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IQRA National University, Peshawar
Department of Electrical Engineering
Summers 20

Name: ______________

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Instructor: Engr. Sanaullah Ahmad

Electrical Machines

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"

Yasir Ahmad 13788

Q1

Ans

Speed Control of DC shunt Motor.

speed of a shunt motor

(i) flux control method.

(ii) Armature control method.

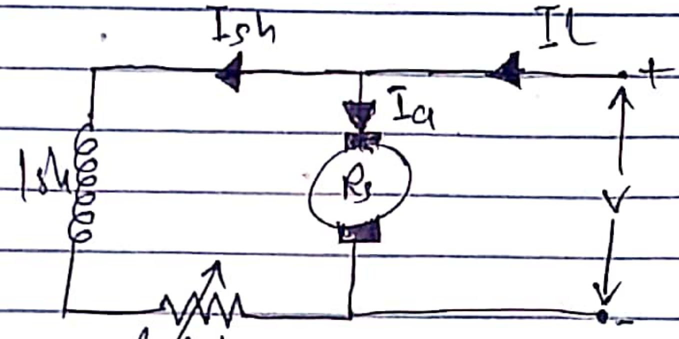
(iii) ward Leonard system (voltage control method).

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.



① This is an easy and convenient method.

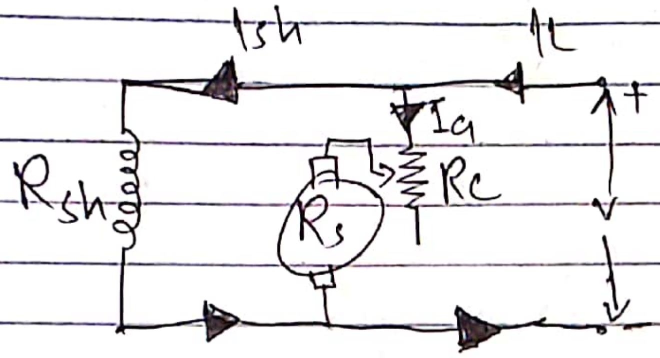
(ii) it is an inexpensive method, since very little power is wasted in the shunt field rheostat due to relativily small value of Ish.

Armature Control Method.

→ This done by inserting a variable resistance RC (known as Controller resistance) in series with the Armature as known.

→ The flux remains Constant while Armature current is changed produces change in speed.

