

Q. Calculation of Step Angle (stepper motor) →

$$\beta = \frac{N_s - N_r}{N_s N_r} \times 360^\circ$$

$N_r$  = Rotor poles (teeth)

$N_s$  = Stator " ( " )

$\beta$  = Step Angle.

$$\text{Resolution} = \frac{360^\circ}{\text{Step Angle}} = \frac{\text{No. of steps}}{\text{revolution}}$$

30.1, 392 → Book (there) → Page-1537

Q. A hybrid VR stepping motor has 8 main poles which have been cartleated to have 5 teeth each. If the rotor has 50 teeth, calculate the stepping Angle and resolution.

Here,

$N_r = 50$  teeth (poles)

$N_s = (8 \times 5) = 40$  " "



$$\therefore \beta = \frac{40 - 50}{40 \times 50} \times 360^\circ$$

$$= -1.8^\circ$$

$$\therefore \text{Resolution} = \frac{360^\circ}{-1.8^\circ}$$

$$= -200 \text{ steps/revolution.}$$

(Terega → 1283 Page)

Power input of the stator of 440V, 50Hz, 6 Pole, 3-phase, induction motor is 80 kW. The rotor emf is observed to make 100 complete alternation per minute. Calculate →

- i) slip ii) the rotor speed. iii) rotor cu (copper losses per phase)

i)

Here,

$$\text{Pole} = 6 ; f = 50 \text{ Hz}$$

$$\therefore \text{Slip, } f' = sf$$

Rotor 100 complete alternation means rotor

$$\text{frequency } (f') = \frac{100}{60} \text{ cycle/s} = 1.6667 \text{ Hz}$$

$$\therefore s = \frac{f'}{f} = \frac{1.6667 \text{ Hz}}{50 \text{ Hz}} = 0.333 = 3.33\%$$

ii)

$$N_s = \frac{120f}{P} = \frac{120 \times 50}{6} = 1000 \text{ rpm.}$$

$$\begin{aligned} \text{Rotor Speed, } N &= (1-s) N_s \\ &= (1-0.333) 1000 = 666.67 \text{ rpm.} \end{aligned}$$

iii) we know,

$$\text{rotor cu losses} = s \times \text{rotor input (single phase)}$$

$$\therefore \text{ " " " per phase} = \frac{s \times \text{rotor input}}{3}$$

Here, rotor input power = 80 kW.

$$\begin{aligned} \therefore \text{rotor cu loss per phase} &= \frac{1}{3} (0.333 \times 80) \\ &= 0.8888 \text{ kW} \end{aligned}$$

Ex → 6.1 (Chapman Page- 335)

A 208-V, 10-hp, 4 (four pole), 60 Hz, Y-connected induction motor has a full load slip of 5%.

- What is the synchronous speed of this motor.
- What is the rotor speed of this motor at rated load?
- What is the rotor frequency of this motor at rated load?
- What is the shaft torque of this motor at the rated load?

a).

We know,

$$N_s = \frac{120f}{P}$$

$$= \frac{120 \times 60}{4}$$

$$= 1800 \text{ RPM. } \blacktriangleleft$$

Here,

$$f = 60 \text{ Hz}$$

$$P = 4$$

$$s = 5\%$$

$$= 0.05$$

b)

We know,

$$N = (1-s)N_s$$

$$= (1-0.05)1800$$

$$= 1710 \text{ RPM. } \blacktriangleleft$$

c)

We know,

$$f_r = sf$$

$$= 0.05 \times 60$$

$$= 3 \text{ Hz. } \blacktriangleleft$$

motor →

d) We know,

$$P = \omega \tau$$

$$\therefore \tau = \frac{P}{\omega}$$

$$= \frac{7460 \text{ watt}}{179.071 \text{ rad/s}}$$

$$= 41.7 \text{ N.m}$$

$$P = 10 \text{ hp}$$

$$= (10 \times 746) \text{ watt}$$

$$= 7460 \text{ watt}$$

impair.

$$\omega = \frac{2\pi N}{60}$$

$$= \frac{2 \times \pi \times 1710}{60}$$

$$= 179.071 \text{ rad/s}$$

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$$N = 1710 \rightarrow \text{rotor speed}$$

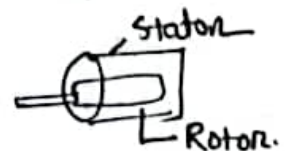
we observe

that shaft

rotor is

rotor

is not



1502

## Difference between synchronous and induction motor →

### Synchronous motor

### Induction motor

- |   |  |
|---|--|
| 1. Construction is complicated  | 1. Construction is simpler.  |
| 2. Not self starting  | 2. Self starting   |
| 3. Separate D.C. Source is required for rotor excitation.                         | 3. Rotor gets excited by the induced e.m.f. so separate source is not necessary. |
| 4. The speed is always synchronous irrespective of the load.                      | 4. The speed always less than synchronous but never synchronous.                 |
| 5. As load increases, load angle increases, keeping speed constant at synchronous | 5. As load increases, the speed keeps on decreasing.                             |
| 6. It can be used as synchronous Condenser for power factor improvement.          | 6. It can not be used as synchronous Condenser                                   |
| 7. This is comparatively more efficient than induction motor.                     | 7. It is comparatively less efficient.   |
| 8. It's torque is more sensitive to change in supply voltage.                     | 8. It's torque is less sensitive to change in supply voltage.                    |