IQRA National University, Peshawar
Department of Electrical Engineering
Summers 20

Electrical Machines

Name: Idrees Iqbal

Reg.No: 13171

Instructor: Engr. Sanaullah Ahmad

Total Marks : 50
Attempt All Questions.
Sketch neat and labeled diagrams.
.

Question No 1.

A. Discuss any two methods of speed control each for series and shunt wound DC motors? **(CLO – 3)** 15

B. Consider a 8 poles DC Generator, Number of conductors Z are 480, emf induced per conductor is 2.2V , current per conductor is 100A find the terminal voltage E , output current I and power generated for both lap and Wave windings ? **(CLO – 1)** 10

Question No 2.

A. Determine Relationship between torque and armature current? **(CLO – 2)** 15

B. Differentiate between lap winding and wave winding? **(CLO – 3)** 10

"GOOD LUCK"

Name Idrees Iqbal ID 13171

QNo 1

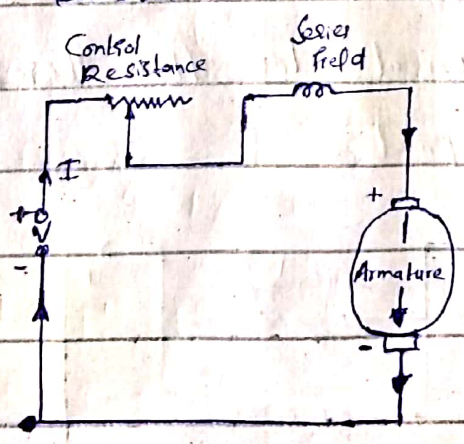
A.

Speed Control of Dc Series Motor.

* Armature Resistance Control Method
* Field Diverter Method

(1) Armature Resistance Control Method.

Here the Controlling Resistance is Connected directly in Series With the supply of the Motor as shown.



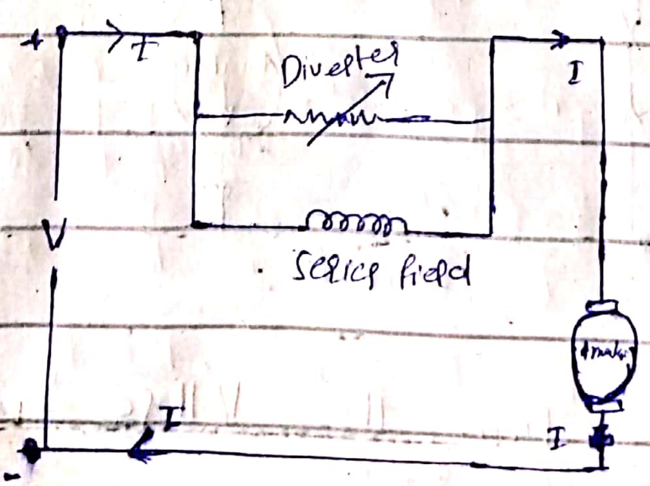
This Reduces the Voltage available

across the armature and hence the speed falls. By changing the value of variable resistance.

This method of speed control is most ~~effe~~ economical for constant torque.

(2) Field Diverted Method:

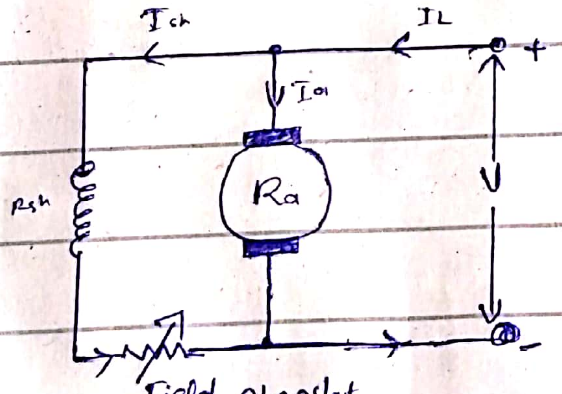
This method uses a diverter. Here the field flux can be reduced by shunting a portion of motor current around the series field. Lesser the diverter resistance less is the field current less flux therefore more speed.



