Mechanical-to-Electrical Energy Conversion

4. Fundamental of ac generators

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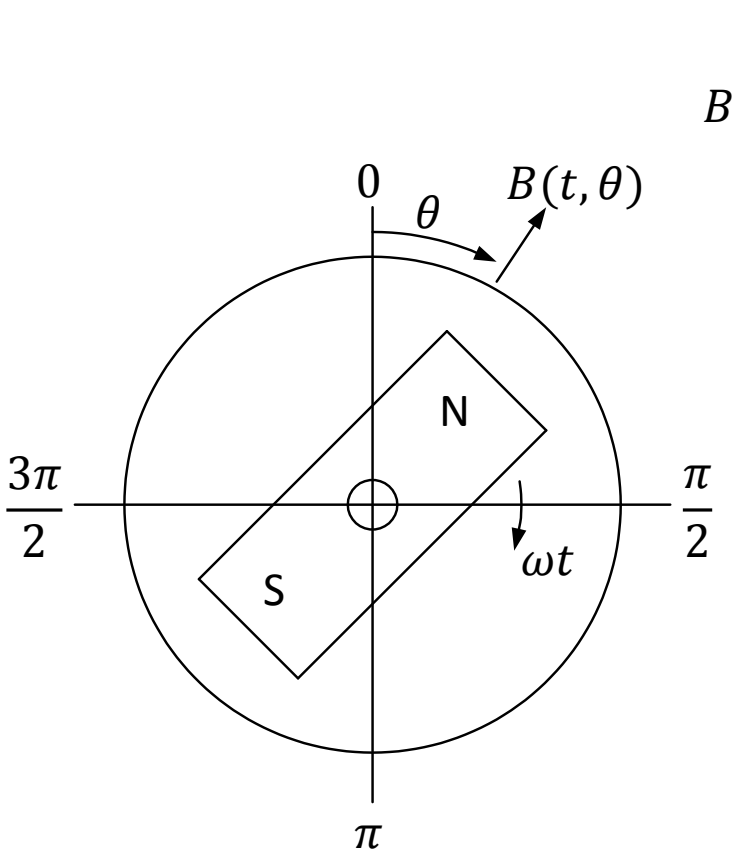
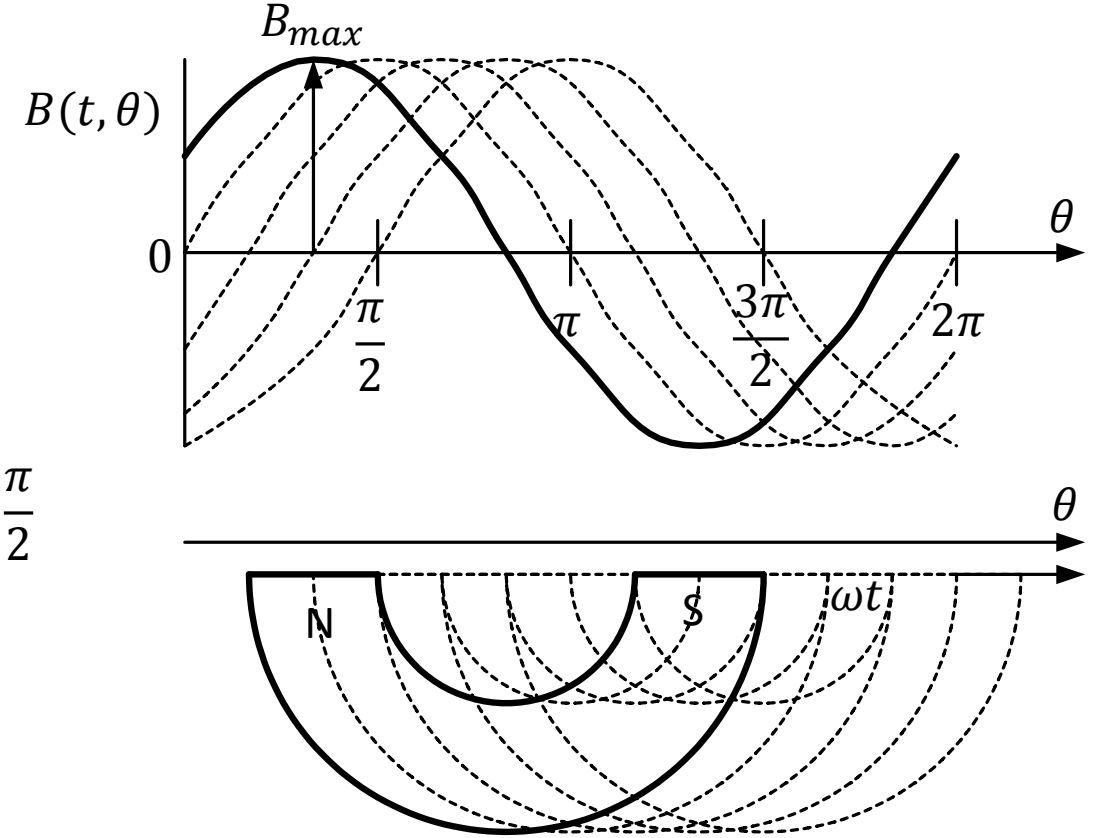
Contents Today

