IQRA National University, Peshawar
Department of Electrical Engineering
Summers 20

Name: _____

Reg.No:_____

Instructor: Engr. Sanaullah Ahmad

Electrical Machines

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

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Question No 1.

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

B. Consider a 8 poles DC Generator, Number of conductors Z are 480, emf induced per 10 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)**

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"

①

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Question#01

(a) Two methods of Speed Control each for Series and shunt wound DC motors?

Answer:

Speed Control Methods of DC Motors:

→ Speed Control is intentional change in Speed of Motor.

→ It is different from Concept of Speed regulation where there is natural change in Speed due to loading and unloading of shaft

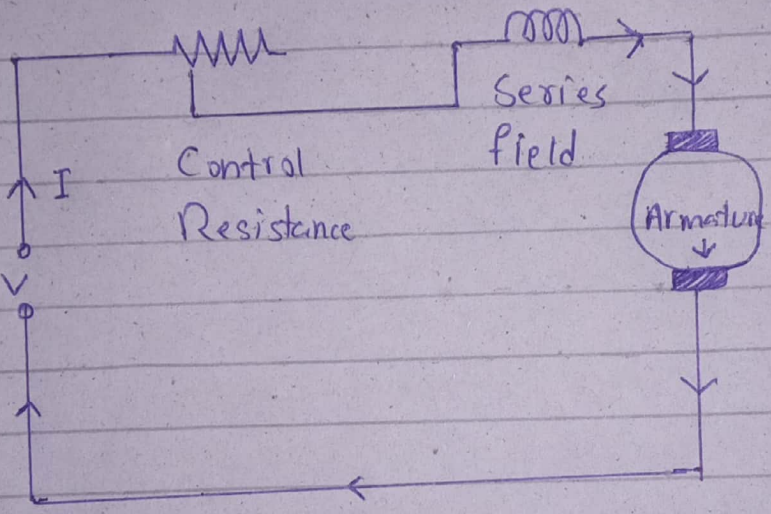
→ Speed change is done manually or by automatically Control devices.

②

Speed Control of DC Series Motor:

1- Armature Resistance Control method:

Here the Controlling resistance is Connected directly in Series with the supply of the motor.

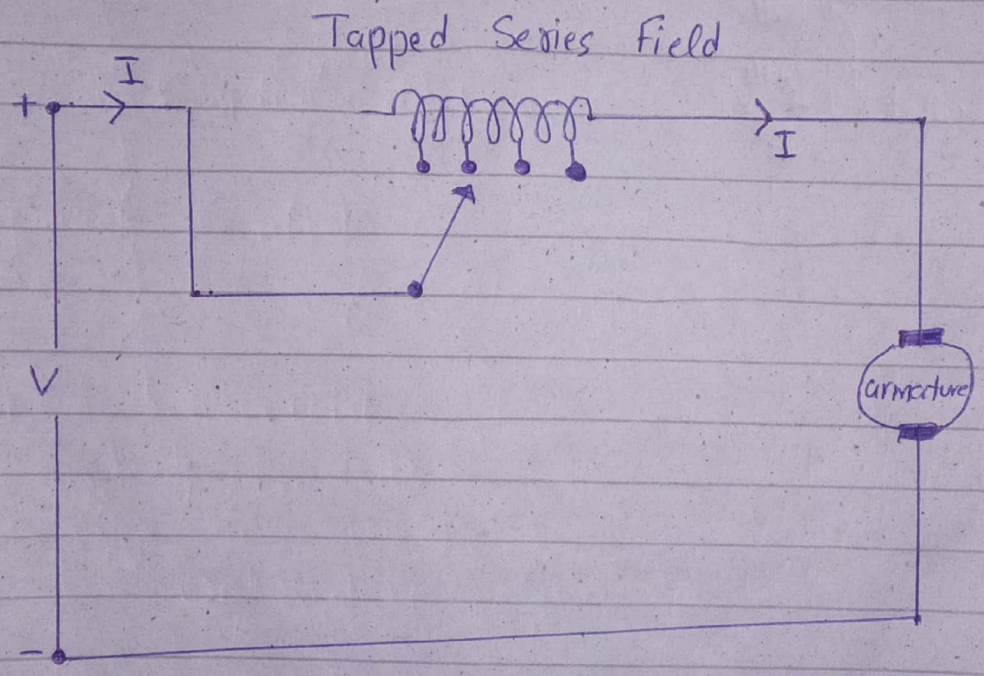


This reduce the voltage available across the armature and hence the speed falls. By changing the value of variable resistance.

This method of Speed Control is most economical for Constant torque.

2- Tapped 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.

