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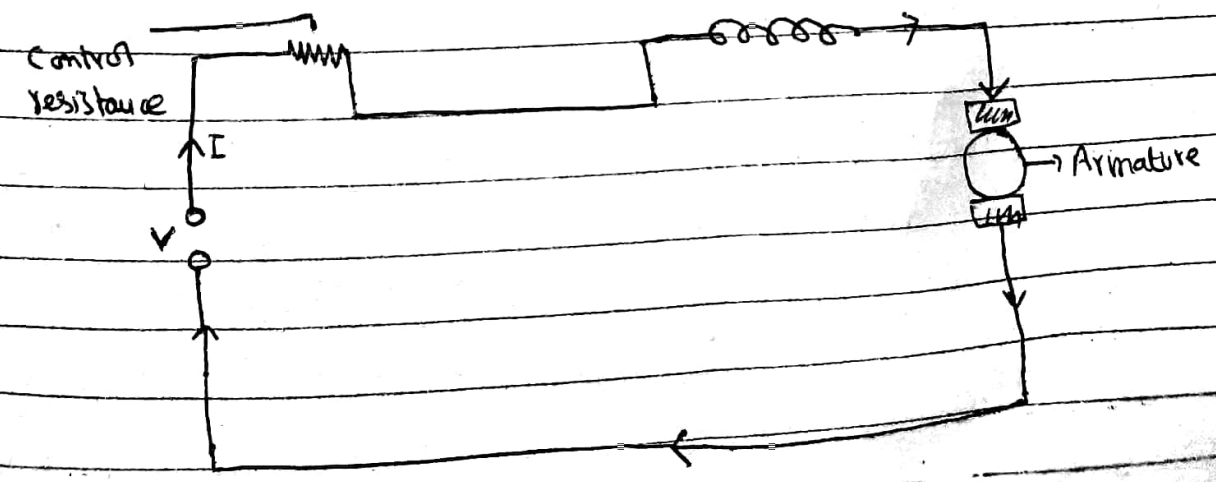
Subject :- Electrical Machines

Q1)
a)
Speed Control Method for DC Motors:-

1) Speed Control is an intentional change in speed of motor.
2) It is different from Concept of speed regulation where there is natural change in speed due to loading and unloading of the Shaft.
3) Speed change is done manually or by automatically control devices.

Speed Control of DC Series Motor:-
1) Armature Resistance Control method:-

In this the controlling resistance is connected directly in series with the supply of the motor.

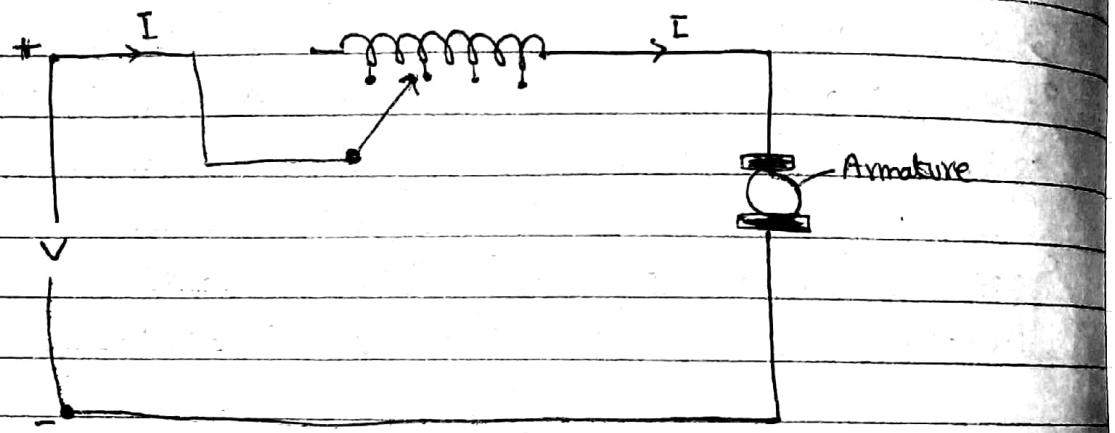


This reduce the voltage available across the armature and hence the speed falls by changing the value of variable resistance.

This method of speed control is most economical for Constant torque.

2) Topped Field Control:-

This is the another method of increasing the speed by reducing the flux and it is done by lowering number of turns of field winding through which current flows.

