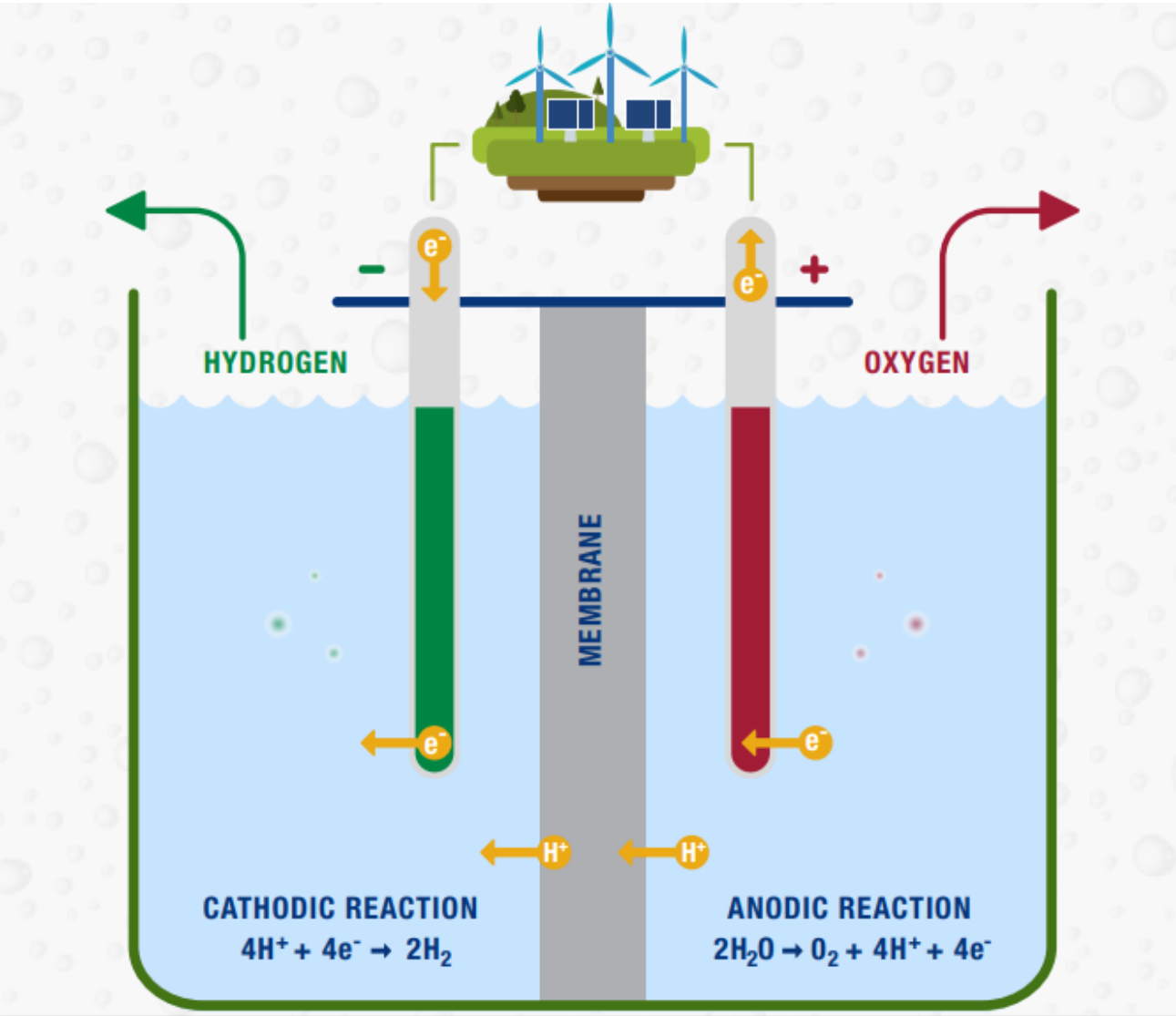
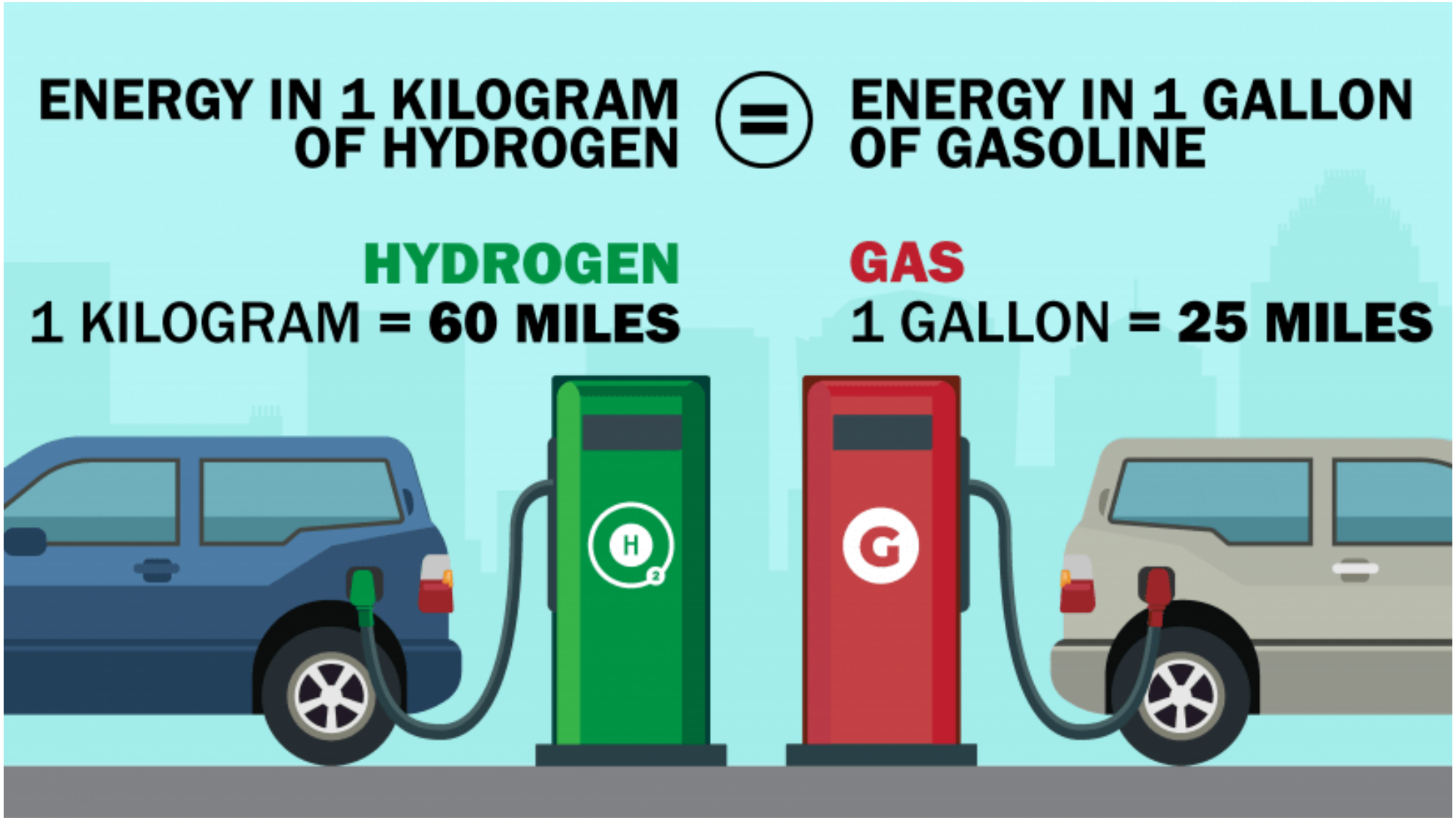
Unit - III
3.6 Generator Types and Elementary Motors

