QUSTION BANK

UNIT IV - CONVENTIONAL & SOLID STATE SPEED CONTROL OF D.C. DRIVES

PART – A

1) What are the factors on which the speed of a dc motor depends?

Flux in the air gap
Resistance in the armature circuit
Voltage applied to the armature circuit

2) What are the advantages of field control?

The regulating resistance, which has to carry only a small current
Power wasted in regulating resistance is very small

3) What are the methods on which speed of a dc motor be controlled?

Flux control
Armature resistance
Armature voltage

4) What will be the effect of change in supply voltage on the speed of dc shunt motor?

The reduction of supply voltage to the armature of dc shunt motor causes reduction of back-emf of the motor which inturn reduces the speed as the speed is directly proportional to the back emf

5) List the different methods of speed control to 3 phase squirrel cage induction motor?

Speed control by changing supply frequency
Speed control by changing no. of poles
Speed control by changing slip

6) What is meant by speed control?

The initial change of drive speed to a value required for performing the specific work process is called as a speed control.

7) What are the advantages of field control method?

Conventional and easy method
Since, the shunt field current Ish is small the power wasted in the field rheostat also small
Independent of load on the motor
Economical and efficient method

8) What are the disadvantages of field control method?

There is a maximum limit of speed that can be obtained with this method. It is due to fact that flux per pole is too much weakened commutation becomes poorer.

9) What is the application of ward- Leonard system speed control?

This method normally adopted in very sensitive speed control like electric excavators, elevators, coillery winders, main drives in steel mills and paper mills.

10) What are the advantages of Ward-Leonard speed control?

Wide range of speed control is possible
Full forward and reverse speed can be achieved
Power is automatically regenerated to the ac line through the motor generator set which speed is reduced.
Short time over load capacity is large
The armature current of the motor is smooth

11 Define slip

The difference between the synchronous speed and the actual speed of the motor is called slip.

12) What is Slip-Power recovery system?

The slip power can be recovered to the supply source can be used to supply an additional motor which is mechanically coupled to the main motor.This type of drive is known as slip-power recovery system

13) In which type of control the field current and armature current control?

i).For armature control method (or) voltage control method the field current is kept constant

ii).For field control (or) flux control the armature current kept constant

14) What are the advantages of slip-power recovery system?

i).The slip power from the slip-rings can be recorded and fed back to the supply.

ii).The overall efficiency also improved

15) What is meant by frequency control?

The speed of the induction motor can be controlled by varying the supply frequency, because the speed is directly proportional to frequency.

16) What is meant by flux control (or) field control method?

By varying the field flux the speed can be controlled is called flux control. This method can be used for increasing the speed of the motor is inversely proportional to the field flux

17) Write the advantage of flux control method

Convenient and easy method
In this method is independent of load on the motor
Economical and efficient method

18) What is meant by armature control?

The armature having controller resistance in series during the speed control. By varying the controller resistance R, the potential drop across the armature is varied. Hence the speed of the motor also varied. This method of speed control is applicable for speed less than no load speed.

19).What is meant by voltage control in induction motor? and where it is applicable?

In Induction motor speed can be controlled by varying the stator voltage. This can be done by using transformer. This method is called voltage control.

This is suitable only for controlling the speed below rated value.

20).What is static Ward – Leonard drive?

Controlled rectifiers are used to get variable dc voltage from an ac source of fixed voltage. Controlled rectifiers fed dc drives are known as “static Ward – Leonard drive”.

21) What is meant by V/F control?

When the frequency is reduced the input voltage must be reduced proportionally so as to maintain constant flux. Otherwise the core will get saturated resulting in excessive iron loss and magnetizing current. This type of induction motor behaviour is similar to the working of dc series motors.

PART- B BIG QUESTION

1) What is meant by armature control method?

2) List out the methods of speed control in Dc motors?

3) Explain the working of following methods with neat circuit diagram

i).Kramer system ii).Scherbius system

4) Explain in details rotor resistance method of speed control of a slip ring induction motor.

