

No class on 8th Jan.
Make-up on 10th Jan. @ 7

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Date	

EML (Power electronics)

* Why laptop power is so light?

India, avg Power generating 300 Gigawatts.
abt 70% consumed by motors (industrial) (Induction Machines).

$$T_L \propto \omega_r^2 \quad (\text{Pump \& fan, Load Torque})$$
$$P \propto \omega_r^3 \quad (I \omega)$$

* 4 pole, 50Hz, 1485 rpm.

↳ Speed of motor at full load

IM can't run at synchronous speed.

$$N_s = \frac{120f}{P} = 1500 \text{ rpm.}$$

At no load, it may run at 1485 rpm.

From No load to full load, red in speed just 30 rpm.
almost 2%.

For practical purposes, IM have almost constant speed, doesn't depend on load.

* How to convert variable freq. & voltages to constant freq. & voltage.

* Transformer & rectifier. 230V \rightarrow 3V DC.

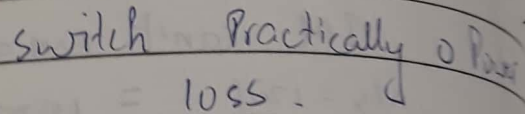
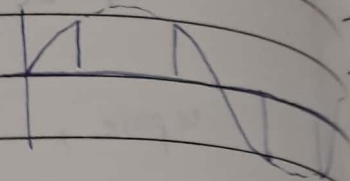
If $f \uparrow$, $N \downarrow$, copper req. \downarrow .

but if $f \uparrow$, loss \uparrow , eddy loss core loss $\propto f, f^2$

* If connecting a IM to 3-phase,
initial current is very high, $I = 6 I_{\text{full load}}$.

2

Reduce f. $\text{SO}_4^{2-} \rightarrow \text{SO}_2$



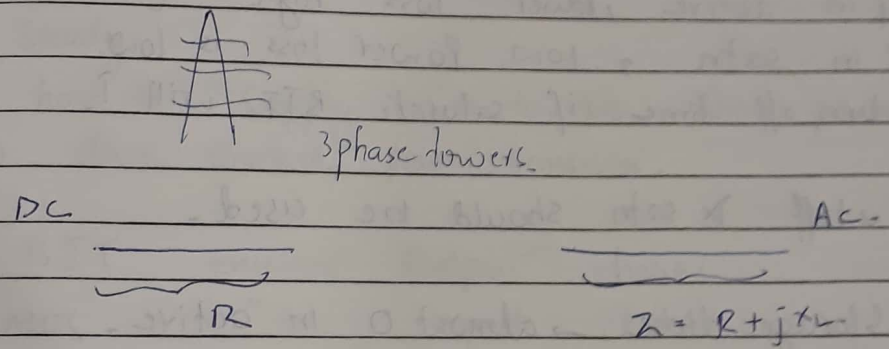
As doping V_I , doping
Base emitter always high.

If fwd bias, can block upto $220\text{Hz} = 330\text{V}$.
In reverse bias, can't block more than 25V .

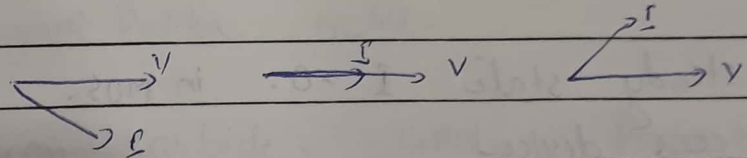
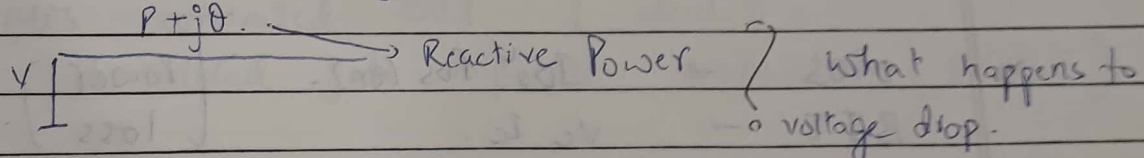
- Scanned by CamScanner

- i) How to vary Nr. of IM or SE (separately excited) DC.
- ii) Reduce weight of Power Supply.
- iii) Limitation of Led lamp.
- iv) Consumer return product.
- v) How to use power from renewable source.
- vi) How to transmit bulk power.

Chandrapur (near Nagpur). Bulk power supply. halogen rectifier. Power transfered as H.Voltage DC.

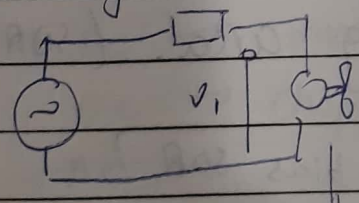


voltage drops.

