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

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IML (Power electronics)

* Why laptop power is so light?

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

$T_L \propto \omega_r^2$ (Pump & fan, Load Torque).
$P \propto \omega_r^3$ $(T\omega)$.

* 4pole, 50Hz, 1455 rpm.
  ↳ speed of motor at full load.

IM can't run at synchronous speed.

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

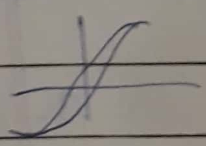
At no load, it may run at 1485 rpm.
From No load to full load, red in speed just 30rpm.
almost 2%.

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 → 3V DC.

If $f\uparrow$, $N\downarrow$, copper req. $\downarrow$.
but if $f\uparrow$, loss$\uparrow$, eddy loss core loss $\propto f, f^2$

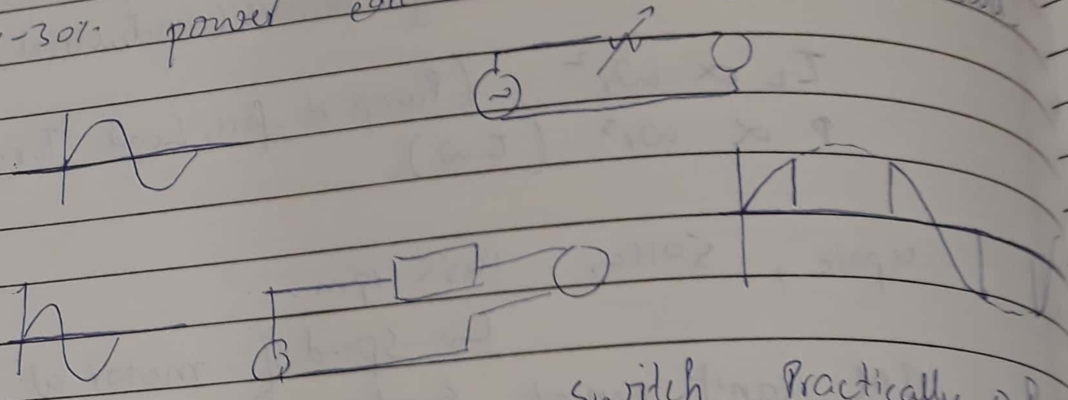


* If connecting a IM to 3-phase, initial current is very high, $I = 6\, I_{full\ load}$.

Why I.P. 2 bcz of very high R. Speed, a.h. voltage is induced in rotor.

Reduce the Ns. $\frac{120f}{P}$. Reduce f. 50Hz → 5Hz

28-30% ~~power~~ can be saved by a soft start



switch Practically 0 Power loss.

Q Can I use AC to

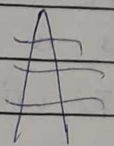
~~at doping~~ VI, doping
Base emmitor always high.

If fwd bias, can block upto 220fz = 330V.
In reverse bias, can't block more than 25V.

1. M.H. Rashid. - "Power electronics: Circuits, Devices & Application"
2. Ned Mohan, "Power electronics, Applications & design".
3. Cyril Lander, "Power electronics".

* i) How to vary Nr. of IM or SE (seperately 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.

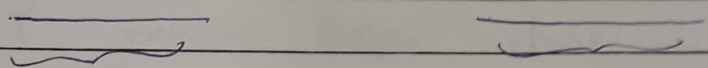
* Chandrapur (near Nagpur). Bulk power supply. kalyan recieves. Power tranfered as H.Voltage DC.



3phase towers.

DC

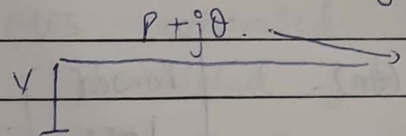
AC.



R

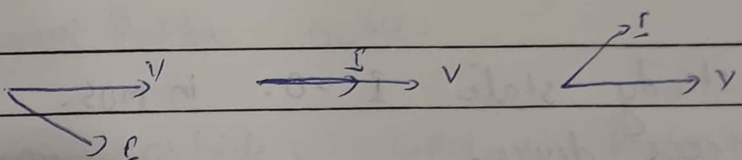
$Z = R + jX_L$

voltage drops.



