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DEPARTMENT BE (E)

SUBJECT ELECTRICAL MACHINE

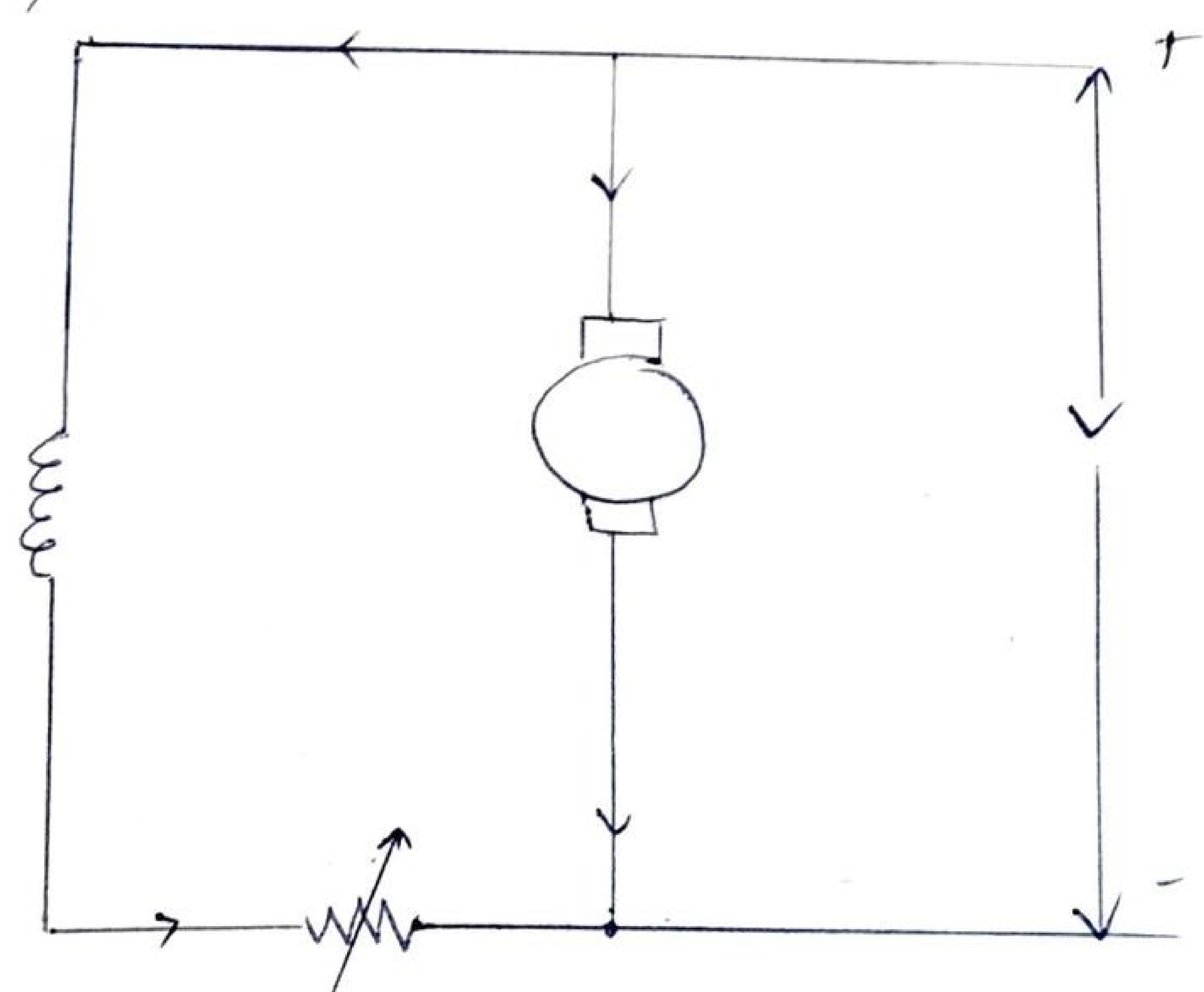
Q1(a) Discuss two methods of speed control each for series and shunt wound DC motors. (1)

Ans:- **Speed Control of DC Shunt Motor:-**

(i) FLUX CONTROL METHOD:-

In this Method, a variable resistance is placed in series with shunt field winding.