Dr.Santhosh.T.K.

Green Hydrogen




ENERGY IN 1 KILOGRAM OF HYDROGEN
=
ENERGY IN 1 GALLON OF GASOLINE
HYDROGEN
1 KILOGRAM = 60 MILES
GAS
1 GALLON = 25 MILES
H2
G

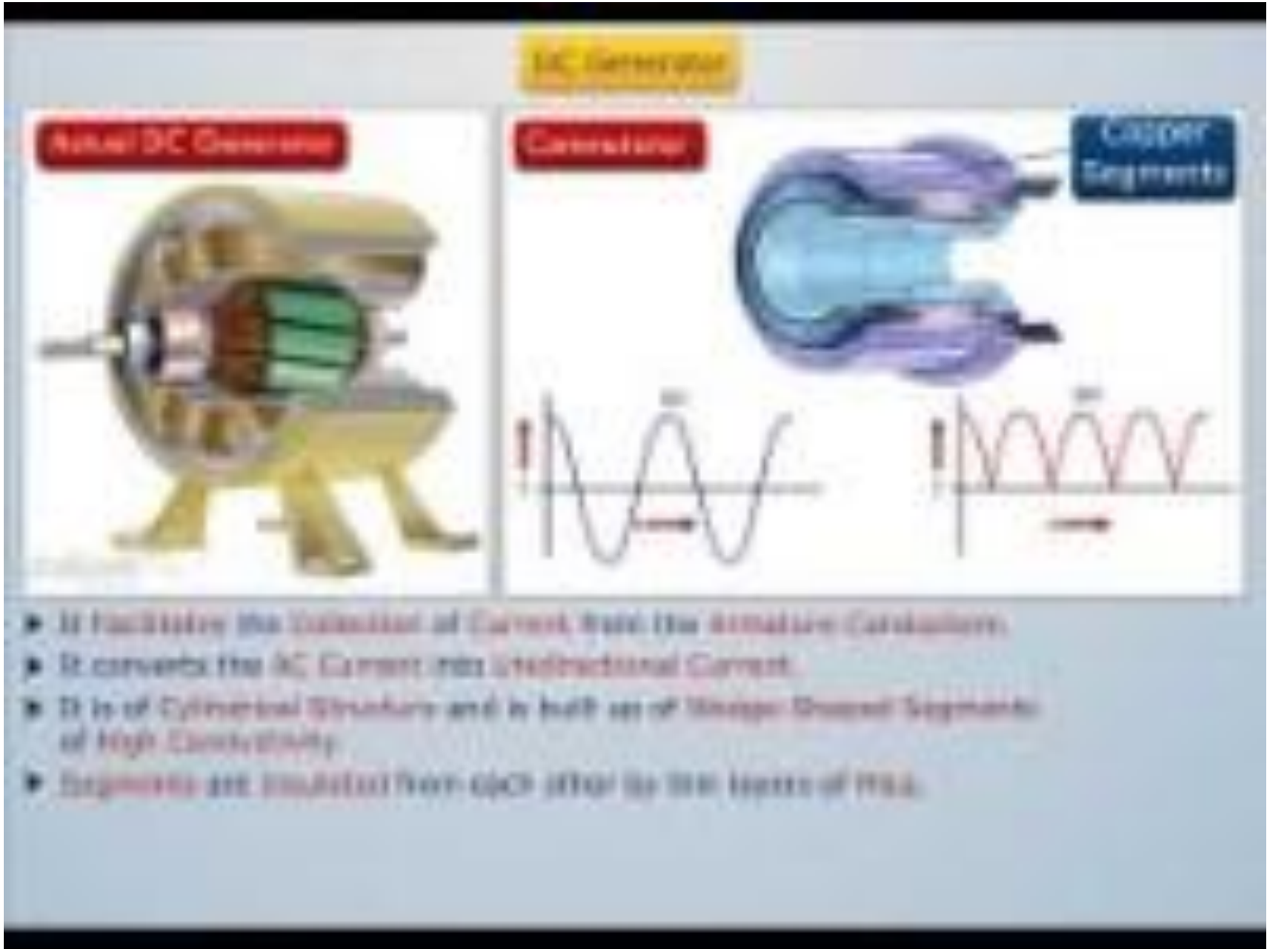
Syllabus

UNIT – III **10 Periods**

Principles of Electro Magnetics and Electro-mechanics: Electricity and Magnetism - magnetic field and faraday's law - self and mutual inductance - Ampere's law - Magnetic circuit - Magnetic material and B-H Curve – Single phase transformer - principle of operation - EMF equation - voltage ratio - current ratio – KVA rating - Electromechanical energy conversion – Elementary generator and motors.