5) Explain any one of the slip power recovery method of speed control

UNIT IV

Part-B

① Explain any three methods of speed control of DC shunt motor.

Speed control of dc shunt motor.

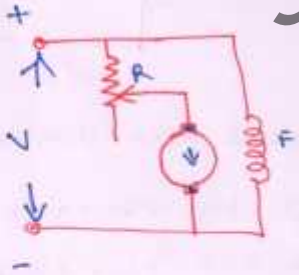
$$N = \frac{V - I_a R_a}{2\phi} \quad \left(\frac{A}{P}\right)$$

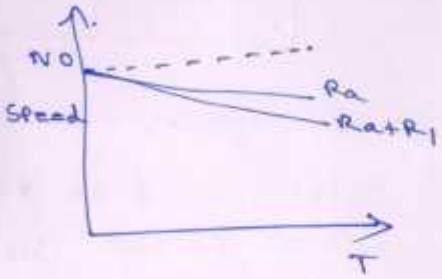
$$\Rightarrow \frac{V - I_a R_a}{K_b \phi}$$

$N \propto \frac{E_b}{\phi}$

From above three methods of control are possible

i) varying Resistance in armature circuit





$$N = \frac{V - I_a(R_a + R)}{K_b \phi}$$

- by increasing the resistance, applied voltage across the armature decreased. ∴ motor speed decreases.

- This method of speed control only applicable for speed less than no load speed.

Advantage

Simple method.

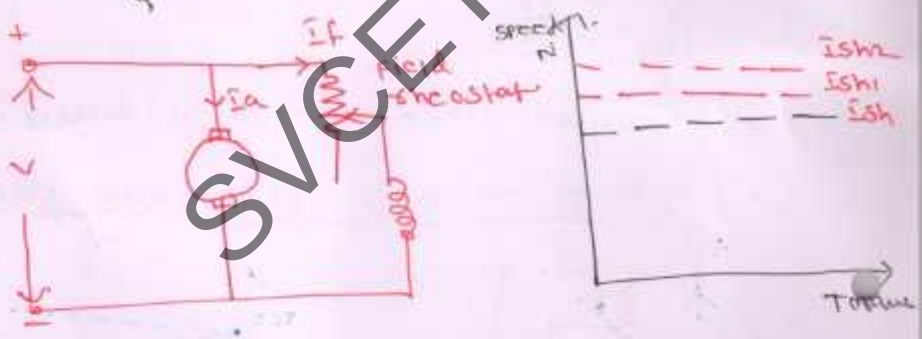
Disadvantage

- more power wasted in external resistance

By varying Flux.

The speed is inversely proportional to Flux.

