



Induction Motor Circuit Formulas

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Examples!

Conversions!

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List of 28 Induction Motor Circuit Formulas

Induction Motor Circuit (

1) Armature Current given Power in Induction Motor 🛂



 $I_{
m a} = rac{{
m P}_{
m out}}{{
m V}_{
m a}}$

Open Calculator 2

2) Breakdown Slip of Induction Motor

Open Calculator

3) Field Current using Load Current in Induction Motor 🗲

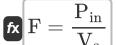
fx $m [I_f = I_a - I_L]$

Open Calculator

0.75A = 3.7A - 2.95A



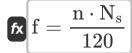
4) Force by Linear Induction Motor



Open Calculator

$$0.296296 ext{N} = rac{40 ext{W}}{135 ext{m/s}}$$

5) Frequency given Number of Poles in Induction Motor



Open Calculator

$$oxed{\mathbf{ex}} 54.66371 \mathrm{Hz} = rac{4 \cdot 15660 \mathrm{rev/min}}{120}$$

fx $m P_m = (1-s) \cdot P_{in}$

6) Gross Mechanical Power in Induction Motor 🔽

$$\mathbf{ex} \ 32.4 \mathrm{W} = (1-0.19) \cdot 40 \mathrm{W}$$

Open Calculator

fx $\mathrm{E_{i}} = \mathrm{V_{s} \cdot B \cdot l}$

Open Calculator

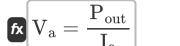
$$4.8654 \mathrm{V} = 135 \mathrm{m/s} \cdot 0.68 \mathrm{T} \cdot 53 \mathrm{mm}$$

7) Induced EMF given Linear Synchronous Speed 🖸



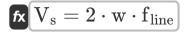


8) Induced Voltage given Power 🗹



Open Calculator

9) Linear Synchronous Speed 🖸



Open Calculator

$$\texttt{ex} \ 135 \text{m/s} = 2 \cdot 150 \text{mm} \cdot 450 \text{Hz}$$

10) Load Current in Induction Motor



Open Calculator

Open Calculator 2

40.44 : 5 : 7 (3)



$$au_{
m run} = rac{3\cdot {
m E}^2}{4\cdot \pi \cdot {
m N_s}\cdot {
m X}}$$

[2.95A = 3.7A - 0.75A]

$$ag{0.181512 ext{N*m}} = rac{3\cdot(305.8 ext{V})^2}{4\cdot\pi\cdot15660 ext{rev/min}\cdot75\Omega}$$





12) Motor Speed given Efficiency in Induction Motor

fx $N_{m}=\eta\cdot N_{s}$

Open Calculator

 $= 14094 \mathrm{rev/min} = 0.90 \cdot 15660 \mathrm{rev/min}$

13) Pitch Factor in Induction Motor

 $K_{
m p}=\cos\!\left(rac{ heta}{2}
ight)$

Open Calculator

 $\boxed{\textbf{ex} \left[0.707107 = \cos\!\left(\frac{90°}{2}\right)\right]}$

14) Power Converted in Induction Motor

 $extbf{P}_{ ext{conv}} = ext{P}_{ ext{ag}} - ext{P}_{ ext{r(cu)}}$

Open Calculator

 $10.45 \mathrm{W} = 12 \mathrm{W} - 1.55 \mathrm{W}$

15) Reactance given Slip at Maximum Torque

 $X = \frac{R}{s}$

Open Calculator

 $\boxed{75\Omega = \frac{14.25\Omega}{0.19}}$

16) Resistance given Slip at Maximum Torque 🗗

fx $R = s \cdot X$

Open Calculator

 $\textbf{ex} \ 14.25\Omega = 0.19 \cdot 75\Omega$

fx $P_{
m r(cu)} = {
m s} \cdot P_{
m in(r)}$

17) Rotor Copper Loss given Input Rotor Power

17) Rotor Copper Loss given input Ro

Open Calculator

 $= 1.482W = 0.19 \cdot 7.8W$

18) Rotor Copper Loss in Induction Motor

 $extbf{F}_{ ext{r(cu)}} = 3 \cdot ext{I}_{ ext{r}}^2 \cdot ext{R}_{ ext{r}}$

Open Calculator

 $\mathbf{ex} \Big[1.55952 \mathrm{W} = 3 \cdot (0.285 \mathrm{A})^2 \cdot 6.4 \Omega \Big]$

19) Rotor Current in Induction Motor

 $\mathbf{K} \mathbf{I_r} = rac{\mathbf{s} \cdot \mathbf{E_i}}{\sqrt{\mathbf{R_{r(ph)}^2 + \left(\mathbf{s} \cdot \mathbf{X_{r(ph)}}
ight)^2}}}$

Open Calculator

ex $0.218591 \mathrm{A} = rac{0.19 \cdot 67.3 \mathrm{V}}{\sqrt{\left(56\Omega\right)^2 + \left(0.19 \cdot 89\Omega\right)^2}}$



20) Rotor Efficiency in Induction Motor

Open Calculator

 $oxed{ex} 0.916347 = rac{14350 \mathrm{rev/min}}{15660 \mathrm{rev/min}}$

21) Rotor Frequency given Supply Frequency 🛂

fx $[f_r = s \cdot f]$

 $\mathbf{ex} \ 10.374 \mathrm{Hz} = 0.19 \cdot 54.6 \mathrm{Hz}$

22) Rotor Input Power in Induction Motor 🗗

fx ${ m P_{in(r)}}={ m P_{in}}-{ m P_{sl}}$

Open Calculator

Open Calculator

Open Calculator

7.8W = 40W - 32.2W

23) Slip given Efficiency in Induction Motor 🖸

fx $|\mathbf{s}=1-\eta|$

0.1 = 1 - 0.90



24) Starting Torque of Induction Motor

 $au = rac{3 \cdot ext{E}^2 \cdot ext{R}}{2 \cdot \pi \cdot ext{N}_{ ext{s}} \cdot \left(ext{R}^2 + ext{X}^2
ight)}$