DC Machine Construction

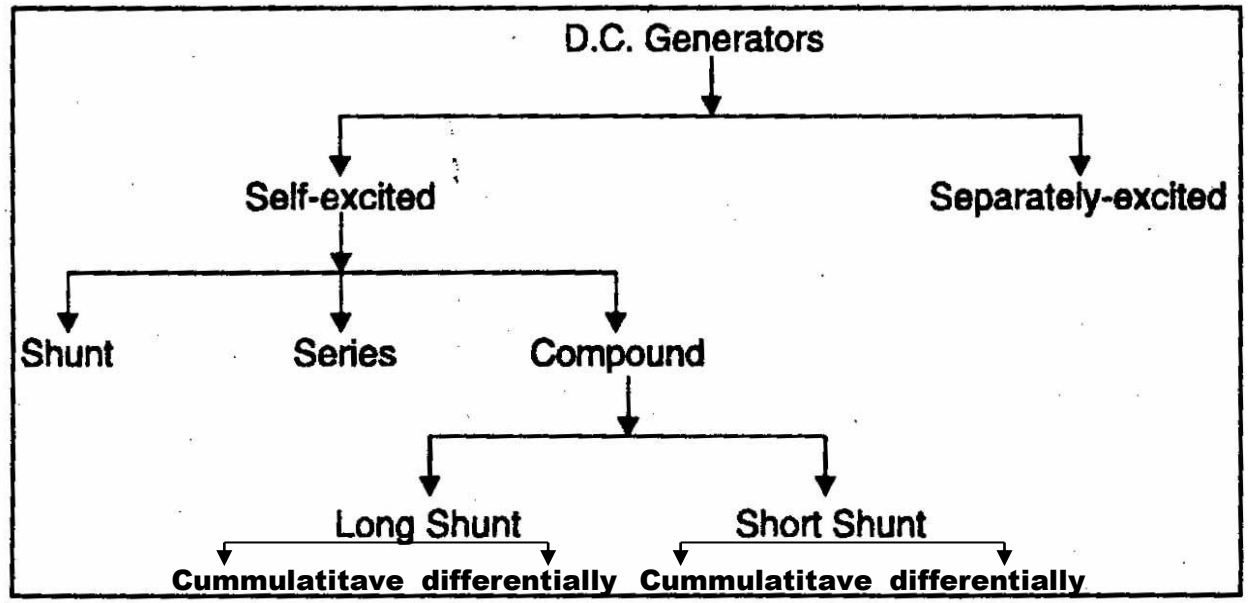
Video 2



Generators

D.C Generators

A.C Generators
(Alternators)