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

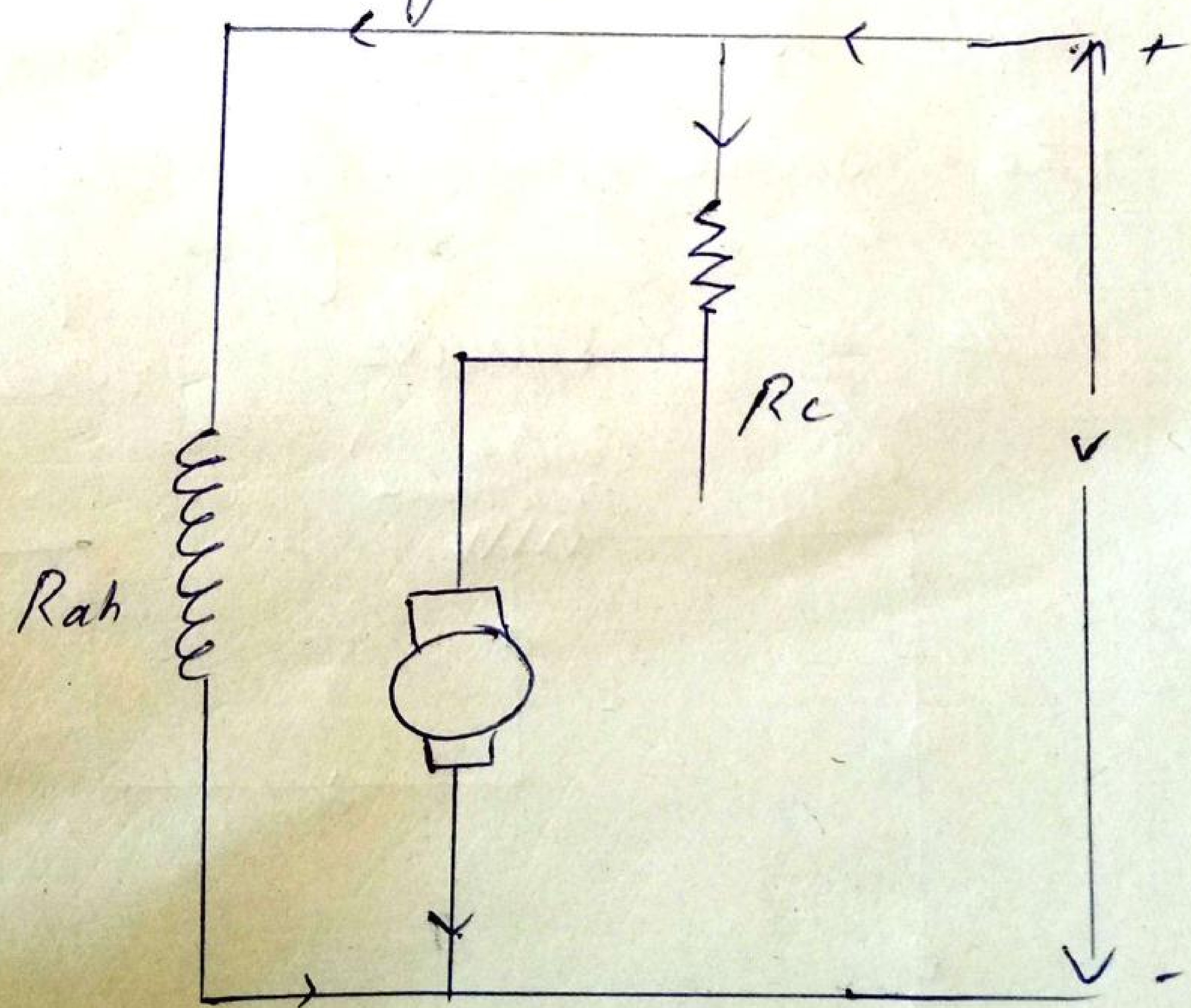


Field Rheostate

(2) ARMATURE CONTROL METHOD:- (2)

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

* The flux remains constant while armature current is changed produces chang in speed