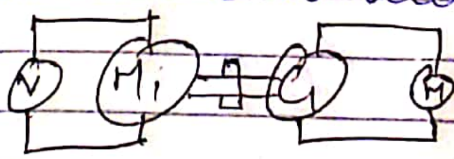
P#3

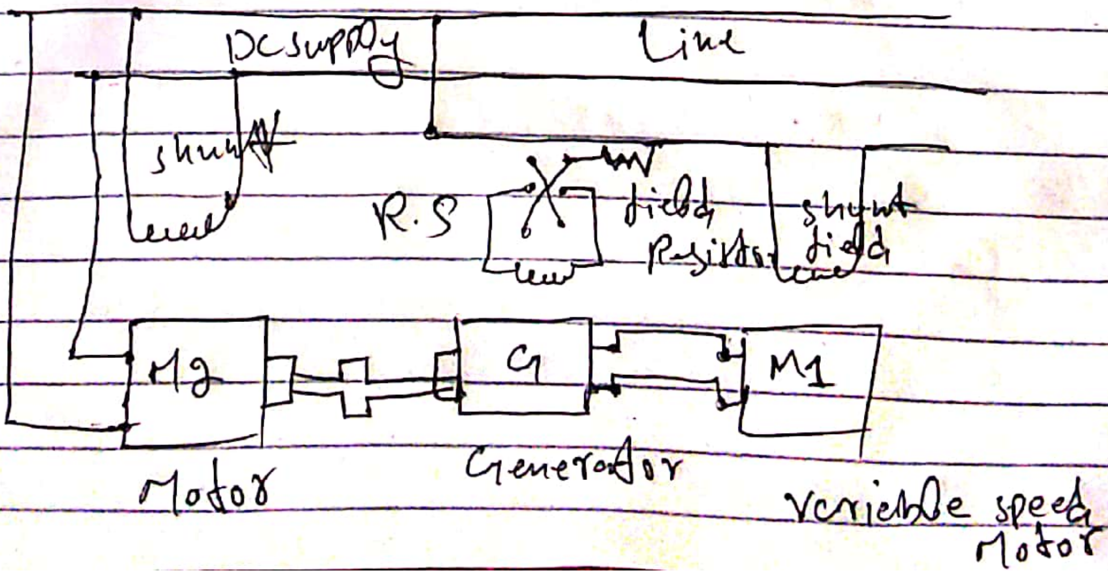


Large Amount of Power is wasted in the controller resistance since it carries full armature current Ia.

Ward Leonard system (voltage control method)

→ This system is used where very sensitive speed control of motor is required (e.g electric excavators, elevators etc).





The speed of the motor can be adjusted through a wide range without resistance losses which ~~range~~ results in high efficiency.

Page #4

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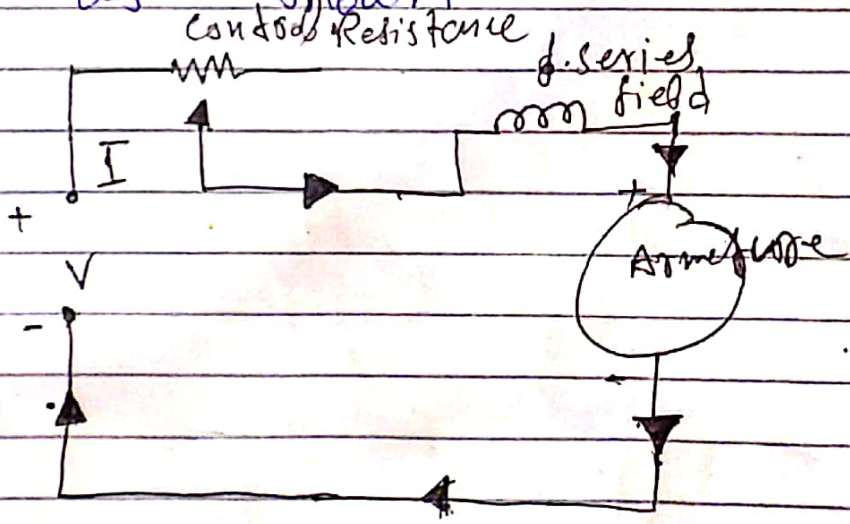
Speed Control of DC series Motor.

Armature Resistance Control Method.

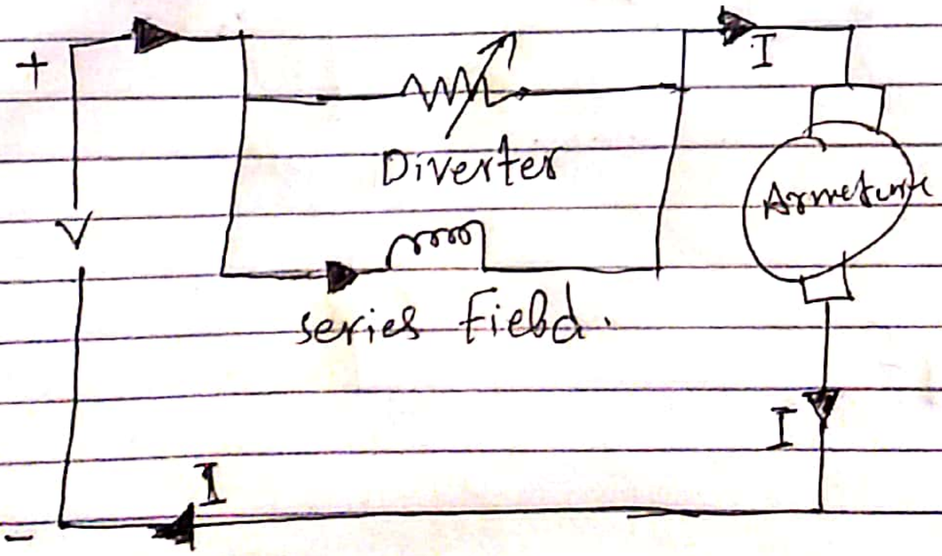
Here the controlling resistance is connected directly in series with the supply of the moter as shown



This reduces the voltage available across the armature and hence the speed falls. By changing the value of variable resistance. The method of speed control is most economical for constant torque.

