# EN 206: Power Electronics and Machines

## Electro-Mechanical Energy Conversion Principles

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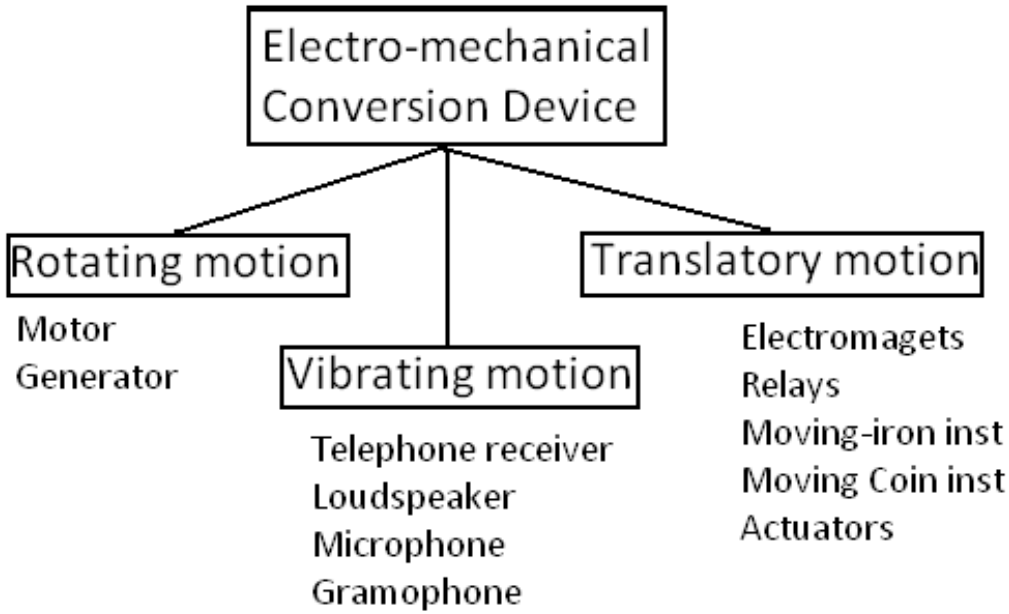
# Conversion Devices

- A device which converts electrical energy into mechanical energy or vice-versa is called electro-mechanical energy conversion device




Why Most of the electromechanical energy converions devices use magnetic field as coupling medium?

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- For Generator action: Total mechanical input = Mechanical energy output + total energy stored + total energy dissipated

# Torque Production

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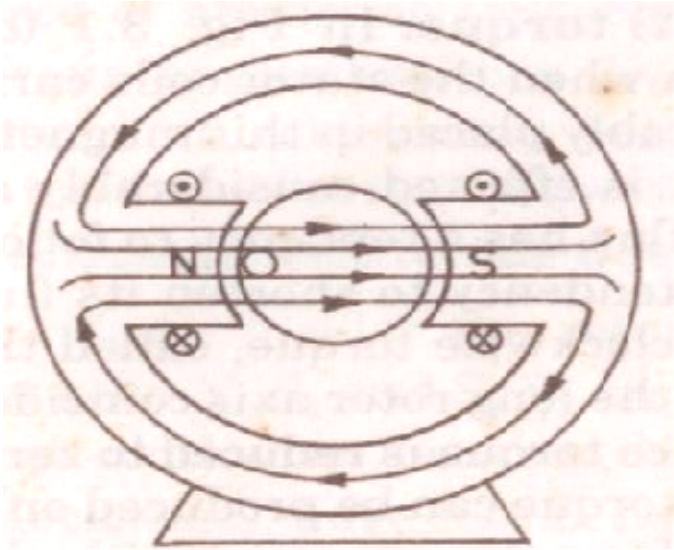