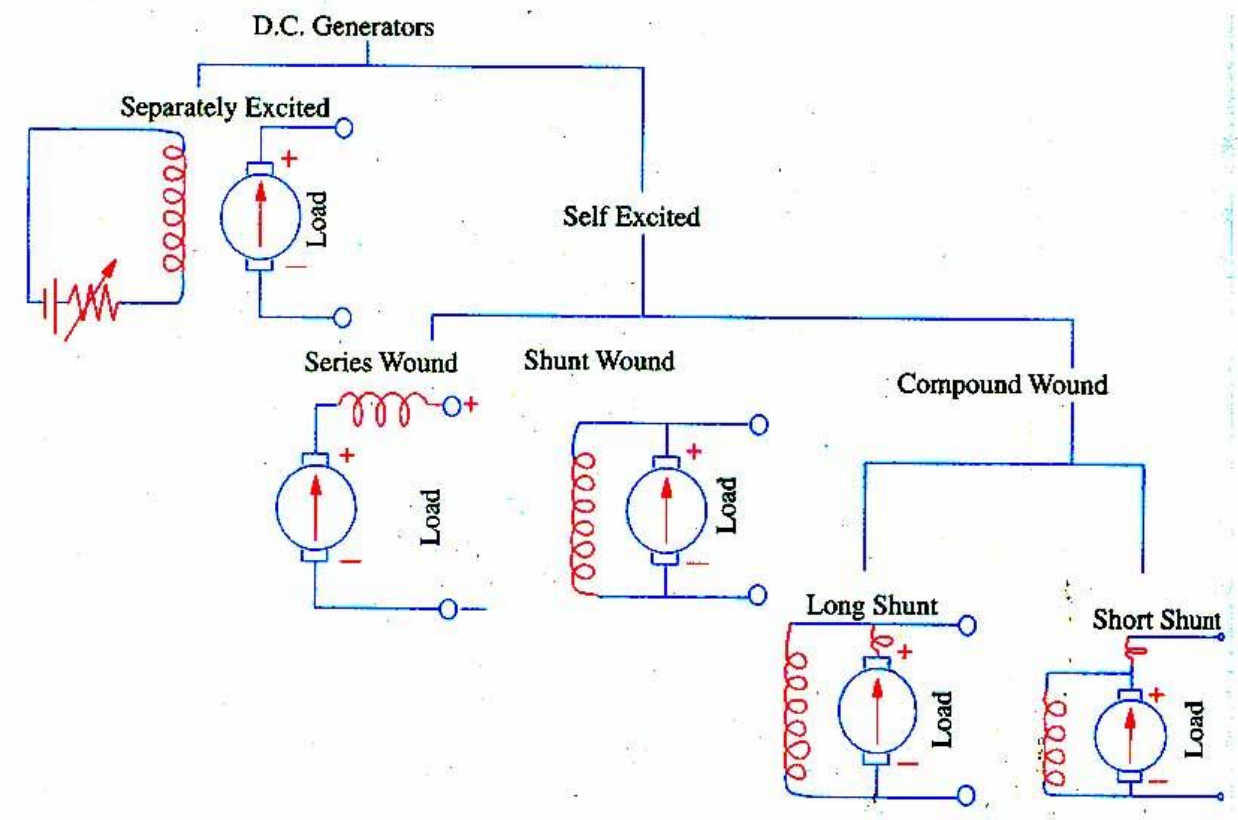
Types of Generators

1)Separately excited generators

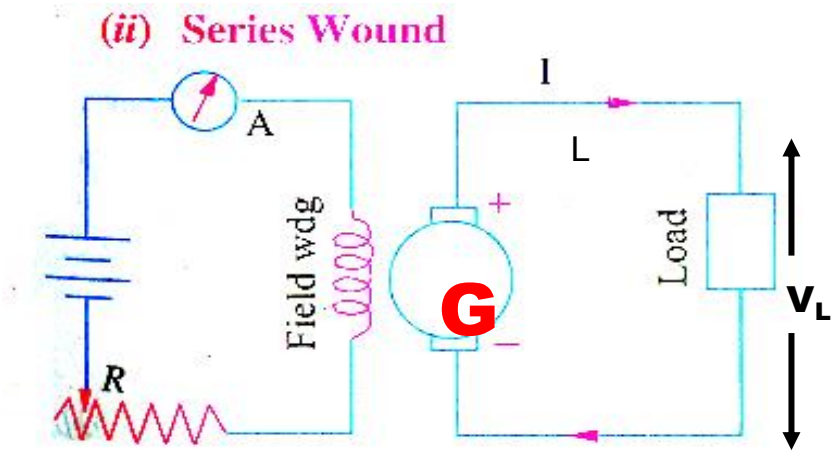
2)Self excited generators

- i) shunt wound
- ii) series wound
- iii) compound wound
  - a) long shunt
  - b) short shunt

Classification of Generators



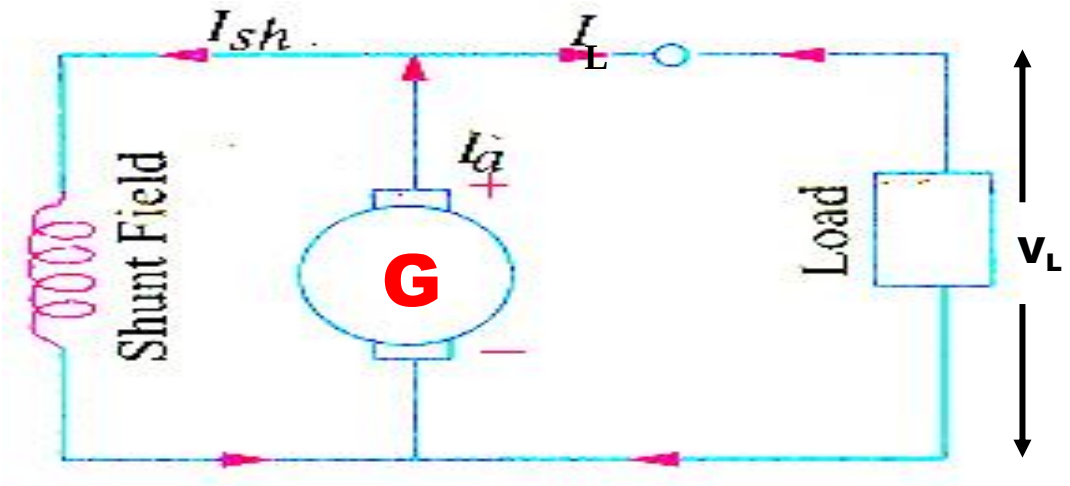
Separately Excited Generators



$I_a = I_L$

$E = V_t + I_a R_a + BCD$

shunt wound



Shunt generator

(a)