$N \propto \frac{1}{\phi}$

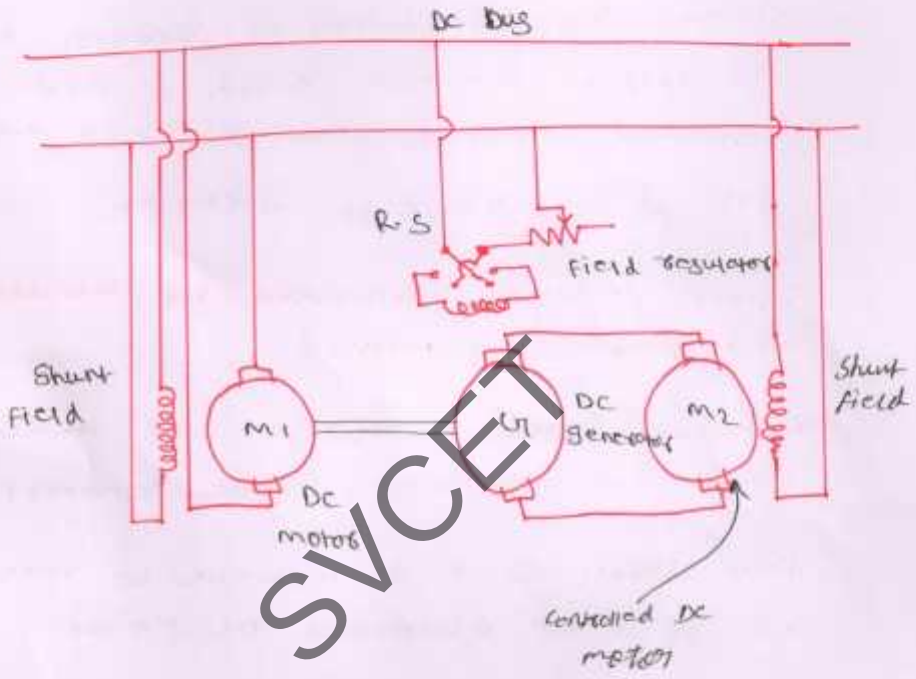


- By varying flux, the speed also varied.

- The flux can be changed by changing the field current (Ish) with the help of field rheostat.

→ by vary the field resistance, the field current is decreased ~~and~~ flux decreased and speed is increased. & speed control is applicable only above the base speed

⑯ Explain the ward-Leonard speed control system with neat sketch also mention its advantage and disadvantage.



- It consists of three dc machines, two dc motor and one dc generator.
- M_1 is main motor is directly coupled to dc generator G_1.
- Dc supply is given to armature as well as shunt field winding. and runs at constant speed.
- The voltage of Generator can be varied from zero to maximum value by means of field regulation.

- The generated dc voltage is feed to controlled dc motor M2

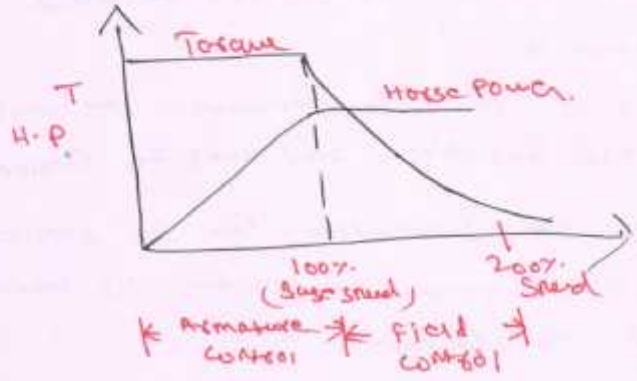
- The controlled dc motor M2 rotation can be changed by field current of generator with the help of Reverse switch S and generated voltage is reversed and motor rotates in reverse direction.

In this method combined by armature and Flux control method.

- Armature voltage control → it is achieved by varying the field of dc generator.

Flux control → it is achieved by varying the field of controlled DC motor.

- The ward Leanard system provide a constant torque as well as constant horse power drive



Advantage

(i) Full forward and reverse speed can be achieved

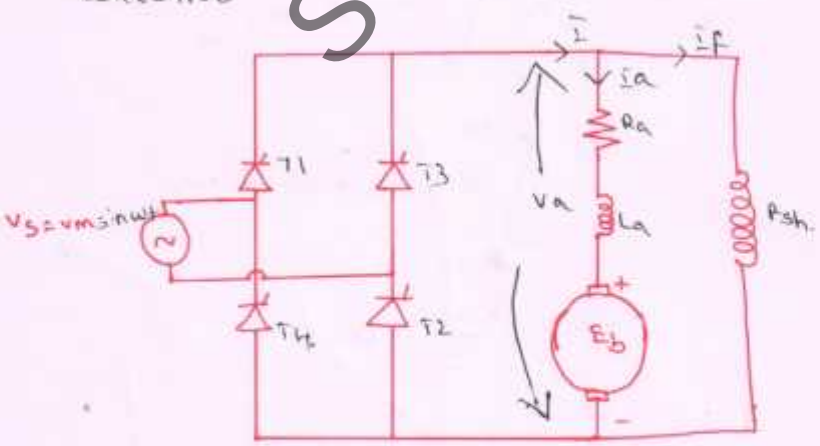
(ii) Wide range of speed control

(iii) Armature current of motor is smooth.

Disadvantage

- High cost
- over all efficiency is low
- drive produced noise.
- Require frequency maintenance.