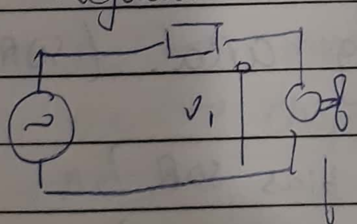
$P + jQ$ → Reactive Power — What happens to voltage drop.

Padh le beta-



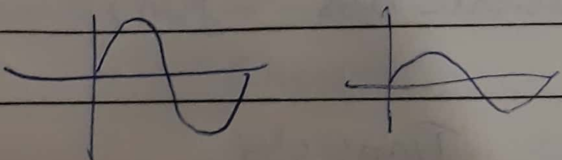
lagging power factor case.

* Fan Regulator :-



Load, speed same. ∴ RM[S]
value of Voltage should be sa[me]

Output voltage should be A[C]
i.e. Avg is 0. (need not be sinosudal



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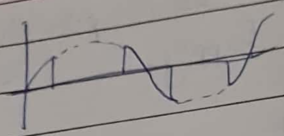
off state → Power loss 0
on-state → " " low
R is very low.



* No BJT in AC , as BE is highly doped , will not withstand high voltage.

* Active cutoff & saturation.

if in active , Power loss high (BCE).
if in satn , low Power loss is low.
if in satn BJT will ↑ turn off time if saturate

Cutoff & satn should be used.

Storage time → almost 0 in active.
"Quasisaturation mode".

* MOS → $I_{DS}^2 r_{DS(on)}$. (Power loss).
BJT → $V_C I_C$.

* at steady state I = 0. in MOS.
* BJT, CCCS device
BC547. SL100. n-p-n transistor.
A<500, 0.8A rating.

HAV (H/W) β - current gain.
Diag → Safe operating area. (SOA)

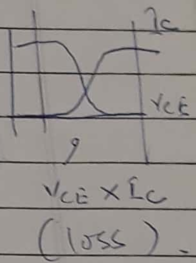
FB SOA. (Fwd. bias SOA)
RB SOA (Reverse bias ").

safety margin.

$\frac{I_C}{\beta}$ gain-6-8. steady state $I_B \approx 1A$

fast req. faster turn-on & turn-off.

∴ loss during turn on.
can reduce by having fast turn-on.
If ↑ 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 ⇒ SMPS → switched mode power supply
high " ⇒ Chopper.
chopper fed DC motor.

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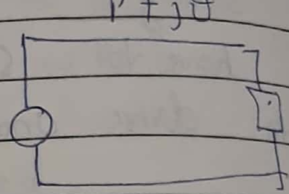
highly efficient, compact, light-weight, Pay-back Per power electronics.

AC → [ ] → AC (freq = const) = Phase
AC (V-V-V-f) controller
Matrix converter.

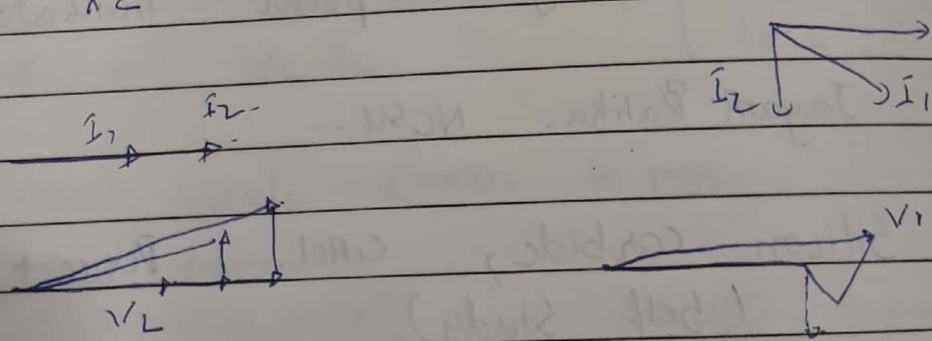
If AC (f=c), Phase controller.
If AC (V-V-V-f), Matrix converter.
(variable voltage variable frequency)

As θ ↑, 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 ↓ with I_L.



V is fixed, V_L ↓, ⇒ θ ↑ (Reactive power demand ↑

As V_L is ↓, I_c ↓,
capacitor expected to supply θ, but not able to supply. unreliable friend.

System require high I_c.