$I_L = I_a - I_{sh}$

$I_a = I_L + I_{sh}$

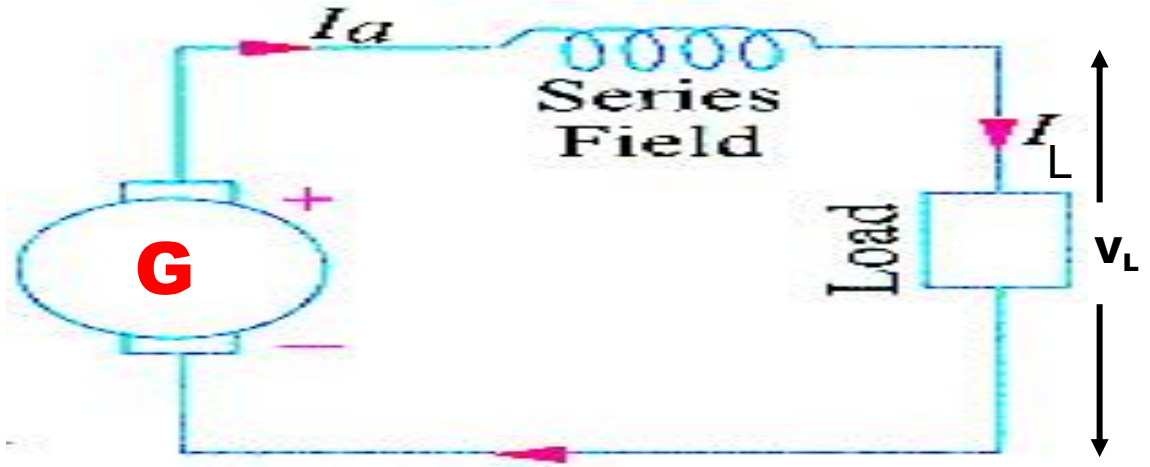
$E_g = V_L + I_a R_a$ + B.C.D (Brush contact drop)

$V_L = R_{sh} \cdot I_{sh} = I_L \cdot R_L$

$I_L = \frac{\text{Load (in watts)}}{V_L}$

R_L = load resistan

series wound



Series generator

(b)