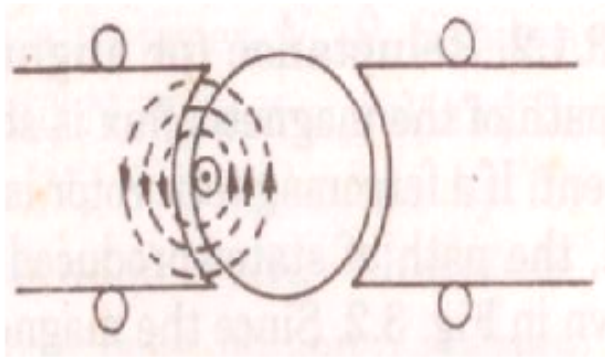

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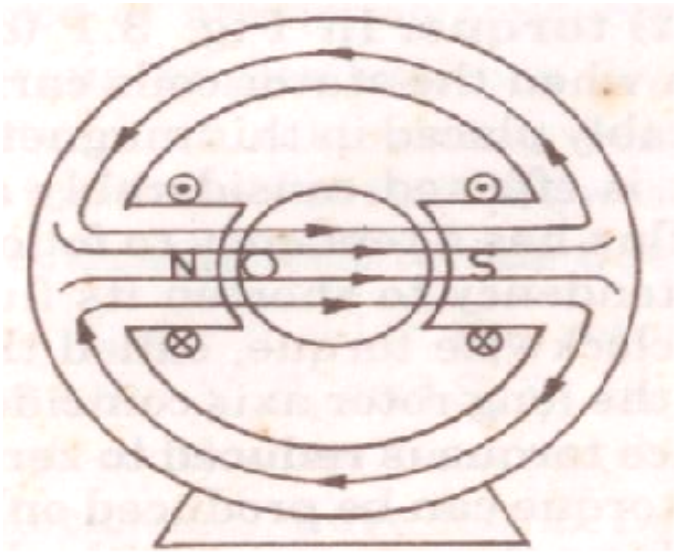


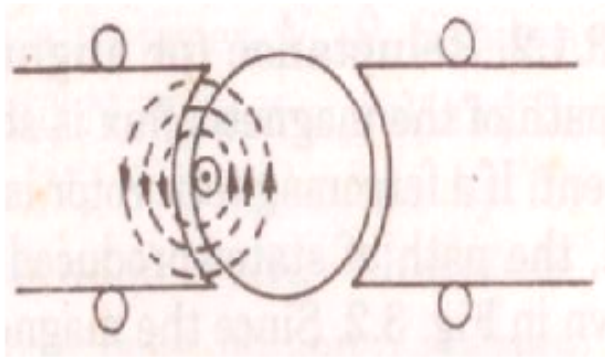

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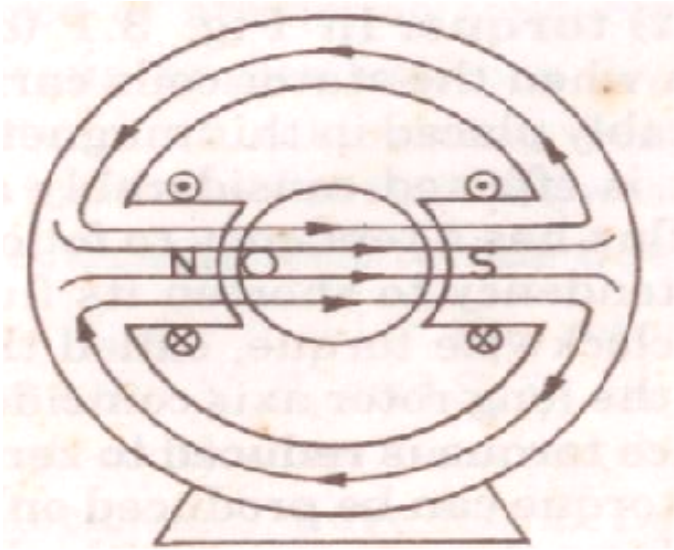
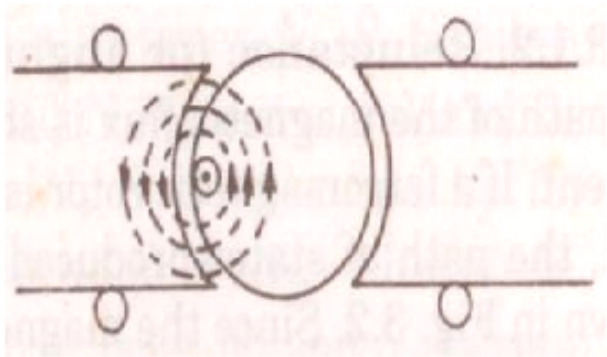
- The tendency of the two fields to align themselves in the same direction is called interaction torque.



