**EE2029: Introduction to Electrical Energy System**

# What is the Complex Power of a Generator?

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# Learning Outcomes

- Single Phase Complex Power
- Three Phase Complex Power
- Steady State Operation

# Complex Power Supplied

- Complex power 'S' supplied by a generator can be calculated.

- Using the equivalent circuit to find complex power in terms of excitation voltage 'E', terminal (grid) voltage 'V', and synchronous reactance 'X'.

- Typically, the resistance 'R' in the armature winding is negligible when compared to a synchronous reactance. **In this analysis, we omit the resistance**.
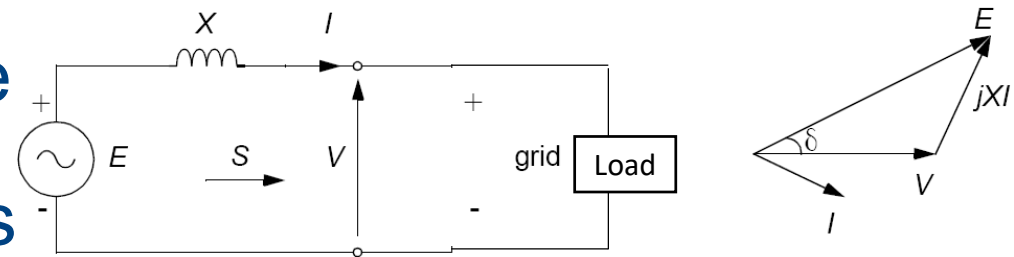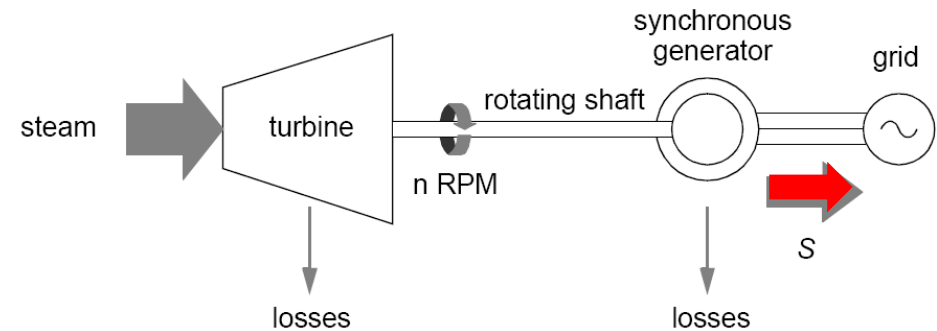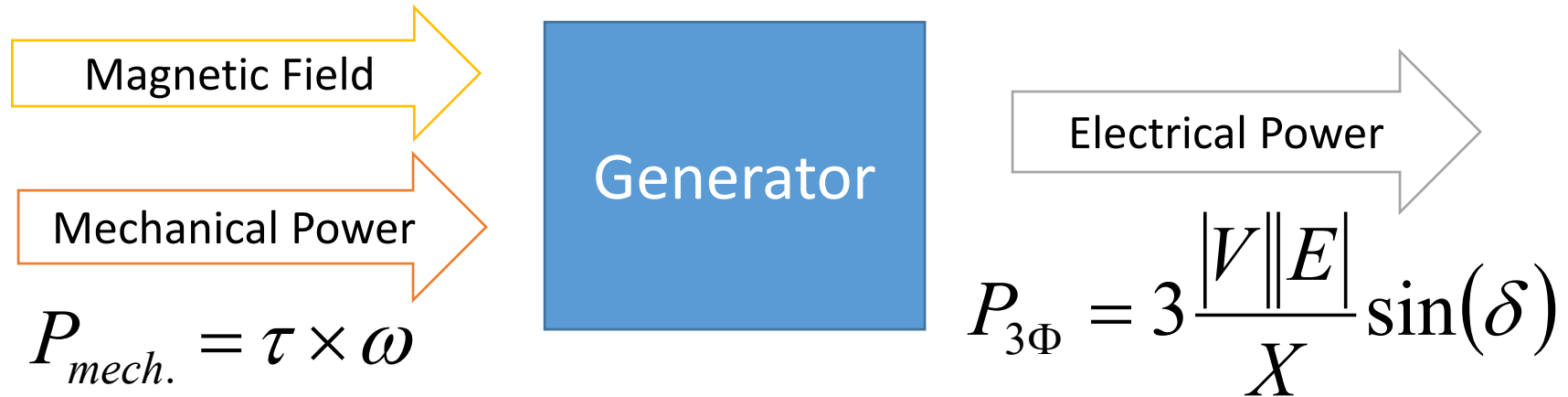
# Complex Power Supplied Per Phase
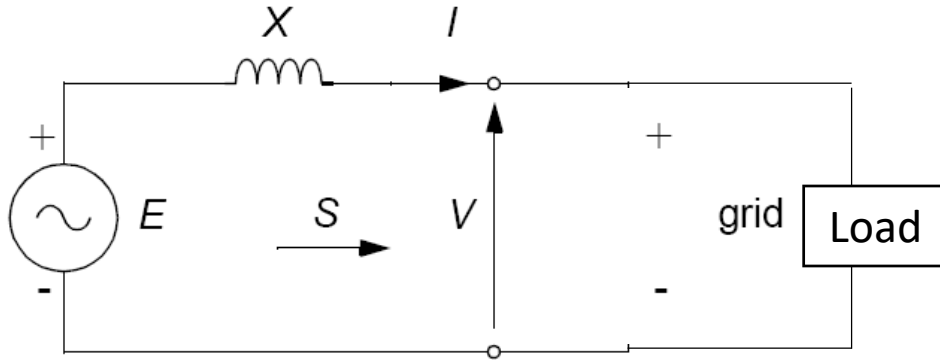
# Complex Power Supplied <u>Per Phase</u>

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# Three-Phase Complex Power Supplied

- We have,

# Steady State Operation

Magnetic Field

Mechanical Power

Generator

Electrical Power

$$P_{mech.} = \tau \times \omega$$

$$P_{3\Phi} = 3\frac{|V||E|}{X}\sin(\delta)$$

- When electrical load is increased, we need to increase mechanical power input.
- The speed of the rotor (ω) needs to be constant because rotor speed determines the voltage frequency and the frequency needs to be kept **constant.**
- We can only increase the **mechanical 'Torque'** to supply additional electrical load while maintaining the same speed.

# Summary