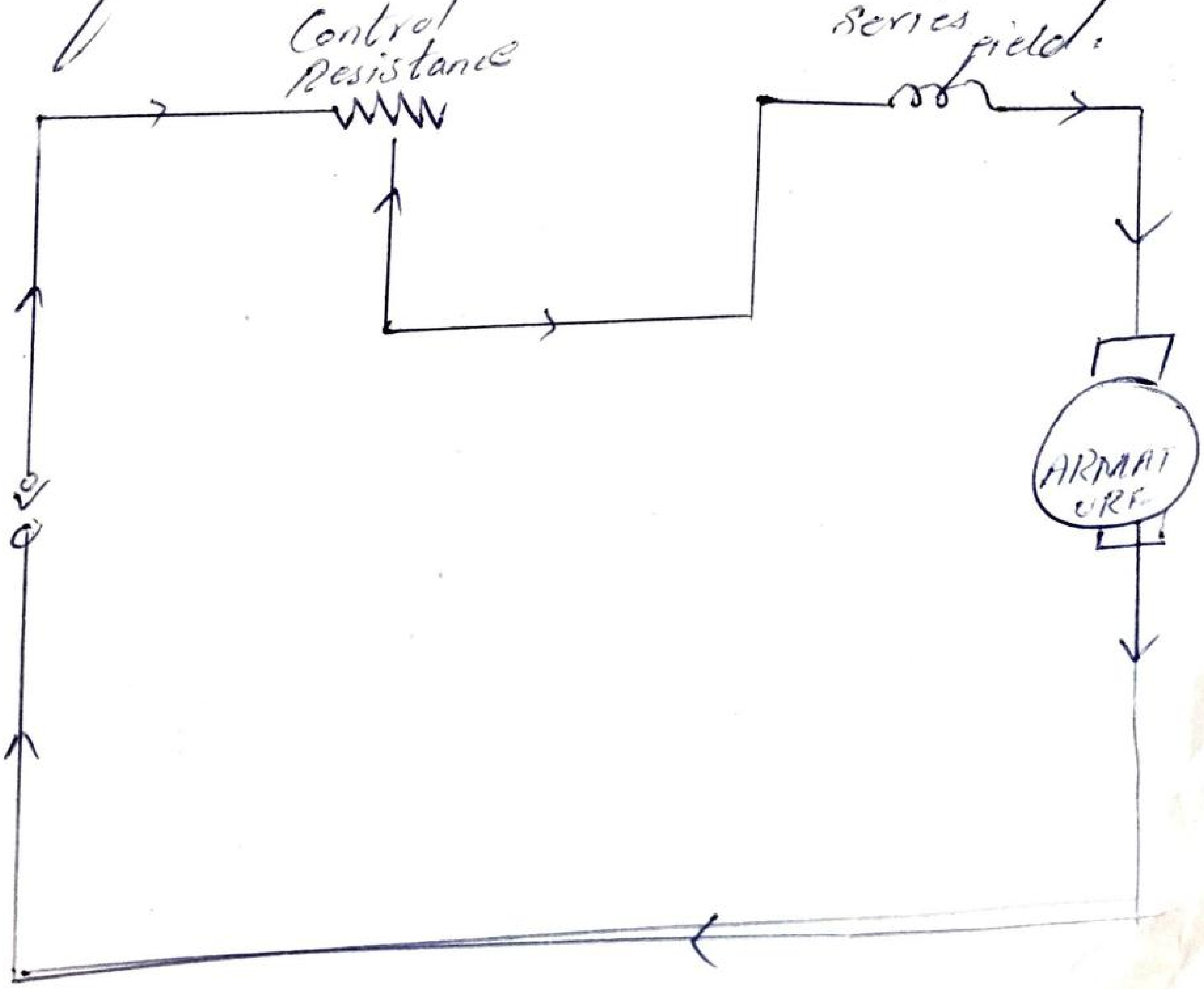


Speed Control of DC Series Motor:: (3)