$$I_L = I_a = I_{se}$$

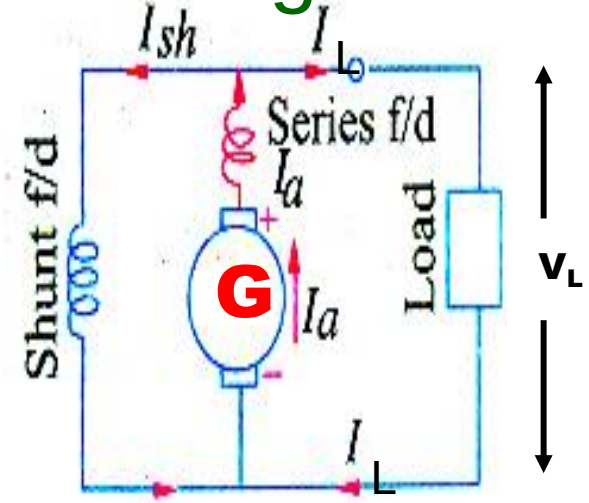
$$Eg = V_L + I_a R_a + I_{se} R_{se}$$

$$= V_L + I_a (R_a + R_{se})$$

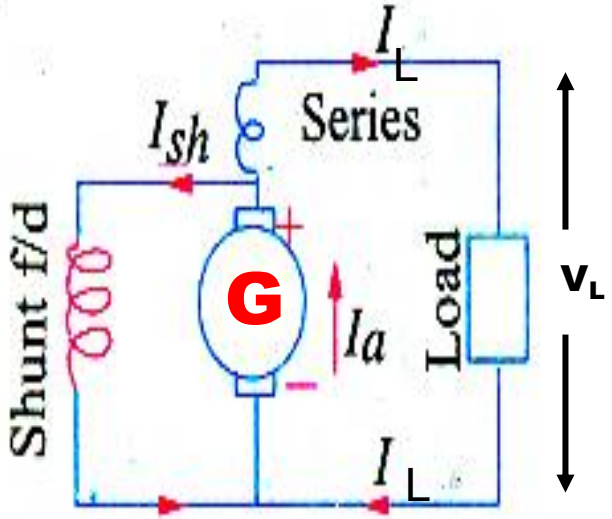
$$V_L = I_L \cdot R_L$$

compound wound

long shunt



short shunt



(c) Long shunt

$I_a = I_{se} = I_L + I_{sh}$

$I_{sh} = \frac{V_L}{R_{sh}}$

$E_g = V_L + I_a R_a + I_{se} R_{se}$

$= V_L + I_a (R_a + R_{se})$

$I_{sh} = \frac{E_g - I_a (R_a + R_{se})}{R_{sh}}$

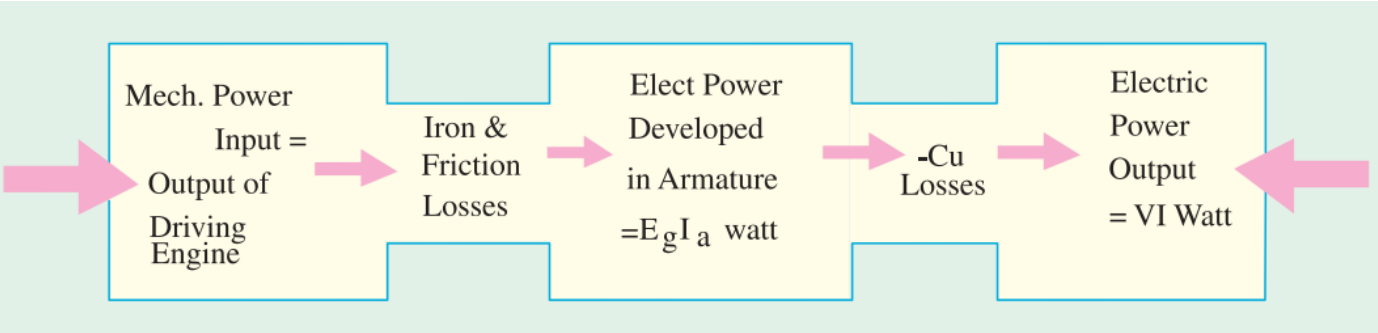
(d) Short shunt.

$I_L = \frac{P_L}{V_L}$ (load in watts), $I_L = I_{se}$

$I_{sh} = \frac{V_L + I_{se} R_{se}}{R_{sh}}$, $I_a = I_L + I_{sh}$

$E_g = V_L + I_a R_a + I_{se} R_{se}$

Power Stages in a DC Machine



Applications of D.C Generators

Separately excited generators

i) These are used for speed control of D.C motors over a large range.

ii) These are used in areas where a wide range of terminal voltage is required

Self excited generators

i) shunt generators :-

i) These are used as exciters for exciting the field of synchronous machines and separately excited D.C generators

ii) These are used for battery charging because it's terminal voltage are almost constant or can be kept constant.

iii) Commonly used in ordinary lighting purposes and power supply purposes.

ii) series generators:-

i) These are used for series arc lighting

ii) Series incandescent lighting

iii) As a series booster for increasing the voltage across the feeder to compensate the resistance drop of the line. because of their rising characteristic.

iv) Special purposes such as supplying the field current for regenerative breaking of D.C locomotives (railway service).

v) Constant current for welding.

