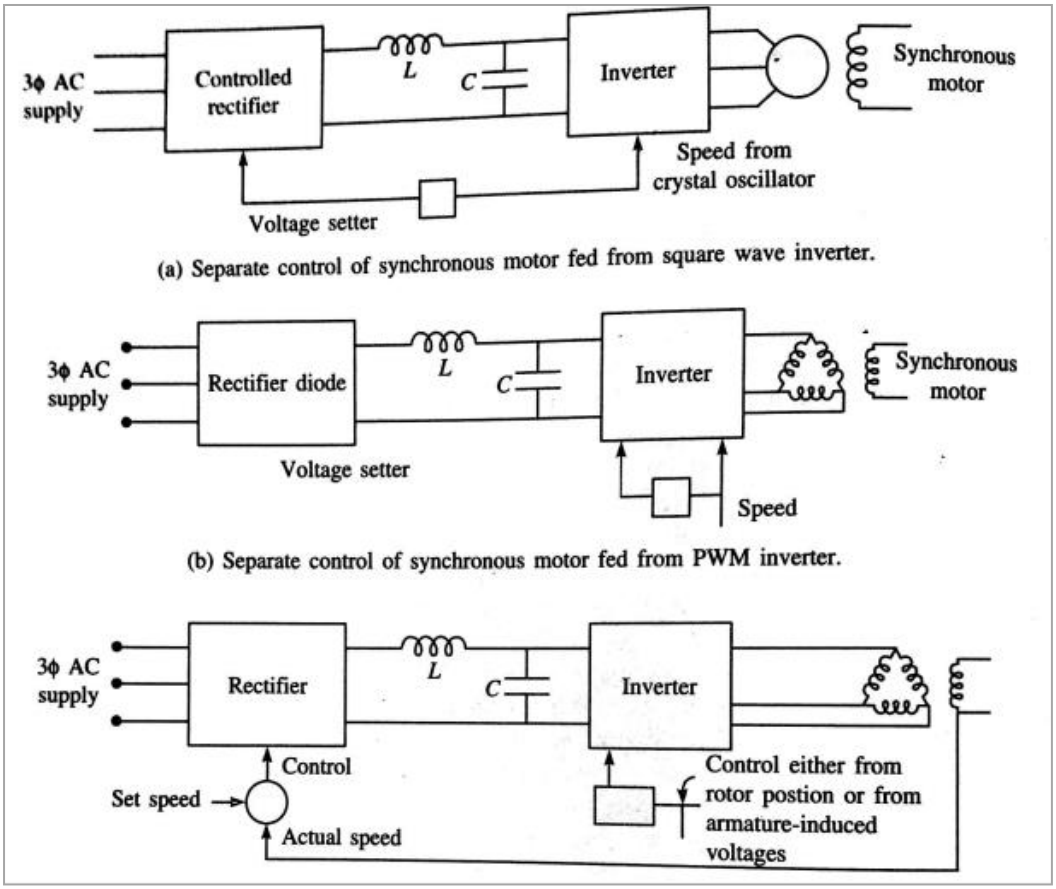


3.List The Advantages Of Lci Synchronous Motor Drive?

The advantages are:

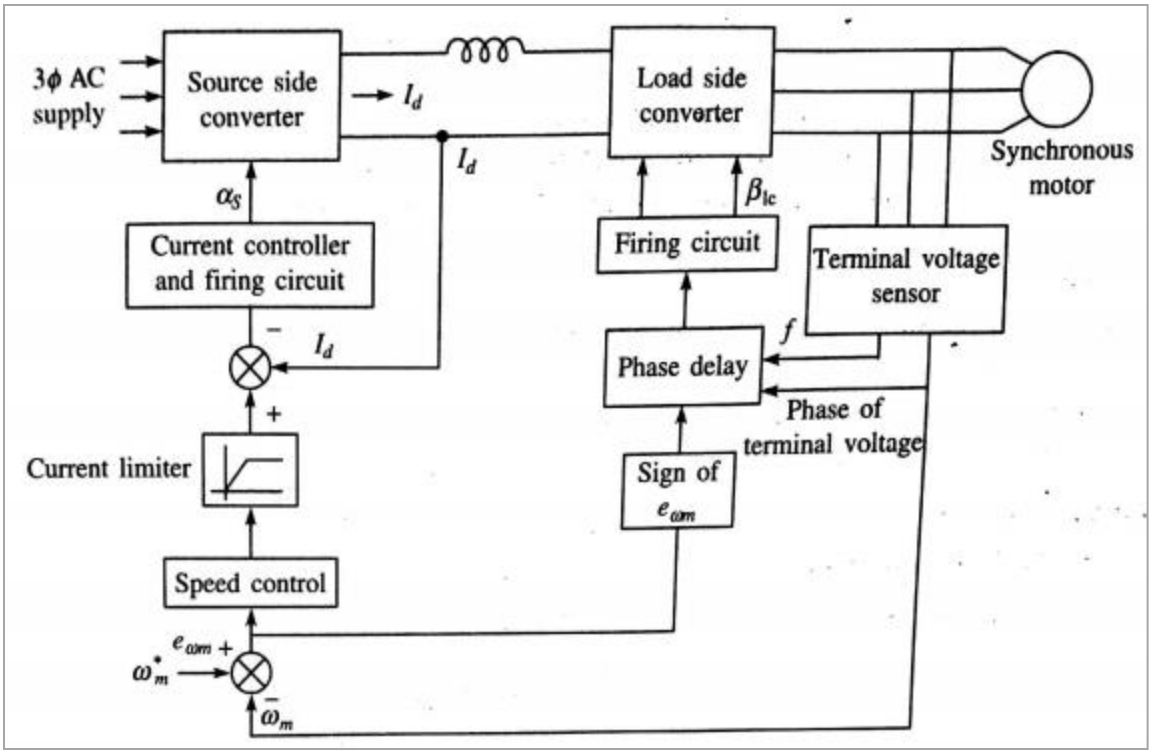
- High efficiency
- Four-quadrant operation with regenerative braking
- High power ratings (up to 100 MW) and ability to run at high speeds

4.Describe VSI fed synchronous motor drive with a suitable block diagram?



5. Sketch The Closed-Loop. -Speed Control Lci Synchronous Motor Drive?

A closed-loop speed control scheme is·shown in ·Fig. . It employs outer speed control loop and inner current control loop with a limiter, like a dc motor. The phase controlled thyristor



6.Disadvantages of Closed Loop Self-control of Synchronous Motors:

The open loop controI discussed above has inherently the following disadvantages:

(i) Hunting of motor

(ii) Problems of instability

(iii) Poor dynamic behaviour, and ..

(iv) Harmonic distortion causing additional losses and parasitic torques

	Vignan's Institute of Information Technology
	Department of Electrical & Electronics Engineering
POWER SEMI CONDUCTOR DRIVES LONG TYPE QUESTIONS	
Year : 3 EEE , II SEM	Faculty: R.Ravi Shankar, K.S. Prakash

UNIT-1
(Fundamentals of Electric Drives)

1. Explain Steady State stability of Motor Load System and derive the condition for it.
2. Explain the concept of Load Equalization with Torque Speed Characteristics.
3. Explain Four Quadrant operation of a drive using Hoist Load.
4. What is Braking? Explain the braking methods for shunt and series motor?

UNIT-2
Three phase converter controlled DC motors

1. Explain the speed control techniques for DC shunt & series motor & and comment on speed – torque characteristics?
2. Explain the operation of three phase semi - controlled converter fed dc shunt & Series motor drive with neat circuit diagram, the output voltage and current waveforms at firing angle of 30, 90, 120 …..degrees derive the average output voltage and speed- torque characteristics?
3. Explain the operation of three phase Full- controlled converter dc shunt & Series motor drive with neat circuit diagram, the output voltage and current waveforms at firing angle of 30, 90, 120…. degrees derive the average output voltage and speed- torque characteristics?
4. Explain the Four Quadrent Operation of a Drive using Dual Converter ?

UNIT-3
Control of DC motors by DC–DC converters

1. a)Explain briefly about the operation of Type A chopper for series & shunt motor ?

   b) Draw the Block Diagram and explain the operation of closed-loop speed control with inner-current loop and field weakening?

2. Derive the expressions for average motor current, current I_{max}, I_{min} and average torque for a chopper fed separately excited d.c. motor (Type A) ?

3 Explain the four quadrant operation operation of drive using choppers and plot the waveforms for it?

4.Explain a two quadrant operation of Type – C and Type- D choppers and draw the waveforms and conditions for the quadrant of operation ?

Unit -4

Induction motor control – Stator side

1. Draw a Closed loop block diagram for the speed control Technique for induction motor drive.
2. What are the different 3-phase AC voltage controller circuits available for stator voltage control of Induction motor? Discuss their relative merits and demerits.
3. Explain the VSI fed induction motor drive and PWM inverter operation for speed control of induction motor drive.
4. Explain variable frequency control of induction motor to obtain speeds below base speed.
   a) Constant Flux Operation b) Constant V/F. Derive the necessary equations and draw the speed-torque characteristics.