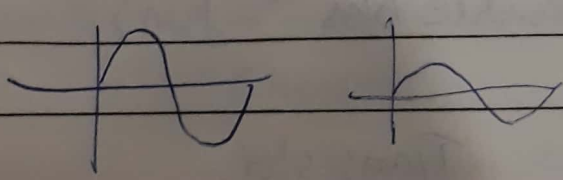


lagging power factor case.

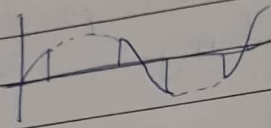
* Fan Regulator



load, speed same. \therefore Rm value of voltage should be same



Output voltage should be AC i.e. Avg is 0. (need not be sinusoidal)



off state \rightarrow Power loss 0.
on-state \rightarrow " " low
 R is very low.

* No BJT in AC, as β_{FE} is highly doped, will not withstand high voltage.

* Active cutoff & saturation.

If in active, Power loss high (β_{FE}).

If in satn, low Power loss is low.

turn off time if saturate BJT will \uparrow .

Cutoff & satn should be used.

Storage time \rightarrow almost 0 in active.
"Quasi-saturation mode".

* MOS $\rightarrow I_D^2$ for (on). (Power loss)
BJT $\rightarrow V_C I_C$.

* at steady state $I = 0$ in MOS.

* BJT, cccs device

BC547.

SL100. n-p-n transistor.

$A = 500$, 0.5A rating.

HAU (H \rightarrow) β - current gain.

Diag \rightarrow Safe operating area. (SOA)

FB SOA. (Fwd. bias SOA)

RB SOA (Reverse bias ").

loss 0.
" low
is very low.
will not

safety margin.

$$\frac{I_c}{\beta}$$

gain-6-8.

steady state

$$I_B \approx I_A$$

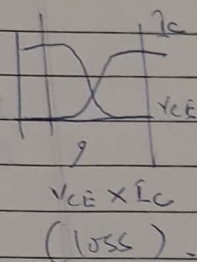
Fast reg.

faster turn-on & turn-off.

∴ loss during turn on.

can reduce by having fast turn-on.

If I the I_B , turn-on time reduce.



Steady

have to supply 1.5A to I_B . One power transistor to drive another power transistor.

* BJT excellent output charac.
MOS " input charac.

* MOS controlled BJT (ideal)
Insulated gate bipolar transistor (IGBT)

Prof. Jayant Balika. NCSU.

Silicon carbide, GAN. Device + Power
(Self Study).

AC → converter → DC (avg. value is finite).

DC → inverter → AC (" " " 0)

DC → Chopper → (DC variable).

AC → → AC (freq. = const)

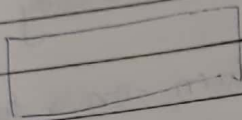
low power ⇒ (MPS) → switched mode power supply

high " ⇒ Chopper.

chopper fed DC motor.

highly efficient, compact, light-weight, pay-back less
Power electronics.

AC →



→ AC (freq. = const) = Phase

AC (V-V-V-f) - controller

Matrix converter.

AC (f=c), Phase controller.

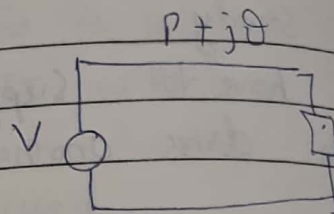
AC (V-V-V-f), Matrix converter.

(variable voltage variable frequency)

New day

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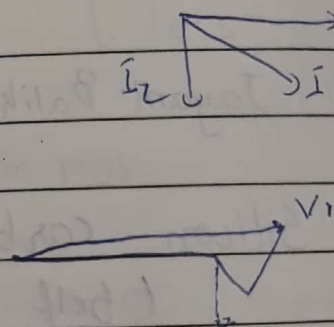
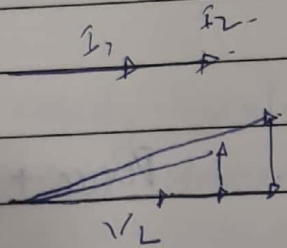
DC

As $\theta \uparrow$, for a given V ,

No need to transmit Reactive Power - can generate locally by using a capacitor.

$$I_c = \frac{V_L}{X_c}$$

V is fixed.

 V_L is \downarrow with θ .

V is fixed, $V_L \downarrow$, $\Rightarrow \theta \uparrow$ (Reactive power demand \uparrow)

As V_L is \downarrow , $I_c \downarrow$,

capacitor expected to supply θ , but not able to supply - unreliable friend.

System require high I_c .