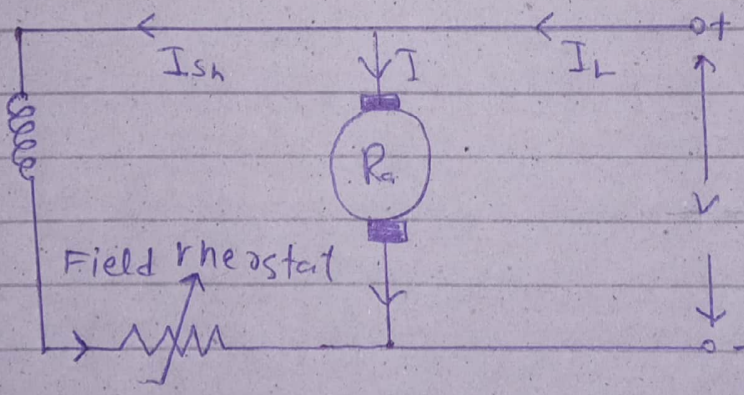


Speed Control of DC Shunt Motor:

1. Flux Control Method:

In this method, a 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.



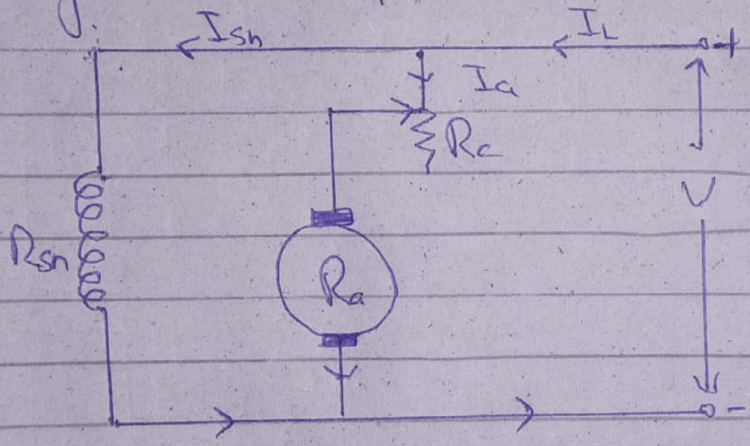
- This is an easy and convenient method.
- It is an inexpensive method since very little power is wasted in the shunt field rheostat due to relatively small value of I_{sh}.

(5)

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 # 01

part (b)

Given Data:

$Z = 480$
$P = 8$
emf per 10 conductor = 2.2V
Current per conducto = 100A
Total terminal Voltage = ?
output Current = ? (For lap and wave)
power generated = ?

Solution:

For LAP:

Parallel paths, so $A = P$
$A = 8$

$$\text{emf total} = (\text{emf/conductor}) \times \frac{Z}{P}$$

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

$$\text{emf total} = 132V$$

(7)

Current Induced = (Current/Conducto) x P

= 100 x 8
= 800 A

Power = (Voltage)(Current)

= 800 x 132
= 105600
= 105.6KW

For Wave:

A = 2

emf total = $2.2 \times \frac{480}{2}$

= 528V

Current induced = 100 x 2
= 200 A

Power = 528 x 200
= 105600
= 105.6×10^3 W
= 105.6KW

(8)

Question # 02

(A) Relation Between torque and armature.

Answer:

Torque & Armature Current Relation:

Pe = Electrical Power

Pm = Mechanical Power

So,

$Pe = Pm$

where

$Pe = Ea\,Ia$ (as $Ea = Eb + Ia\,Ra$)

$Pe = (Eb + Ia\,Ra)(Ia)$

$Pe = Eb\,Ia + Ia^2 Ra$

where ($Ia^2 Ra$) dissipate in form of heat)

$Pe = Eb\,Ia$

Now

$Pm = Tg\,W$ :: Tg (Torque in N.M)

W (angular speed in rad/sec)

(9)

1 radian = $\frac{1}{2\pi}$ ∵ in RPM = $N \times \frac{2\pi}{60}$ = rad/sec

$P_m = T_g N \frac{2\pi}{60}$

$P_m = P_e$

$T_g N \frac{2\pi}{60} = E_b I_a$, $E_b = \frac{P \cdot \phi \cdot Z \cdot N}{60 \cdot A}$

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

Hence T_g is directly proportional to I_a.

Question #02

(B) Differentiat between Lap and Wave winding!

LAP Winding:-

- The Coil is lap back to the Succeeding Coil.
- The end of the armature Coil is Connected to an adjecent Segment on the Commutators.
- The numberss of parallel path are equal to the total total of number poles.
- Parallel Winding or Multiple Winding.
- Emf is less
- Numbers of brushes are equals to paralled paths.

(11)

- Its types are Simplex and Duplex lap Winding.
- Efficiency is less.
- Additional Coil: Equalizer Ring.
- Winding Cost is high because more Conductor is required.
- Uses in low Voltage, high Curret machines.

Wave Winding:

- The Coil of the Winding form the wave shape.
- The end of the armature Coil is Connected to Commulator Segment some distance apart.
- The numbers of parallel paths equal to two.
- Also called Series Winding or two-Circuit.

- EMF is More
- Numbers of brushes are two.
- types are, Progressive and Retro-gressive wave winding.
- Efficiency is less.
- Additional coil is Dummy coil.
- Winding cost is low
- Uses In high Voltage, low Current machines