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PAPER : Electrical Machine

Q 1 : (a)

Answer :

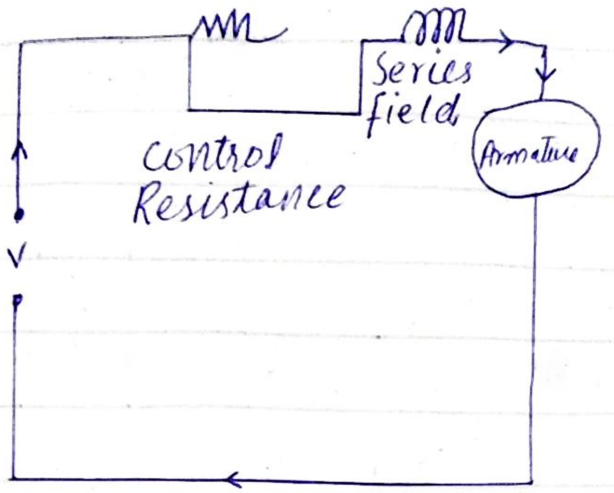
Speed control Methods of DC Motors:

- 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.

Speed Control of DC Series motor:

- Armature Resistance control Method: Here the controlling resistance is connected directly in series with the supply of the motor.

(PTO)



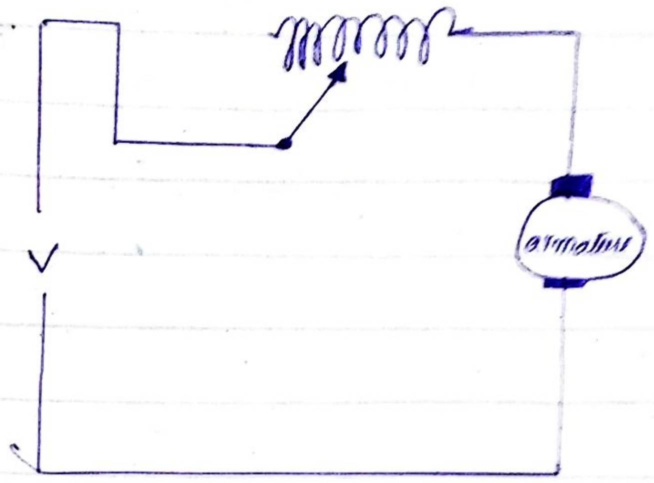
This reduce the voltage available across the armature and hence the speed falls. By changing the value of variable resistance.

This method of speed control is the most economical for constant Torque.

→ 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.

(P To)

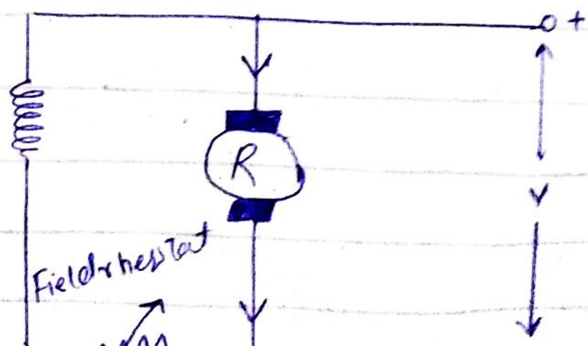


→ <u>Speed Control of DC Shunt Motor:</u>

<u>Flux Control Method</u>

→ In flux Control Method the 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.

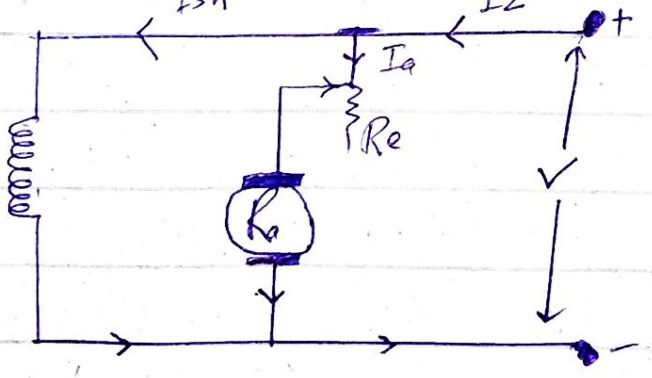


- This is an easy and convenient method.
- It is an inexpensive method since very little power is wasted in the shunt field rheostat due to relatively small value of I_{sh}.

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 contant 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.

Q1 (b)

Given data:

Z = 480

P = 8

emf = 2.2V

current = 100 A.

Total voltage = ?

o/p current = ?

P = ?

Solution:

for lap A = 8

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

$current = 100 \times 8 = 800$

$P = VI = 800 \times 132 = 105 kW$

for wave

A = 2

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

$current = 100 \times 2 = 200$

$P = 105 kW.$

Answer:

Torque and Armature Current Relationship

$Pe = Pm$

Pe = Electrical power

Pm = Mechanical power

$pe = Ea\,Ia$ as $(Ea = Eb + IaRa)$ KVL

$Pe = (Eb + IaRa)Ia$

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

$Pe = Eb\,Ia$

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

$Pm = Tg\,N\,2\pi/60$

$Pm = Pe$

$Tg\,N\,2\pi/60 = Eb\,Ia$

$$Eb = \frac{P \phi Z \cdot V}{GD \cdot 4}$$

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

Q2 (b)

Answer:

Difference b/w lap and wave winding

Basic for comparison	Lap winding	Wave winding
Definition →	The coil lap back to the succeeding coil.	→ The coil of the winding from the wave shap.
Connection →	The end of the armature coil is connected to an adjacent segment on the commutators	→ The end of the armature coil is connected to commutators segments some distance apart.
Parallel path	→ The number of parrallel path are equal to the total of numbers poles	→ The number of parrallel paths are equal to two.
other Name →	parallel winding or Multiple winding	→ Two-circuit or series winding
EMF	→ Less	→ More
Number of Brushes	→ Equal to the number of parrallel paths	→ Two
Types	Simplex and Duplex lap winding	→ Progressive and Retrogressive wave winding

→ Efficiency	→ Less	→ High
→ Additional Coil	→ Equalizes Ring	→ Dummy coil
→ winding Cost	→ High	→ Low
→ uses	→ In low voltage, high ~~voltage~~ current machine	→ In high voltage, Low current machines

End