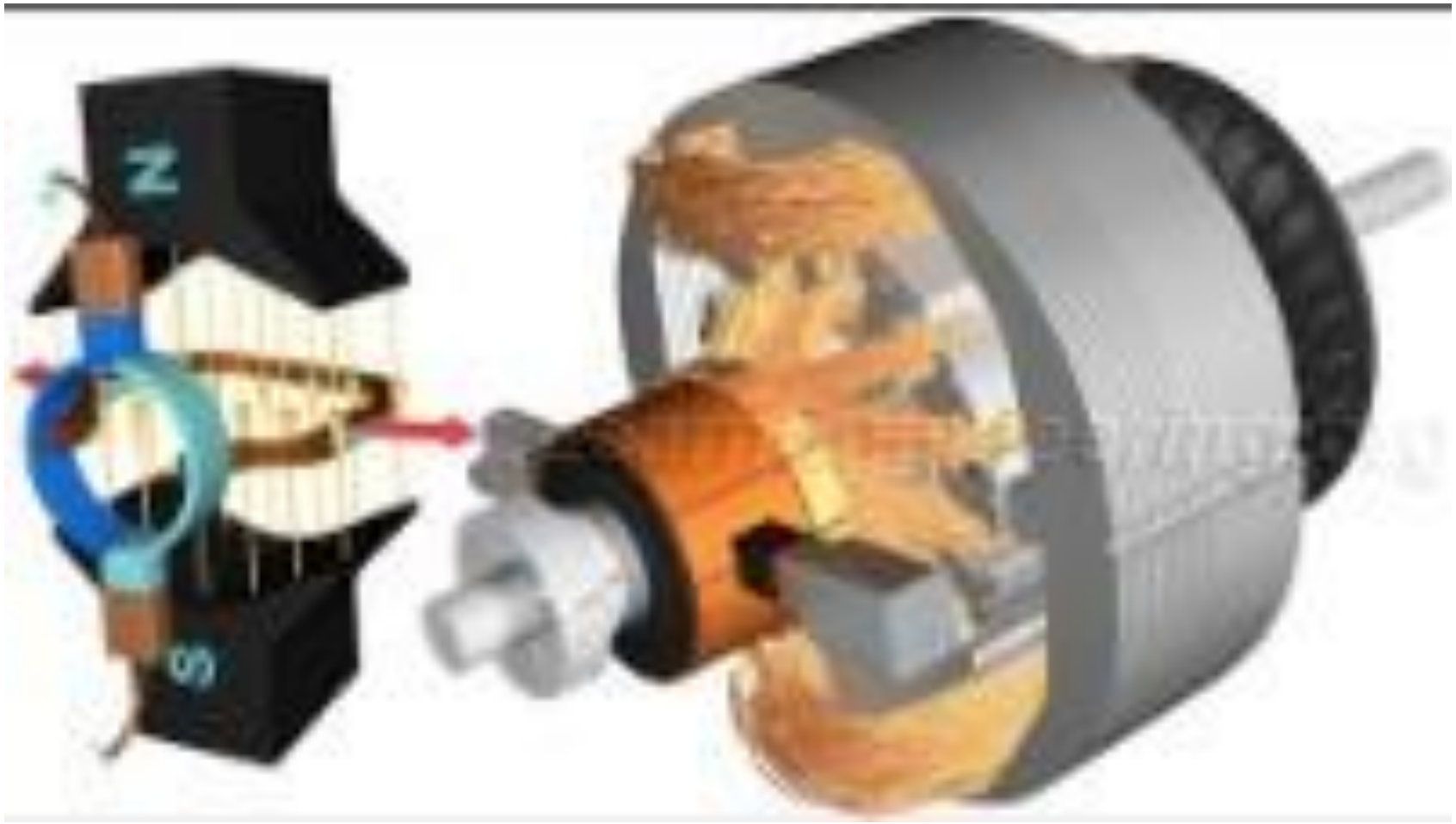
iii) compound generators:-

i) Compound generators are used where constant terminal voltages have to be maintained for different loading conditions.

ii) Cumulatively compound generators:-These are for domestic lighting purposes and to transmit energy over long distance and for heavy power service such as electric railways.

iii) Differential compound generator:- The use of this type of generators is very rare and it is used for special application like arc welding.

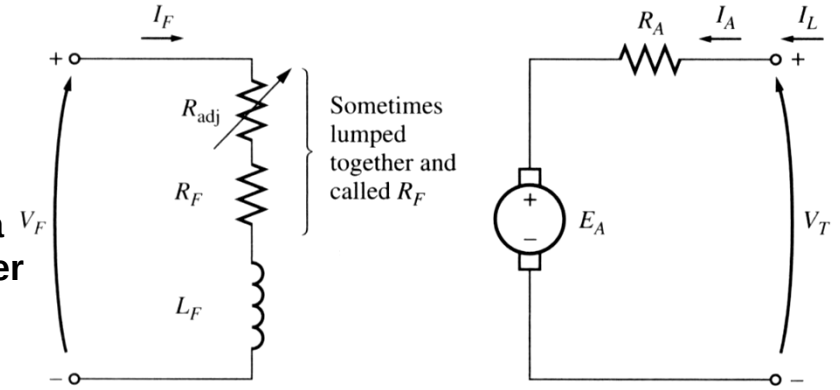
Motors



Video

Motor types: Separately Excited DC motors.

Separately excited DC motor:
a field circuit is supplied from a separate constant voltage power source.



The Equivalent Circuit of Separately Excited dc Motor.

From the above figure,

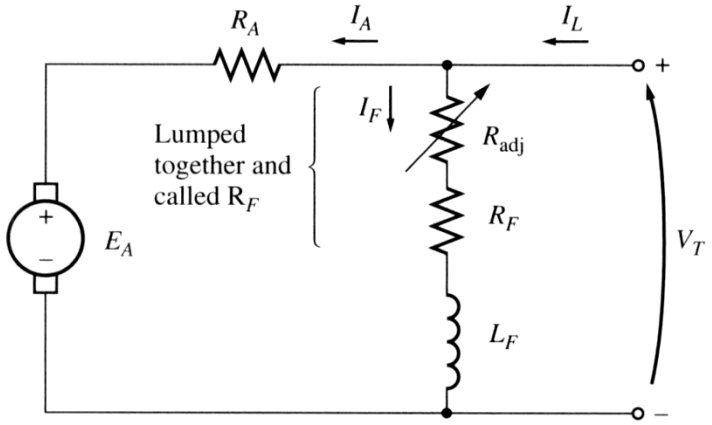
$$I_F = \frac{V_F}{R_F}$$

$$V_T = E_A + I_A R_A$$

$$I_L = I_A$$

Motor types: Shunt DC motors.

Shunt DC motor:
a field circuit gets its power from the armature terminals of the motor.



The Equivalent Circuit of a Shunt dc Motor.

- From the above figure, $I_F = \frac{V_F}{R_F}$

$$V_T = E_A + I_A R_A$$

$$I_L = I_A + I_F$$

Summary

- Elementary generators
- Construction of a DC machine
- Types