Lecture-1) Introduction

* What is PE
* Converter Types
* Major Components
* Applications

PE } Processing Power
I/P } electrical
O/P } electrical

DC - DC
DC - AC
AC - DC
AC - AC
} 4 combinations

1) Conversion among the 4 combinations

DC-DC (Solar)
AC-AC (Ceiling Fan)

EV } Battery : 300-400V
Other comps need 5-12V
} DC-DC converters

2) Control : (Voltage / Current)

3) Conditioning : Switching is done } KHz, MHz
(Waveforms Become rough; pulses)

Vo  actual avg. needed

Before PE } DC-DC Conv. } ⇒ DC motor (E→M) (Noisy, Slow, Huge)
↓
Generator (M→E) (Instead: Small PE Converters)

Bigger Regulators (non-PE) } ⇒ Used Earlier

Power gen. in Thermal plants } very inefficient

Renewable energy } Uses PE

Advantages:

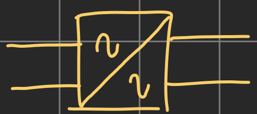
- More efficient
- Smaller
- Faster
- Static
- Directional

Disadvantages:

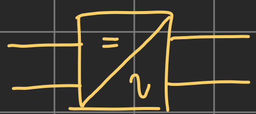
- Poor Quality
- Complex

Converter Types:

AC/AC : Converter

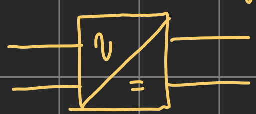


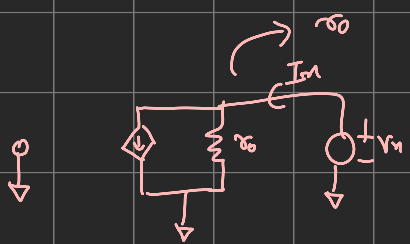
DC/AC : Inverter



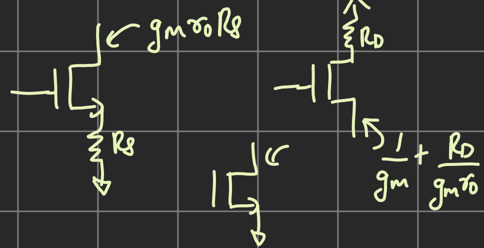
DC/DC : Chopper

AC/DC : Rectifier





Motor Choice : PMSM (Permanent Magnet Synchronous Machine)

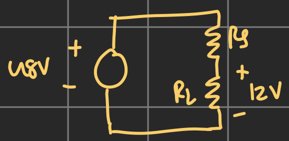


Solar Power } DC

For Appliances, DC − AC Conversion

* Design system to Convert 48V DC to 12V DC

Voltage divider:



Drawbacks:

* if R_L varies, to keep $V_o = 12V$, R_s needs to vary

$$\frac{48}{(R_s+R_L)} = I$$

$$P_{in} = \frac{(48)^2}{(R_s+R_L)}$$

$$P_{out} = \frac{(48)^2 R_L}{(R_s+R_L)^2}$$

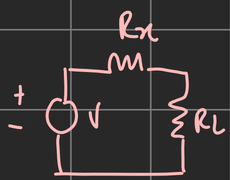
$$\frac{\cancel{(48)^2} R_L}{(R_s+R_L)^2} \times \frac{\cancel{(R_s+R_L)}}{\cancel{(48)^2}}$$

$$\Rightarrow \frac{R_L}{(R_s+R_L)} \quad \% \text{ efficiency}$$

(Common drain ckt)

Analog ckts:

- Series/Shunt regulator



$$\frac{V}{(R_x+R_L)}$$

$$P_L = V_{rx} \times I_{rx}$$
$$= I_{rx}^2 R_x$$
$$P_L = \frac{V^2 R_x}{(R_x+R_L)^2}$$

$R_x \to 0$, $R_x \to \infty$ (can become 0)

(Switch between these; indefinitely)