Open Calculator 🖸

 $= \frac{3 \cdot \left(305.8 \text{V}\right)^2 \cdot 14.25 \Omega}{2 \cdot \pi \cdot 15660 \text{rev/min} \cdot \left(\left(14.25 \Omega\right)^2 + \left(75 \Omega\right)^2\right)}$

25) Stator Copper Loss in Induction Motor

 $\left| \mathbf{F}_{\mathrm{s(cu)}} = 3 \cdot \mathrm{I_{s}^{2}} \cdot \mathrm{R_{s}}
ight|$

Open Calculator

 $\mathbf{ex} \left[13.98037 \mathrm{W} = 3 \cdot (0.85 \mathrm{A})^2 \cdot 6.45 \Omega \right]$

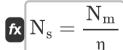
26) Synchronous Speed in Induction Motor

 $N_{
m s} = rac{120 \cdot f}{n}$

Open Calculator

 $\boxed{\textbf{ex}} \ 15641.75 \text{rev/min} = \frac{120 \cdot 54.6 \text{Hz}}{4}$

27) Synchronous Speed of Induction Motor given Efficiency



Open Calculator

= $15944.44 ext{rev/min} = rac{14350 ext{rev/min}}{0.90}$





28) Torque of Induction Motor under Running Condition 🗗



Open Calculator 2

$$au = rac{3 \cdot \mathrm{s} \cdot \mathrm{E}^2 \cdot \mathrm{R}}{2 \cdot \pi \cdot \mathrm{N_s} \cdot \left(\mathrm{R}^2 + \left(\mathrm{X}^2 \cdot \mathrm{s}
ight)
ight)}$$

$$0.057962 \mathrm{N^*m} = rac{3 \cdot 0.19 \cdot \left(305.8 \mathrm{V}
ight)^2 \cdot 14.25 \Omega}{2 \cdot \pi \cdot 15660 \mathrm{rev/min} \cdot \left(\left(14.25 \Omega
ight)^2 + \left(\left(75 \Omega
ight)^2 \cdot 0.19
ight)
ight)}$$



Variables Used

- B Magnetic Flux Density (Tesla)
- **E** EMF (Volt)
- Ei Induced EMF (Volt)
- **f** Frequency (Hertz)
- F Force (Newton)
- fline Line Frequency (Hertz)
- **f**_r Rotor Frequency (Hertz)
- **l**_a Armature Current (Ampere)
- If Field Current (Ampere)
- I_I Load Current (Ampere)
- I_r Rotor Current (Ampere)
- Is Stator Current (Ampere)
- K_p Pitch Factor
- Length of Conductor (Millimeter)
- n Number of Poles
- N_m Motor Speed (Revolution per Minute)
- N_S Synchronous Speed (Revolution per Minute)
- Pag Air Gap Power (Watt)
- P_{conv} Converted Power (Watt)
- Pin Input Power (Watt)
- Pin(r) Rotor Input Power (Watt)





- P_m Mechanical Power (Watt)
- Pout Output Power (Watt)
- P_{r(cu)} Rotor Copper Loss (Watt)
- P_{s(cu)} Stator Copper Loss (Watt)
- P_{SI} Stator Losses (Watt)
- R Resistance (Ohm)
- R_r Rotor Resistance (Ohm)
- R_{r(ph)} Rotor Resistance per Phase (Ohm)
- R_s Stator Resistance (Ohm)
- S Slip
- **V**_a Armature Voltage (Volt)
- V_s Linear Synchronous Speed (Meter per Second)
- **W** Pole Pitch Width (Millimeter)
- X Reactance (Ohm)
- X_{r(ph)} Rotor Reactance per Phase (Ohm)
- **η** Efficiency
- **0** Short Pitched Angle (Degree)
- T Torque (Newton Meter)
- Trun Running Torque (Newton Meter)

Constants, Functions, Measurements used

- Constant: pi, 3.14159265358979323846264338327950288
 Archimedes' constant
- Function: cos, cos(Angle)

 Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Function: sqrt, sqrt(Number)

 A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: Length in Millimeter (mm)
 Length Unit Conversion
- Measurement: Electric Current in Ampere (A)

 Electric Current Unit Conversion
- Measurement: Speed in Meter per Second (m/s)
 Speed Unit Conversion
- Measurement: Power in Watt (W)
 Power Unit Conversion
- Measurement: Force in Newton (N)
 Force Unit Conversion
- Measurement: Angle in Degree (°)
 Angle Unit Conversion
- Measurement: Frequency in Hertz (Hz)
 Frequency Unit Conversion
- Measurement: Electric Resistance in Ohm (Ω) Electric Resistance Unit Conversion
- Measurement: Magnetic Flux Density in Tesla (T)
 Magnetic Flux Density Unit Conversion





- Measurement: Electric Potential in Volt (V)

 Electric Potential Unit Conversion
- Measurement: Angular Velocity in Revolution per Minute (rev/min)

 Angular Velocity Unit Conversion
- Measurement: Torque in Newton Meter (N*m)

 Torque Unit Conversion





Check other formula lists

Induction Motor Circuit
 Formulas

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