QUIZ – ANSWER KEY

QUIZ NO: 91

TOPIC: ELECTRICAL ENGINEERING

DATE: 21/07/2022

1. A 3-phase 440 V, 50 Hz induction motor has 4% slip. The frequency of rotor current will be ?

   [A] 50 Hz

   [B] 25 Hz

   [C] 5 Hz

   [D] 2 Hz

   Answer: D

   Explanation:-

   Frequency of the rotor current is given as

   $f_r = sf$

   $f_r = 0.4 \times 50 = 2$ Hz

2. The starting torque of a squirrel-cage induction motor is ?

   [A] Full-load torque

   [B] Slightly more than full-load torque

   [C] Low

   [D] Negligible

   Answer: C

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Explanation:-

- Starting torque is directly proportional to the rotor resistance of an induction motor.
- The resistance of squirrel-cage induction motor can not be varied as compared to the slip ring induction motor.
- In the squirrel-cage induction motor, the rotor has very low fixed resistance, therefore, the starting torque is low due to low power factor and high reactance.
- The starting torque could be increased by increasing starting resistance but due to high current in the rotor during starting will increase the copper loss which will decrease the motor efficiency.

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3. The efficiency of an induction motor is about?

[A] 100%

[B] 80-90%

[C] 50-60%

[D] Less than 50%

Answer: B

Explanation:-

- Induction motors are often compared to Transformers because both the machines work under the principle of **"mutual induction".** An induction motor is also called as rotating transformer with secondary winding short-circuited.
- As we know that the transformer's efficiency is greater than 95%.
- An Induction motor includes friction and windage(i.e., mechanical losses) losses addition to the no load and copper losses, hence efficiency comes down to 80% to 90%.

4. A double squirrel-cage induction motor has

[A] Two series winding in stator

[B] Two parallel windings in stator

[C] Two parallel winding in Rotor

[D] Two rotors moving in opposite direction

Answer: C

Explanation:-

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- In the squirrel cage motor, there is no provision made for adding external resistance because the end rings are permanently shorted with the rotor conductor, therefore, the starting torque of the squirrel cage induction motor is very poor due to the low rotor resistance.
- The starting torque could be increased by increasing starting resistance but due to high current in the rotor during starting will increase the copper loss which will decrease the motor efficiency.
- As the name suggests the double squirrel-cage induction motor has two sets of parallel squirrel-cage winding in the same rotor.
- **The outer cage bar** has a smaller cross-section area as compared to the **inner cage bar**
- The outer cage bar is made up of high resistive materials such as aluminum, brass, etc.
- The outer cage has **less leakage flux linkage** because of its relatively open slots hence it has lower reactance.
- **The Lower cage bar** has a high cross-section area and it is made up of low resistance material like copper.
- The upper and lower cage bar is separated by a narrow slit or construction.
- The inner cage has high leakage flux linkage due to the presence of a slit hence it has high self-inductance.
- Therefore during starting period, it gave high resistance means high starting torque whereas it gives low resistance during the running conditions.

5. The starting torque of a 3-phase induction motor is _____ supply voltage.

[A] Independent of

[B] Directly proportional

[C] Directly proportional to square

[D] Inversely proportional

Answer: C

Explanation:-

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$Ts = KE_2^2R^2/(R_2^2 + X_2^2)$

E2 = Rotor induced EMF per phase on standstill condition which is proportional to applied voltage.

$E2 \propto V$

$Ts = KV_2^2R^2/(R_2^2 + X_2^2)$

Hence, $Ts \propto V^2$

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6. A 3 phase induction motor has the facility for pole changing from 4 to 6. When it is operating as a 4 pole machine on 440V, 50Hz balanced 3 Phase supply, the frequency of rotor current is 3Hz. Then the speed of the motor is ?

[A] 1500 RPM

[B] 1200 RPM

[C] 1360 RPM

[D] 1410 RPM

Answer: D

Explanation:-

Synchronous machine of 4 pole machine is;

$N_s = 120f/p = 120 \times 50/4 = 1500$ RPM

Since Rotor frequency is slip times the stator frequency;

$f_r = sf_s$

or

$s = f_r/f_s$

$= 3/50 = 0.06$

Rotor Speed $N_r = (1 - s) N_s$

$N_r = (1 - 0.06)1500$

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Nr = 1410 RPM

7. If the motor were to run at 65% speed as in 'the given above question, but operate as a 6 pole machine, what will be the slip and frequency of the rotor currents?

[A] 4.175 Hz

[B] 3.286 Hz

[C] 2.458 Hz

[D] 1.432 Hz

Answer: A

Explanation:-

Synchronous speed of the 6 pole machine

$N_s = 120f/p = 120 \times 50/6 = 1000$ Hz

N_{r2} = Rotor speed of 6 pole machine

$= 0.65 \times 1410 = 916.5$ RPM

Slip $s = (N_{s2} - N_{r2})/N_{s2}$

$s = (1000 - 916.5)/1000$

$= 0.0835$

Rotor frequency fr = sfs

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= 0.0835 x 50 = 4.175 Hz

8. For a slip of 0.05, find the ratio of rotor speeds with the motor operating with 4 and 6 poles respectively ?

[A] 2.8
[B] 1.5
[C] 3.2
[D] 4.5

Answer: B

Explanation:-

Rotor speed with 4 poles with slip 0.05

= (1 – 0.05)×1500
= **1425 RPM**

Rotor speed with 6 poles with slip 0.05

= (1 – 0.05)1000
= **950 RPM**

The Ratio of rotor speeds with the motor operating with 4 and 6 poles

N_{r4}/N_{r6} = 1425/950 = **1.5**

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9. A 3-phase induction motor is running at 2% slip. If the input to rotor is 1000 W, then mechanical power developed by the motor is .

[A] 500 W
[B] 200 W
[C] 20 W
[D] 980 W

Answer: D

Explanation:-

Mechanical power developed in 3-phase motor = (1 – s) × power input to rotor

= (1 – 0.02) x 1000 = 980 W

10. The approximate efficiency of a 3-phase, 50 Hz, 4-pole induction motor running at 1350 r.p.m. is ?

[A] 90%
[B] 60%
[C] 45%
[D] 100%

Answer: A

Explanation:-

Given;
P = 4
f = 50 Hz
N = 1350 RPM

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Ns = 120f/P = 120 × 50/4 = 1500 RPM

Slip s = (Ns – N)/Ns

= (1500 – 1350)/1500 = 0.1

Approximate efficiency of Induction motor = (1 – s)

1 – 0.1 = 0.9 = 90%