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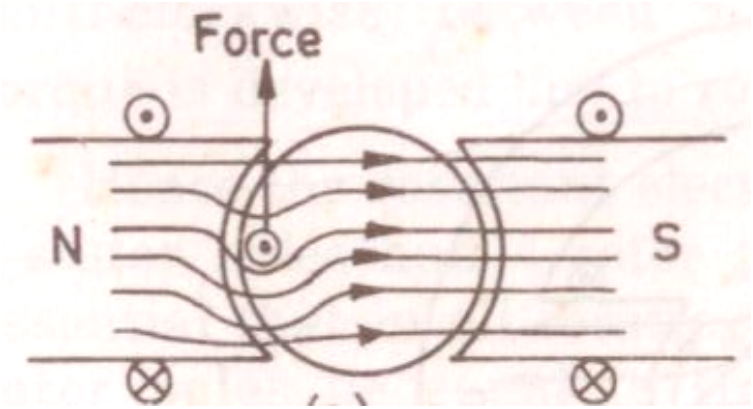


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$T_e$ is proportional to (stator field strength)x(Rotor field strength)xsin($\delta$)

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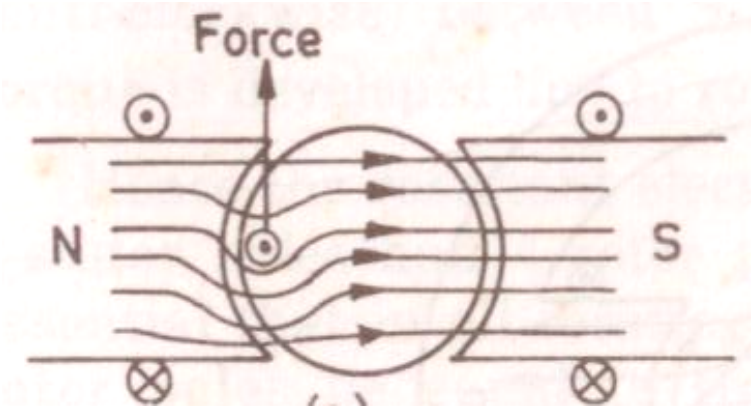


- The angle between stator-field axis and rotor field axis is called rotor torque angle $\delta$.
- The magnitude of electromagnetic or interaction torque in all rotating machines is given by :

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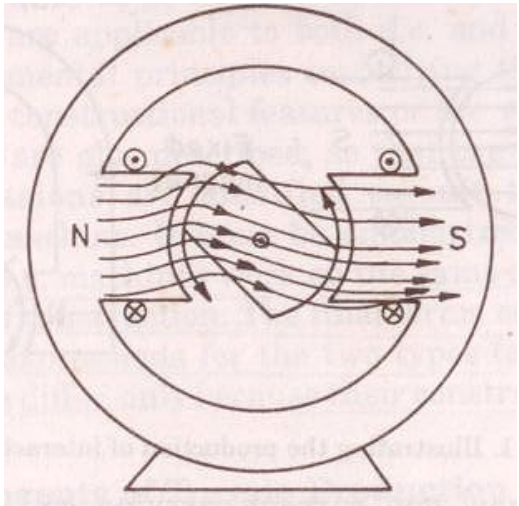
# Reluctance Torque

- When a ferromagnetic rotor is placed in magnetic field, the path of stator-produced flux is effected considerably and the magnetic flux has a tendency to follow minimum reluctance path and hence the rotor experiences a torque called reluctance torque.



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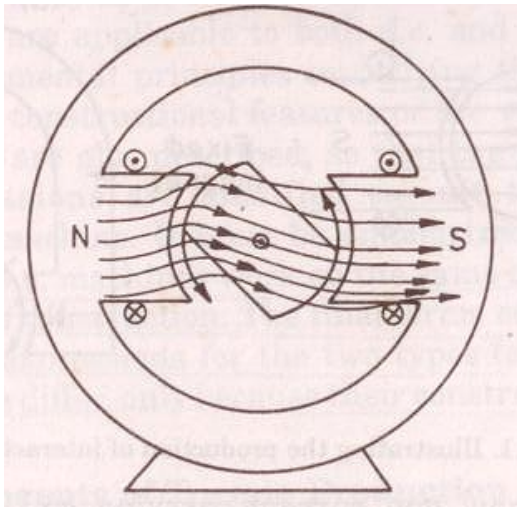