3 Explain with neat sketch about Dc shunt motor speed control by using 1Φ Full controlled bridge converter



Shunt motor

Assume armature current i_a is constant, Here the load is DC shunt motor.

Full converter consist of 4 SCRs and load.

During +ve half cycle (0 to π) SCR T_1 & T_2 are forward biased.

At $\omega t = \alpha$, SCR T_1 & T_2 are triggered and come to on state. These two SCRs conducts up to $\pi + \alpha$

During the period (α to $\pi+\alpha$) SCR T_1 & T_2 are on state

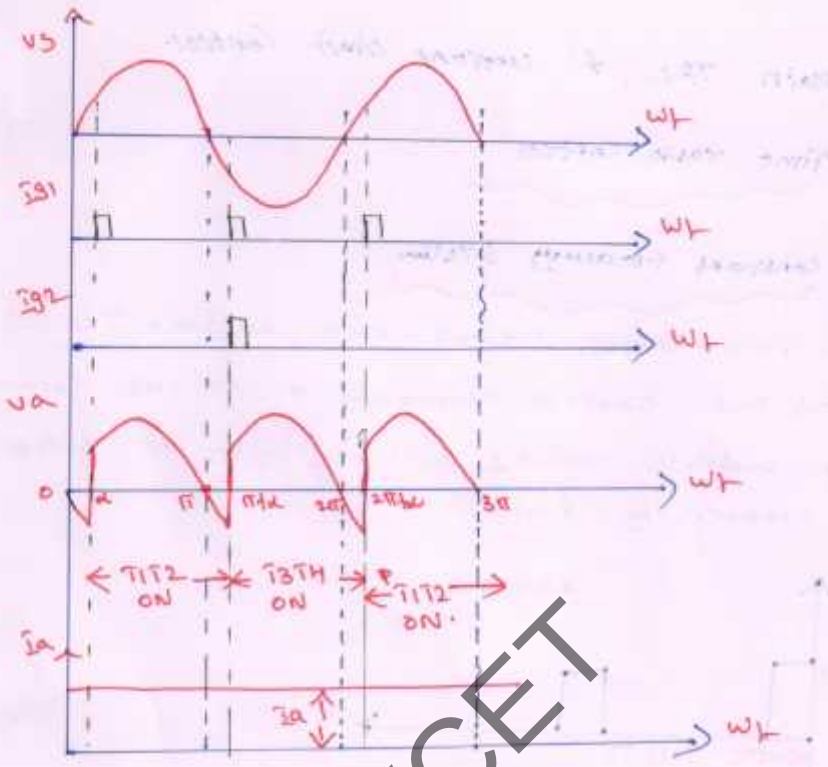
At $\omega t = \pi+\alpha$ SCR T_3 & T_4 are triggered and T_1 & T_2 comes to off state. & SCR T_3 & T_4 conducts up to $\pi+\alpha$

Average output voltage $V_a = V_0$

$$V_a = \frac{1}{\pi} \int_{\alpha}^{\pi+\alpha} V_s \, d(\omega t)$$

$$= \frac{1}{\pi} \int_{\alpha}^{\pi+\alpha} V_m \sin \omega t \, d\omega t$$

$$V_a = \frac{2V_m}{\pi} \cos\alpha$$



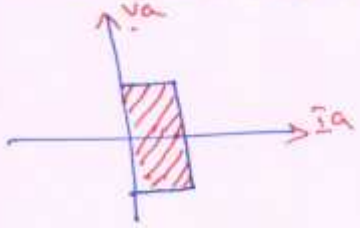
$\alpha = 0^\circ \quad V_a = \frac{2V_m}{\pi}$