* ARMATURE RESISTANCE CONTROL METHOD:-

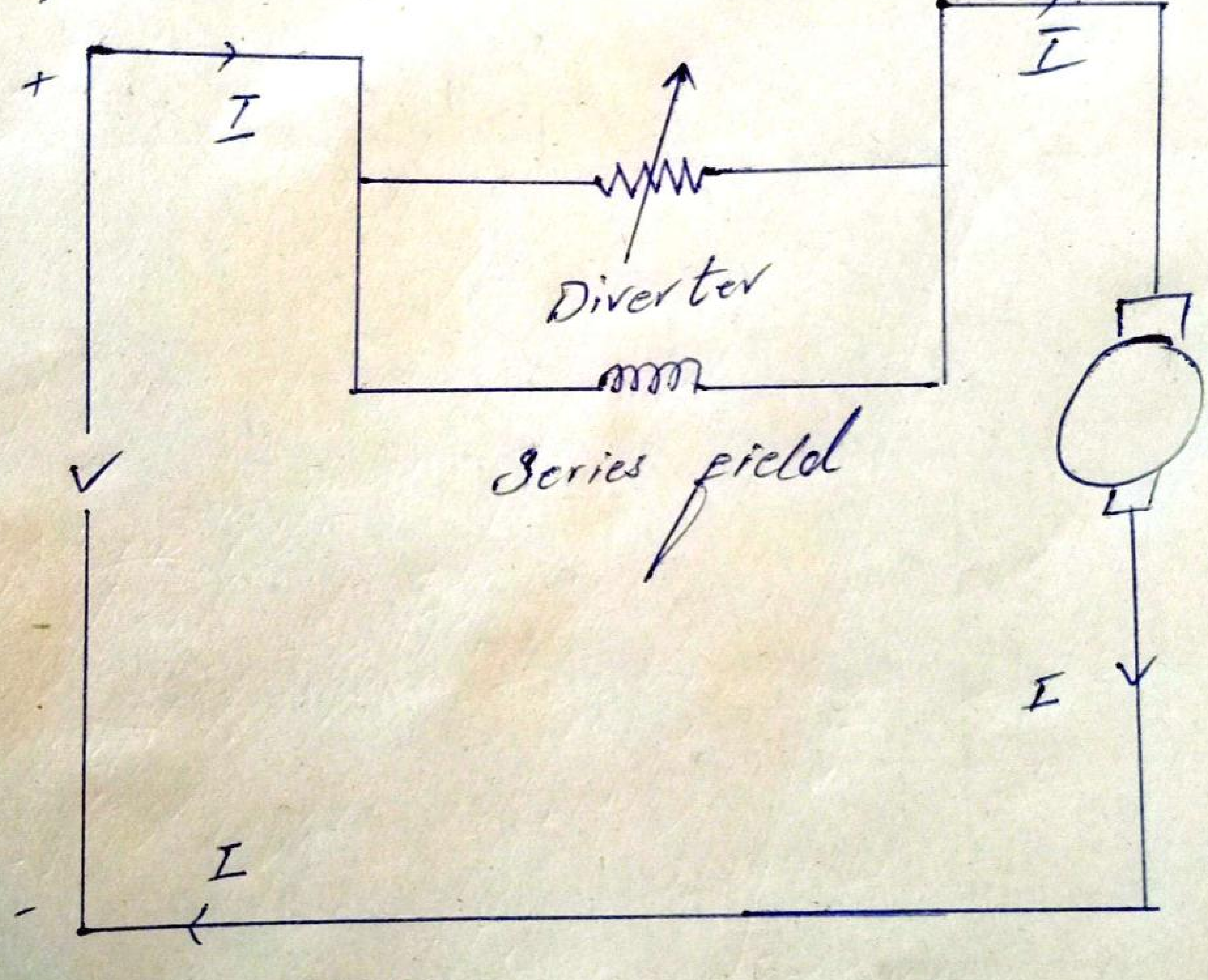
Here the controlling resistance is connected directly in series with the supply of the motor

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



Field Diverter 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.



Q1(b) Consider 8 poles DC ... (5)

... ... Wave Winding.

Sol:-

z = 480

p = 8

emf = 2.2V

current = 100A

total voltage = ?

o/p current = ?

p = ?

For lap A = 8

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

current = 100x8 = 800

p = VI = 800 x 132

= 105 KW

For Wave

A = 2

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

Current = 100x2 = 200

p = 105 KW

Q2(a) Determine Relationship between torque and armature current? (b)

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

$P_e = (E_b + I_a R_a) I_a$

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

$P_e = E_b I_a$

Now

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

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

$P_m = T_g N 2\pi/60$

$P_m = P_e$

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

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

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

Q2(b) Differentiate between lap winding and wave winding? (7)

Ans:-

	LAP WINDING	WAVE WINDING
Definition	The coil is lap back to the succeeding coil.	The coil of the winding form the wave shape
Connection	The end of the armature coil is connected to an adjacent segment on the commutators.	The end of the ~~The number of parallel paths is equal~~ armature coil is connected to commutator segments some distance apart.
Parallel Path	The number of parallel path are equal to the total of number poles.	The number of parallel paths is equal to two
EMF	Less	More
Number of Brushes	Equal to the Number of parallel paths	Two
Types	Simplex and Duplex lap winding	Progressive and Retrogressive wave winding
Efficiency	Less	High
Additional Coil	Equalizer Ring	Dummy coil
Winding Coil	High (because more conductor is required).	Low
Uses	In low voltage, high current machines.	In high voltage, low current machinese.