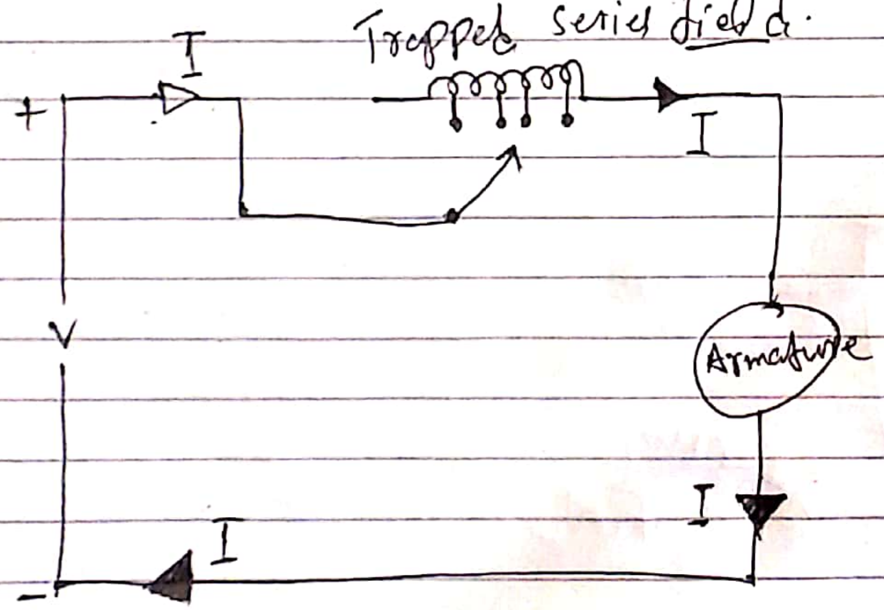
Field Divertor Method

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



Trapped Field Control.

This is 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.



Q1
Part b

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

P = ?

Sol

For lap A = 8

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

Current = 100 x 8 = 800

P = VI = 800 x 132
= 108KW

For wave
A = 2

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

Current = 100x2 = 200

P= 108KW.

Q2 Relationship b/w torque and Armature Current.

Ans

$P_e = P_m$

P_e = electrical power
P_m = Mechanical Power

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

$P_e = (E_b I_a +$ ~~$I_a^2 R_a$~~ (as dissipate in Form of heat)

$P_e = E_b I_a$

Now

$P_m = T_g \omega$ :: (Torque in N.M) and ω (Angular speed in rad/sec)

1 radian = $1/2\pi$ :: in RPM = $N * 2\pi/60$ = rad/sec

$P_M = T_g N 2\pi/60$

$P_M = P_e$

$T_g N 2\pi/60 = E_b I_a$

$E_b = \dfrac{P.\phi.Z.N}{60.A}$

$T = \dfrac{P.Z.\phi.I_a}{2.\pi.A}$ →

Q2 B.

Ans in lap winding the coil is lap back to the succeeding coil whereas in the case
→ wave winding the coil are connected in wave shape.

→ lap winding the End of the Armature coil is connected to Adjacent commutator segment.
→ wave winding the End of the Armature coil is placed in the commutator segment which is placed apart.

→ The wave winding the coils are connected in series and hence is called series winding.
→ lap winding also called parallel winding because their coil are connected in parallel.

→ The emf of lap winding is less as as compared to wave winding.

→ Efficiency of the lap winding is less as compared to the wave winding.

→ lap winding used in low voltage. High current machine, wave winding used in High voltage low current machine.