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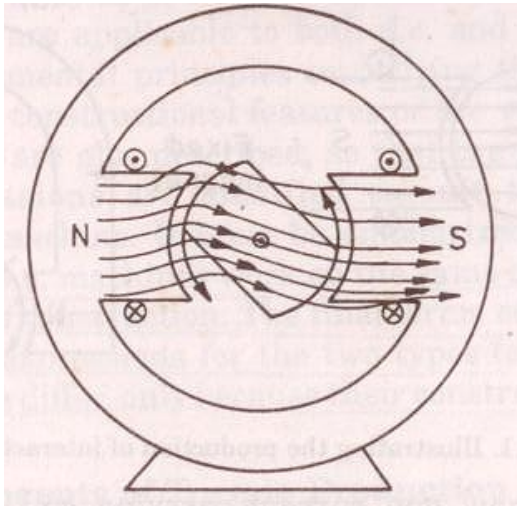
- Alternate north and south poles are placed $90^0$ apart mechanically in rotor circuit



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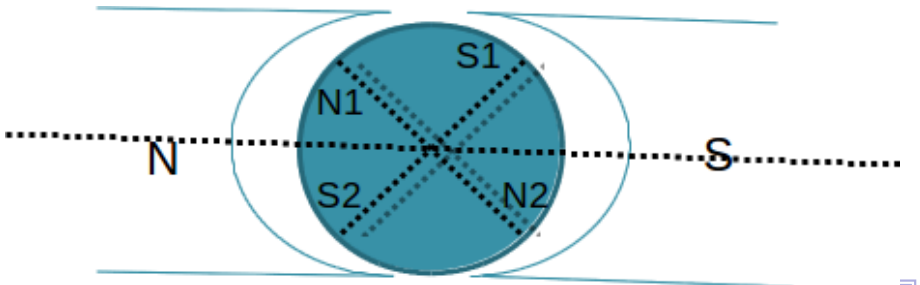

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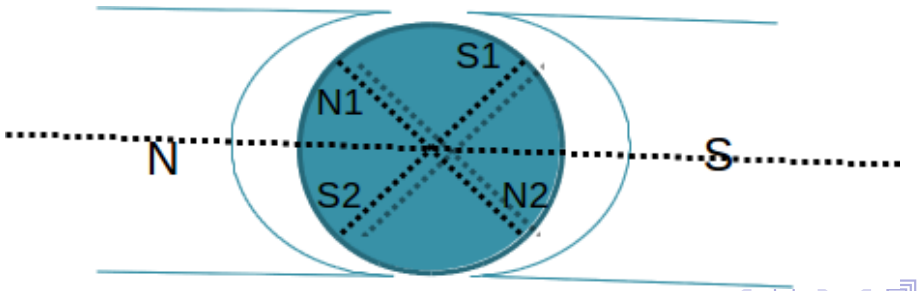

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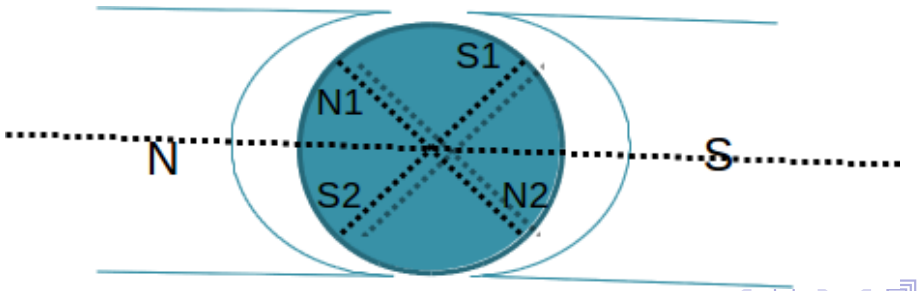

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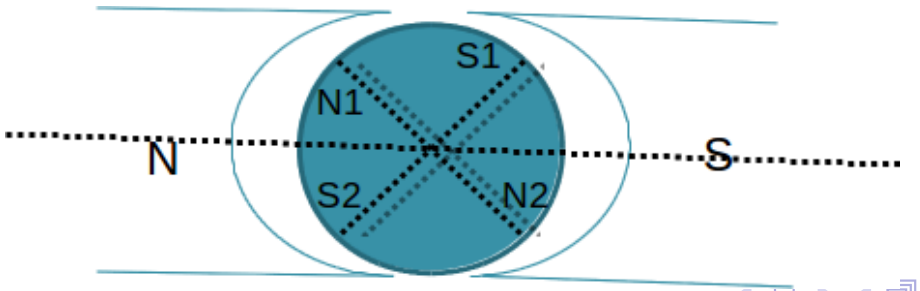