$\alpha = 90^\circ \quad V_a = 0$

$\alpha = 180^\circ \quad V_a = -\frac{2V_m}{\pi}$

average output voltage either +ve (or) -ve

o/p current is always +ve

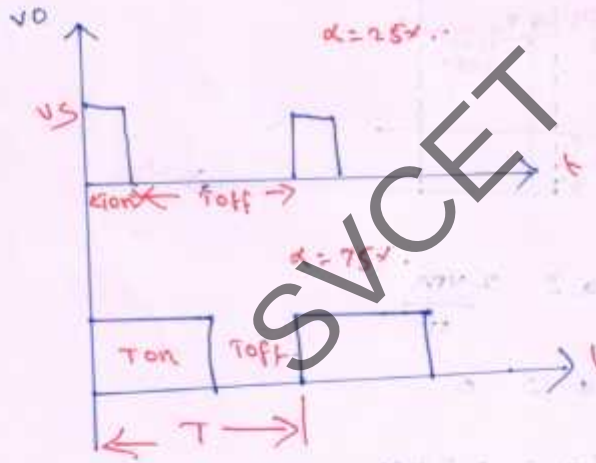


(4) Explain TRC & current limit control.

(i) time ratio control

(ii) constant frequency system

In this control method the on time Ton is varied but chopping frequency f is kept constant. - the width is varied and this type of control is known as PWM



The o/p voltage Vo can be varied between zero to source voltage Vs.

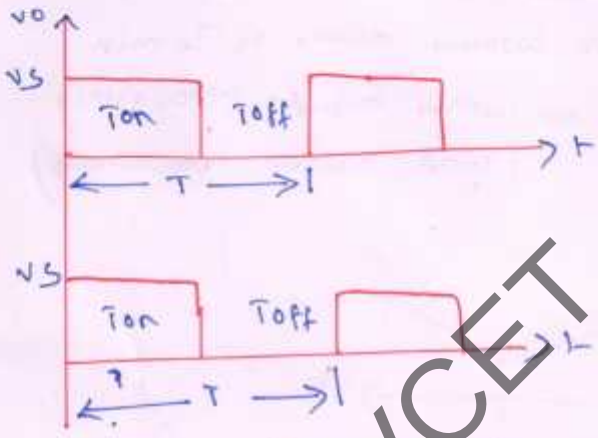
- low ripple & small size of filter

Variable frequency

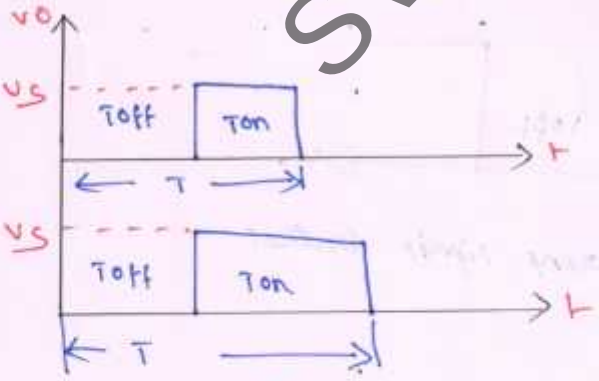
In this control the chopping frequency f is varied and either.

(i) on time Ton is kept const

(ii) off time toff is kept const.



Ton constant



Toff - const.

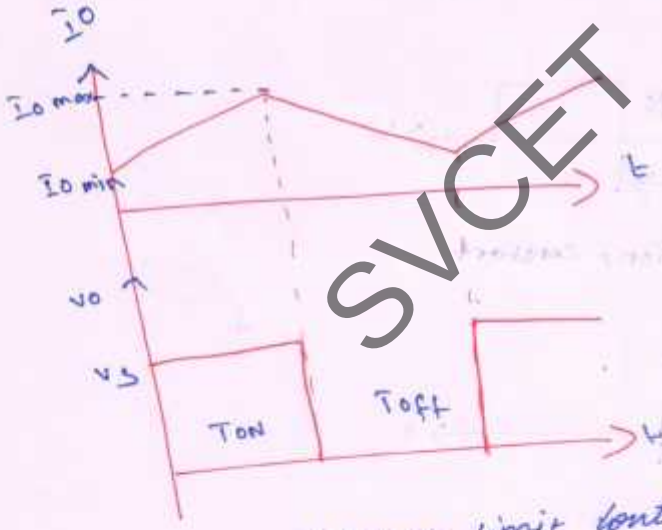
This method of controlling duty cycle α is called frequency modulation in I diagram Ton is kept constant but T is varied.