1. Rotating magnetic field
2. Principle of torque generation
3. Electromotive force in ac machine

Rotating Magnetic Field

- Observe flux density at an angle θ
- Sinusoidal Flux density $B(t,\theta)$





Analysis of Magnetic Field

- Simple addition theorem in trigonometry

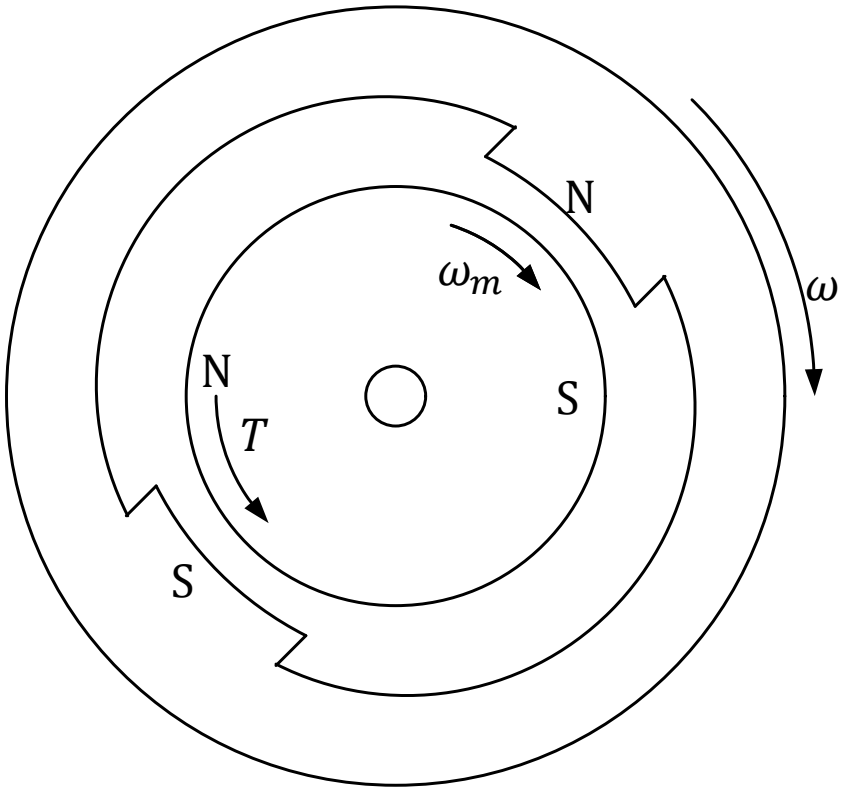
$$B(t,\theta) = B_{max}\cos\theta\cos\omega t$$
$$= \underbrace{\frac{B_{max}\cos(\theta-\omega t)}{2}}_{\text{Clockwise}} + \underbrace{\frac{B_{max}\cos(\theta+\omega t)}{2}}_{\text{Counterclockwise}}$$

- Composed of two rotating components

Torque Cylindrical Magnet

Rotating velocity $\omega = \omega_m$:
Lagging Rotating Magnetic Field:
Counter Clockwise Torque
Generator $T > 0$
Leading Rotating Magnetic Field
Clockwise Torque
Motor $T < 0$

Rotating velocity $\omega \neq \omega_m$:
The average torque becomes zero.
$T = 0$



To be Continued in the Lecture…..