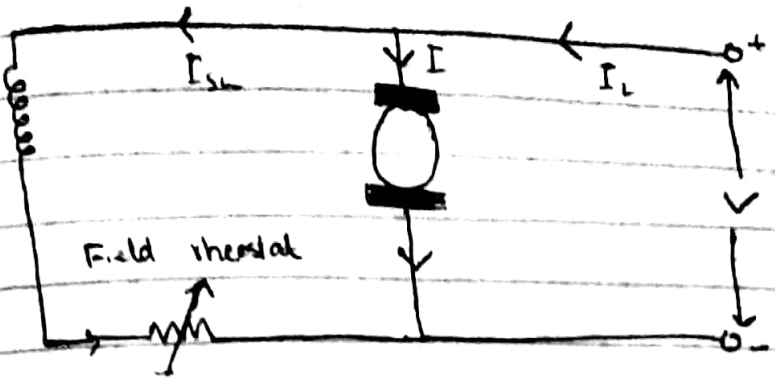


Speed Control of DC Shunt Motor:-

1) Flux Control Method:-

In this method variable resistance (known as Shunt field rheostat) is placed in series with Shunt field winding as

An increase in Controlling resistance reduces the field current with a reduction in flux and an increase in speed.

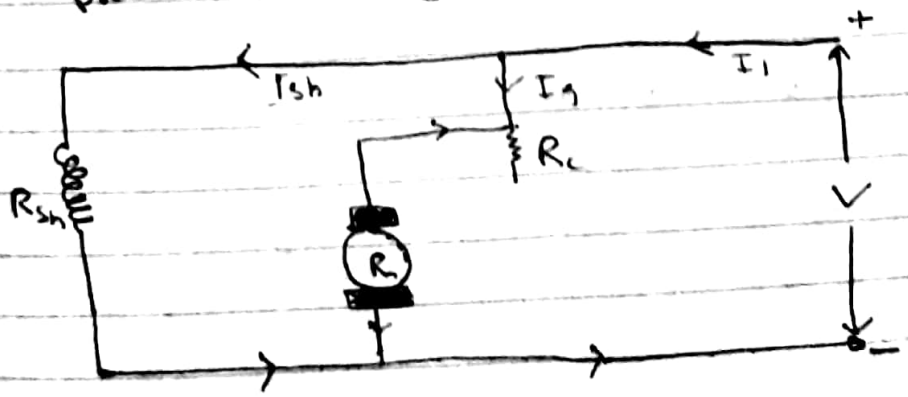


4) This is an easy and convenient method.
2) It is an inexpensive method since very little power is wasted in the Shunt field rheostat due to relitively small value of Ish.

2) Armature Control method :-

This is done by inserting a variable resistance RC (known as controller resistance) in series with the armature.

The flux remain constant while armature current is changed produces change in speed.



Large amount of power is wasted in the controller resistance since it carries full armature current Ia.

Question 1:-
Parts (b)

$Z = 480$
$P = 8$
$emf = 2.2V$
Current = 100A
Total voltage = ?
o/p current = ?
P = ?

Solution:-
For lap $A = 8$

$$Emf = 2.2 \times \frac{480}{8} = 132$$

$$Current = 100 \times 8 = 800$$

$$P = VI = 800 \times 132$$
$$= 105 \text{ KW}$$

As we know
$A = 2$

$$emf = 2.2 \times \frac{480}{2} = 528V$$

$$Current = 100 \times 2 = 200 \text{ Amp}$$

$P = 105$ KW

Question 2
Part (A)

Relationship between Torque & Armature Current:-

Sol:- $P_e = P_m$

P_e = Electrical Power

P_m = Mechanical Power

$P_e = E_a I_a$ as $(E_a = E_b + I_a R_a)$ KVL

$P_e = (E_b + I_a R_a) I_a$

$P_e = E_b I_a + I_a^2 R_a$

$P_e = E_b I_a$

Now

$P_m = T_g W$ :: T_g (Torque in N·M) & W (angular speed in rad/sec)

1 radian = $1/2\pi$ :: In RPM = $N \times 2\pi/60$ = rad/sec

$P_m = T_g N 2\pi/60$

$P_m = P_e$

$T_g N 2\pi/60 = E_b I_a$ $\quad \therefore E_b = \frac{P \cdot \varphi \cdot Z \cdot N}{60 \cdot A}$

$$T = \frac{P \cdot Z \cdot \varphi \cdot I_a}{2 \cdot \pi \cdot A}$$

Hence T_g is directly proportional to I_a

Question 2
Part (b)

*) Lap Winding :-

1) Lap Winding has a coil which can be lap back toward the succeeding coil.
2) In this connection, the armature coil end is connected to the nearby section on the commutators.
3) The number of the parallel path are equal to the total of number poles.
4) The e.m.f of lap winding is Less.
5) The number of brushes is equivalent to the no of parallel paths.
6) The efficiency of lap winding is Less.
7) The additional coil used in the lap winding is Equalizer Ring.
8) This winding cost is very high.
9) It is used for high current and low voltage machines.

*) Wave Winding :-

1) The wave winding can be defined as the loop of the winding can form the signal shape.
2) In this connection, the armature coil end is connected to commutator sections at some distance apart.
3) The number of parallel path is equal to two.
4) The e.m.f of wave winding is More.
5) The number of brushes in wave winding is Equivalent to two.

6) The efficiency of wave winding is high.
7) The additional coil used in wave winding is Dummy coil.
8) The winding cost of the wave winding is Low.
9) It is used for low current and high voltage machines.