# Electric Machines and Power Systems
## Summary of
## Chapter 1: Introduction to Machinery Principles

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| **Electrical Machines** | Transformer, Motor, Generator |
| **Rotational Motion** | Angular position $\theta$ (radians or degrees)<br>Angular velocity $\omega_m = d\theta / dt$ (radians per second)<br>Angular velocity $f_m = \omega_m / 2\pi$<br>Angular velocity $n_m = 60 f_m$<br>Angular acceleration $\alpha = d\omega_m / dt$ (radians per second square)<br>Torque $\tau = rF\sin\theta$ (Newton-meters) |
| **Newton's Law of Rotation** | $F = ma$ (object moving along straight line)<br>$\tau = J\alpha$ ($J$ is moment of inertia) (rotating object) |
| **Work** | $W = \int F dr$<br>$W = \int \tau d\theta$ |
| **Power** | $P = \frac{dW}{dt} = Fv$<br>$P = \frac{dW}{dt} = \tau\omega$ |
| **Magnetic Field** | A current-carrying wire produces a magnetic field in the area around it.<br>A time-changing magnetic field induces a voltage in a coil or wire if it passes through that coil or wire (basis of **transformer** action).<br>A current-carrying wire in the presence of a magnetic field has a force induced on it (basis of **motor** action)<br>A moving wire in the presence of a magnetic field has a voltage induced in it (basis of **generator** action). |
| **Production of Magnetic Field** | Ampere's Law: $\oint \mathbf{H}.dl = I$<br>$\mathbf{B} = \mu\mathbf{H}$ (**B** magnetic flux density; **H** magnetic field intensity)<br>$\phi = \int_A \mathbf{B}.dA = BA$ |
| **Magnetic Circuits** | $V = IR$; $\mathfrak{I} = Ni$ ($\mathfrak{I}$ magnetomotive force)<br>$\mathfrak{I} = \phi R$ |
| **Faraday's Law** | $e_{ind} = -N\frac{d\phi}{dt}$ ($e_{ind}$ = voltage induced in the coil) |
| **Production of Induced Force on a Wire** | $\mathbf{F} = i(\mathbf{l} \times \mathbf{B})$<br>$F = ilB\sin\theta$ |
| **Induced Voltage on a Conductor Moving in a Magnetic Field** | $e_{ind} = (\mathbf{v} \times \mathbf{B}).\mathbf{l}$ |
| **Real Power** | $P = VI$ (DC circuit) |

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| **AC Average Power Or Real Power** | $P = VI\cos\theta$ |
| **Reactive Power** | $Q = VI\sin\theta$ |
| **Complex Power** | $\mathbf{S} = P + jQ$ |
| **Impedance Angle** | $I = \frac{V}{Z} = \frac{V\angle 0^o}{\lvert Z\rvert\angle\theta} = \frac{V}{\lvert Z\rvert}\angle -\theta$ |
| Power Factor | $PF = \cos\theta$ |