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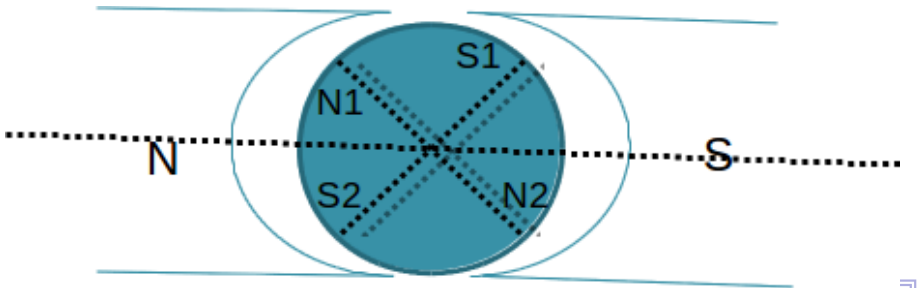

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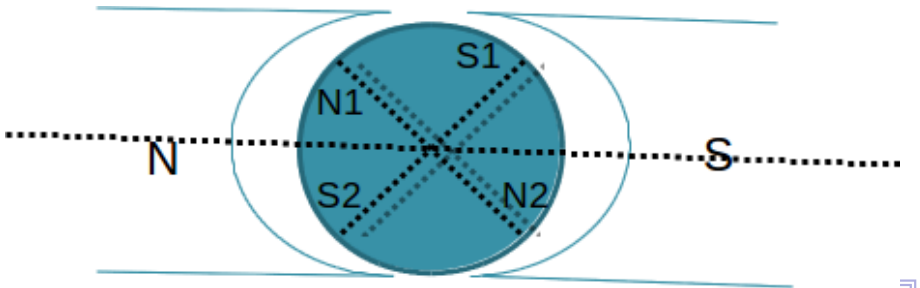

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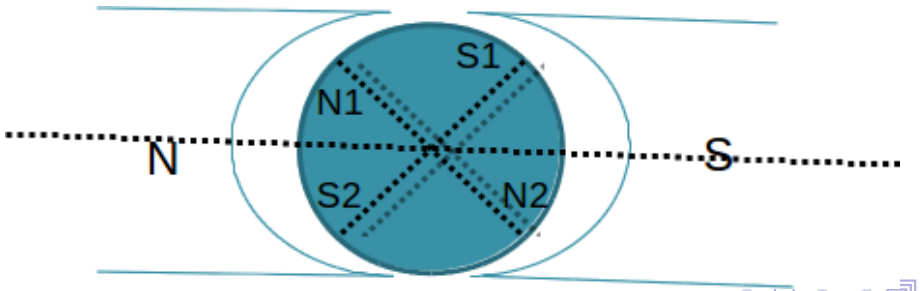
  - Shaft, Bearing, foundation etc.