In diagram-II Toff is kept const but T is varied.

Current limit Control

The chopper is switched ON and OFF so that the current in the load is maintained between two limits ($I_{o\,min}$ to $I_{o\,max}$)

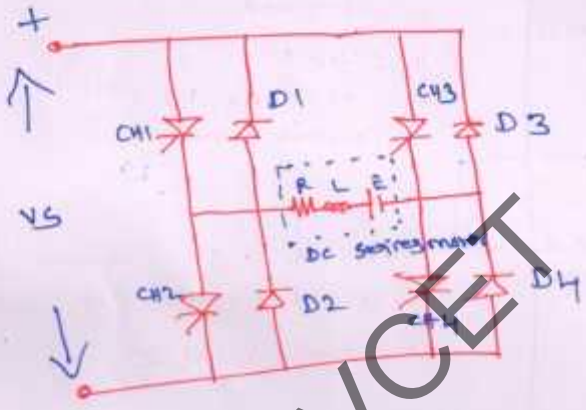
- chopper ON → o/p current rises to $I_{o\,min}$.
- chopper OFF → o/p current exceeds upper limit. (load current freewheels)



Current limit control

(8) Explain the operation of Chopper Fed D.C. Series motor

It consists of four Power Semi Conductor Switches CH1 to CH4 and four Diode D1 to D4 in anti parallel.



Forward motoring

CH1 - operated, CH1, CH4 is on. at this time Va = Vs and load current Ia begins to flow

both Va & Ia +ve

CH1 → OFF +ve current free wheels through D2 & CH2 in this way

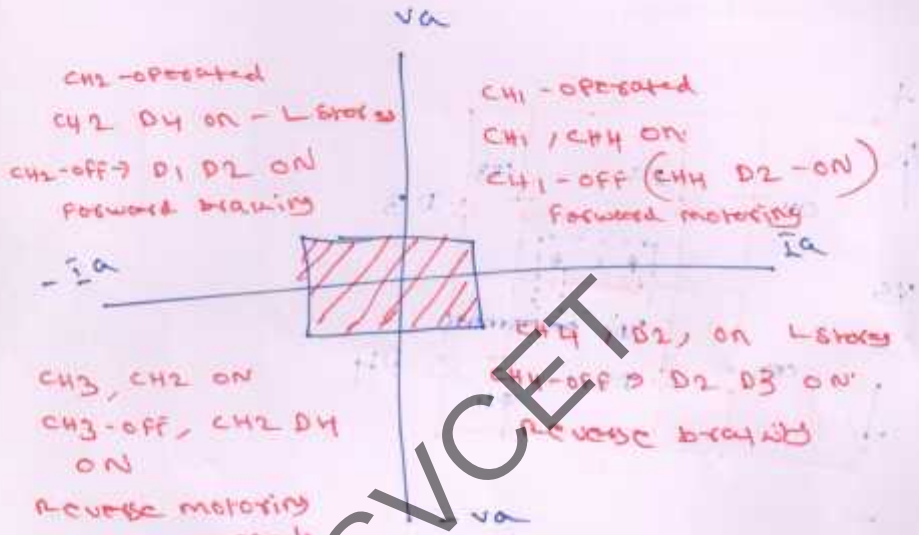
Forward breaking

CH2 - operated, CH2 D4 is on energy stored in inductance [Reverse current flow through L]

CH2 is turned OFF, current is fed back to source through diodes D1 & D4.

Va = +ve

Ia -ve



Reverse motoring

CH2 & CH3 is on - polarity of load emf E must be reversed. so both Ia & Va -ve, CH3 - OFF negative current free wheels through CH2, D4 in this way

Reverse braking

CH4 is +ve current flow through CH4 D2 L & E during this period - Store energy. CH4 is OFF current is feed back to source through diode D2, D3.

Va - -ve

Ia +ve