(2) Speed Control of DC Shunt Motor

* Flux Control Method:

- In this Method, a Variable Resistance (Known as Shunt field Rheostat) is placed in series with shunt field winding as shown.
- An Increase in Controlling Resistance Reduces the field Current with a Reduction in flux and an increase in Speed.



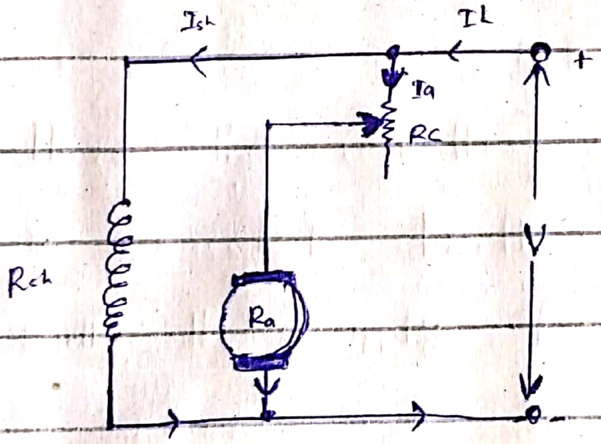
(i) This is an easy and Convenient Method.

(ii) it is an inexpensive method since very little Power is wasted in the shunt field Reheostat due to relatively small Value of Ish.

★ Armature Control Method :

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

The flux remain constant while armature current is changed ~~produce~~ produce change in speed



Large amount of power is wasted in the Controller Resistance since it carries full armature current I_a

Q No 1

B.

Solution:

No of Conductor per path

$\frac{480}{8} = 60$

Terminal Voltage

= emf per Conductor × no of Conductor

= 0.22 × 60

= 13.2 V

⇒ output Current

= Current per Conductor × no of parallel path

= 100 × 8 = 800 A

⇒ power generated for Lap Winding

= output current × generated EMF

= 800 × 13.2

= 10,560 W

For wave winding

no of parallel paths = 2

no of conductor per paths

$480/2 = 240$

terminal voltage $= 0.22 \times 240$

$= 52.8V$

output current

$100 \times 2 = 200A$

power generated for wave winding

$= 200 \times 52.8$

$= 10{,}560\ W$

Q No 2

A. Torque & Armature Current Relationship.

$Pe = Pm$ { Pe = Electrical power, Pm = mechanical " }

$Pe = Ea\, Ia$

as ($Ea = Eb + IaRa$) KVL

$pe = (Eb + IaRa)\, Ia$

$Pe = EbIa + Ia^2Ra$

$pe = EbIa + Ia^2Ra$ (as dissipate in form of heat)

$Pe = EbIa$

Now

$Pm = Tg\, W$ | = Tg (Torque in N·M and w (angular speed in rad/sec)

1 radian = $1/2\pi$ | ∴ In RPM $= N * 2\pi/60$ = rad/sec

$Pm = Tg\, N2\pi/60$

$Pm = Pe$ | $Eb = \frac{P \cdot \phi Z \cdot N}{60 \cdot A}$

$Tg N 2\pi/60 = EbIa$

| $T = \frac{P \cdot Z\phi \cdot Ia}{2 \cdot \pi \cdot A}$

Hence Tg is directly proportional to Ia

Q No 2

B. Differentiate b/w lap winding and wave winding.

	Basic for Comparision	Lap winding	Wave winding
i)	Definition	The coil is lap back to the succeding coil	The coil of the winding form the wave shape.
(ii)	Connections	The end of the armature coil is connected to an adjacent segment on the comutators.	The end of the armature coil is connected to commutators segment distance a part
(iii)	Parallel Path	The number of parallel paths are equal to the total of number poles.	The number of parallel paths is equal to two
(iv)	Other name	Parallel winding or Multiple winding	Two-circuit or series winding
(v)	EMF	less	More
(vi)	Number of brushes	Equal to the number of parallel paths.	Two

	Basic For Composision	Lap Winding	Wave Winding
(vii)	Types	Simplex and Duplex lap Winding	Progressive and Retrogressive Wave Winding
(viii)	Efficiency	Less	High
(ix)	Additional Coil	Equalizer Ring	Dummy Coil
(x)	Winding Cost	High (because more Conductor is required)	Low
(xi)	Uses	In low voltage, high Current machine	In high Voltage low Current machine