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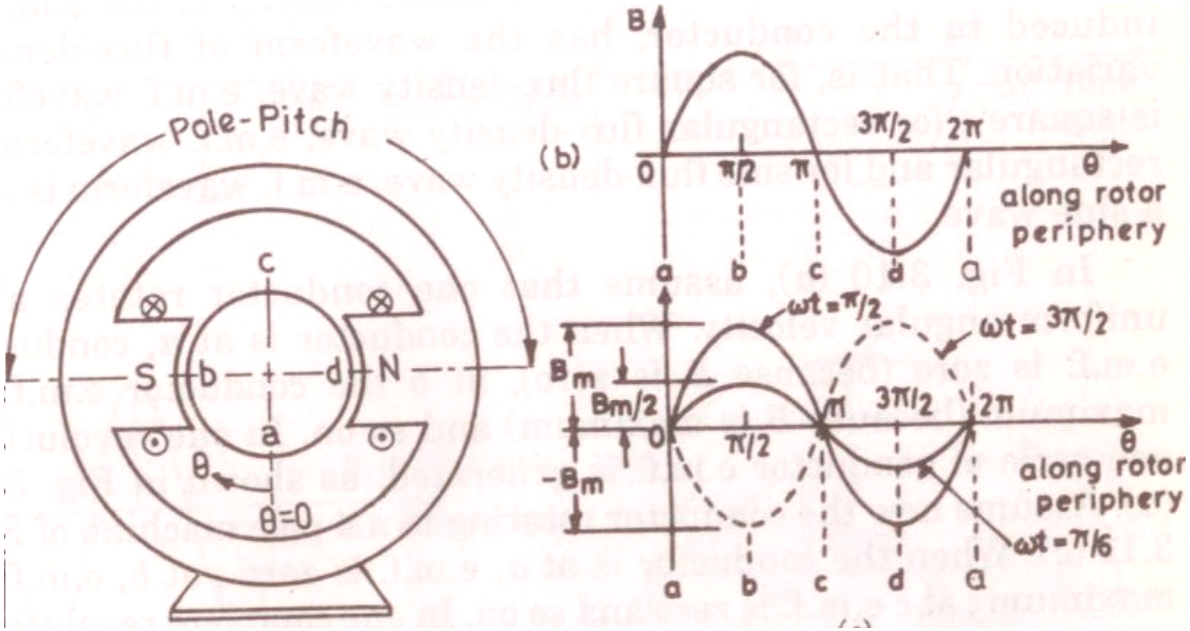
- For cooling: radial and axial ventilating ducts

# EMF Generation

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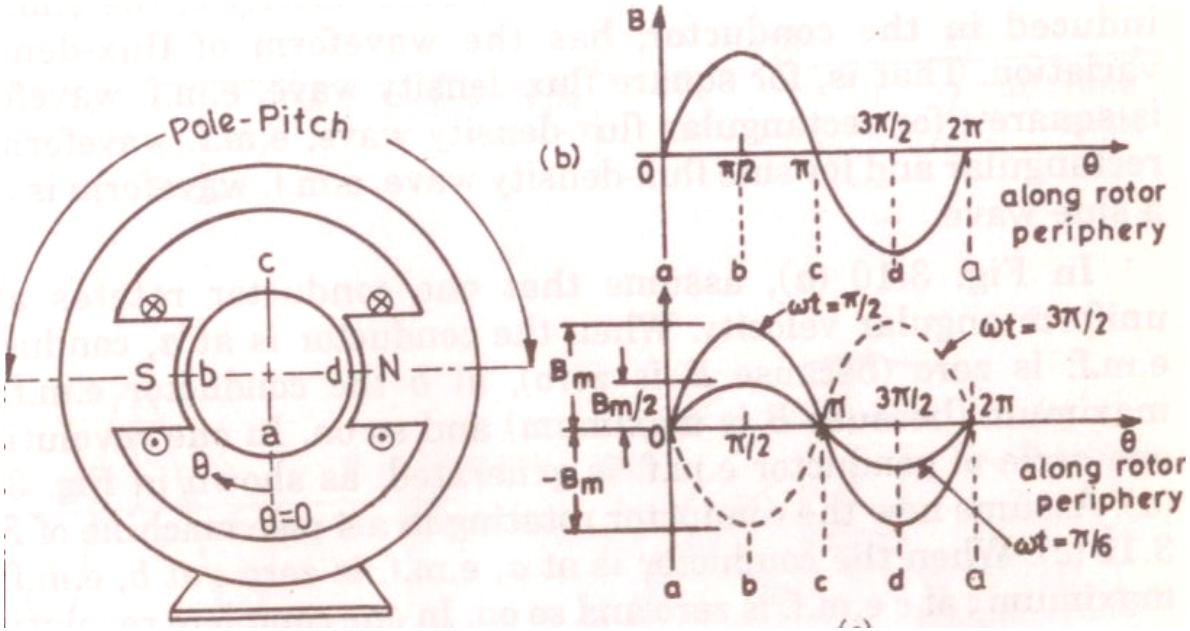


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- The variation of flux long the periphery is assumed sinusoidal and hence in elementary machine, the flux density is sinusoidally distributed in space.

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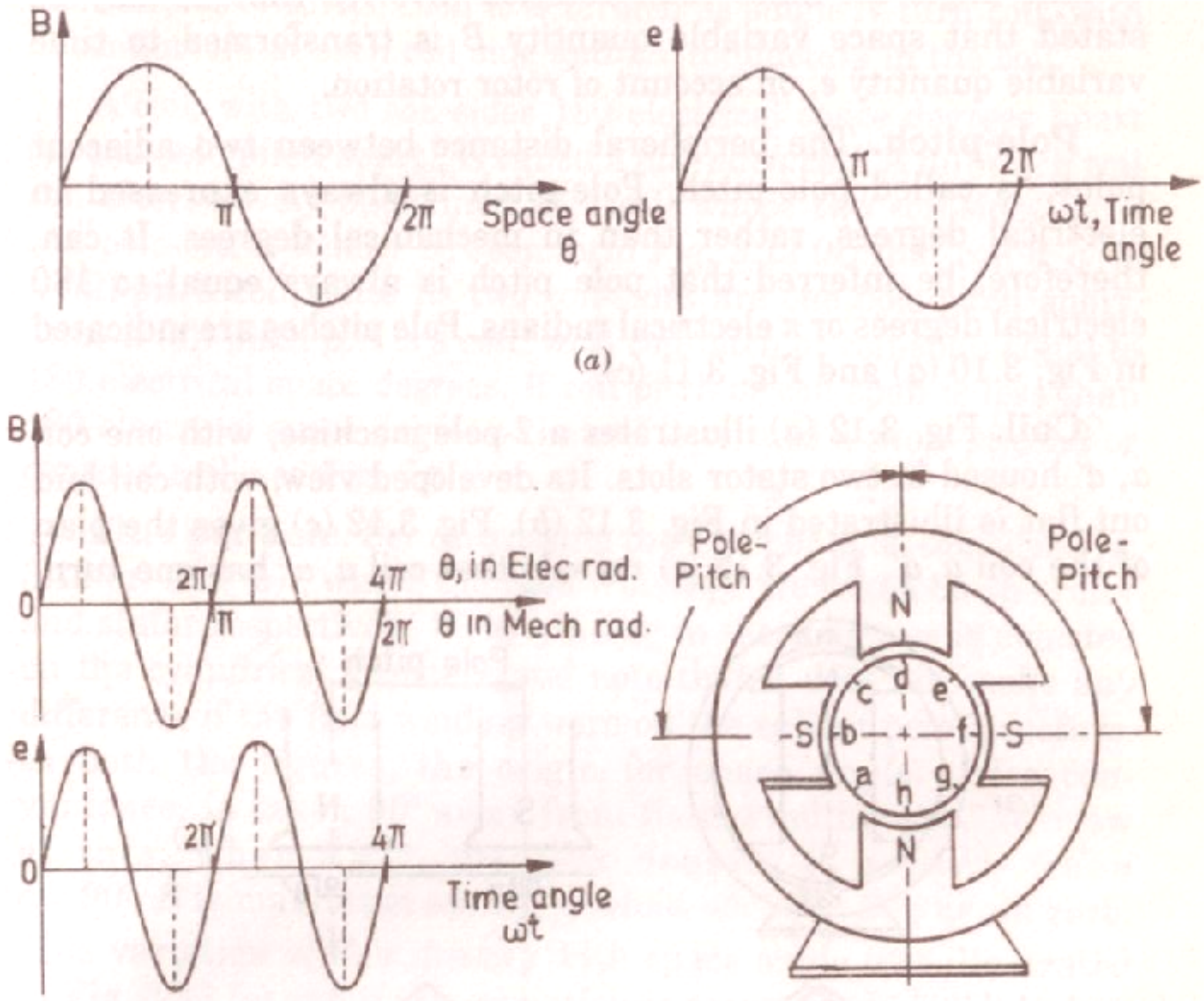

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- The emf waveform induced in the conductor rotating along the airgap periphery takes the shape of flux distribution.

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Also,

$$\frac{d}{dt}(\theta_{electrical}) = \frac{P}{2}\frac{d}{dt}(\theta_{mechanical})$$

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Where $\omega$ and $\omega_m$ is angular speed in electrical radians/sec and mechanical radians/sec.

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- **Pole Pitch** is defined as the peripheral distance between two adjacent poles. It is generally expressed in electrical degrees and is equal to $180^o$.