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Subject AC- Machine

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Question NO 1

Ans:, 1

In This moter the rotor does not receive electric power by Conduction but by induction in exactly as the Secondary of 2-winding Transformer receives its power From the Secondry. that is why Such motors as known as rotating Transformer. when you give three phase Supply to the three phase stator winding then it is Called as three phase induction motor. The effect of Applying load on the speed, Slip Stator Current, power factor, effeciency and Torque are discussed below.

Disadvantages:-

(1) A Single Phase induction motor, unlike a 3 Phase induction motor, does not having a Self Torque

(ii) Speed Control of an induction motor is very difficult to attain the lack of Starting torque

(iii) During Light Load Conditions, the Power factor of the motor drops to a very Low value.

Advantages

(i) The most obvious is the fact that the rotor Speed does not lag.

(ii) veriable Speed by Changing the Frequency

(iii) Due to the absence of Brushes, there are no Sparks in the motor
It Can also be operated in hazardous Conditions.

(iv) Another is not requiring brushes/Commutator to Change the magnetic poles to keep the motor running, and Simplifies the Construction, with less wear and tear.

Question No 2

Given data:-

Motor runs at = 290 r.p.m

Frequency = 50 Hz

Required:-

no of poles

(ii) Slip

Sol

Since N is 290 rpm N_s has to be Somewhere near it Say 300 rpm If N_s is assumed as 300 rpm then

$$300 = \frac{120 \times 50}{P}$$

$$\boxed{P = 20}$$

$$Slip = \frac{300-290}{300}$$

$$= 3.33\%$$

Question No 3

Given data:

Powe input to the rotor = 440V

Frequency = 50 Hz

No pole = 6 pole

3-phase induction motor = 80 kW

emf observed to make = 100 cycle / minute

Required

⇒ The Slip
⇒ The rotor Speed
⇒ rotor Copper losses per phase.

Sol

100 alterations minute = $\frac{100}{60}$ cycles/sec

$1.667\ Hz = sf$

1.667

Here the slip $s = \frac{1.6667}{50}$

0.3333 p.u or 3.333%

(ii) rotor speed

$N = (1-s)N_s = (1-0.03333) \cdot 1000$

Since $N_s = \frac{120 \cdot 50}{6} = 1000$ rpm

$N = 966.67$ rpm

(iii) rotor Copper losses phase

$= \frac{1}{3} \cdot (s \cdot \text{rotor input})$

total rotor power input = 80 kW

rotor Power input Per Phase = 80/3 kW

rotor Copper Losses Per Phase

$= \frac{0.03333 \cdot 80}{3}$ kW 0.8888 kW

Principle of Alternators.

An alternator is an Electrical generator that Converts mechanical energy to electrical energy in the Form of alternating Current.

working principle of Alternator it is just like the basic Principle of DC generator. Its also depends upon Faraday's law of electromagnetic induction which says the Current is induced in the Conductor inside a magnetic Field where there is a relative motion between that Conductor and the magnetic Field.

Construction

It is Consists of a Yoke, pole core, Stator, rotor, armature, slip rings bearings, and Fan.

Yoke = Yoke use for Protecting Cote for the machine.

Pole Core :, it is Consist of Pole shoe that gives support for the winding to rest on the pole shoe.

Stator :, The Stator is the Stationary Part on which armature winding is wound.

rotor :, The rotor is the rotating part of the machine on which Field winding wound.

The armature Core Consists of armature windings, Slip rings, and brushes.

A fan is employed is the exhaust the heat that is generated during the running Conditions.

Question NO 05

Given data:

16 Pole alternator

Slot = 144   10 Conductor Per slots.

flux = 0.03 wb

Speed = 375 r.p.m

Sol

$F = PN/120 = \frac{16 \times 375}{120} \times 50 Hz$

Since Ke is not given would be taken as unity

$n = \frac{144}{16} = 9; \beta = 180^\circ/9 = 20^\circ. m = \frac{144}{16 \times 3} = 3$

$Kd = \frac{\sin 3 \times (20^\circ/2)}{3 \sin (20^\circ/2)} = 0.96$

$Z = 144 \times 10/3 = 480. T = \frac{400}{2} = 240/phase$

$Eph = 4.44 \times 1 \times 0.96 \times 50 \times 0.03 \times 240$

$= 15.34V$

Line Voltage $= E_L = \sqrt{3} \times 1534 = 2658 V$

Question NO 6

Connection of three phase transformer

We know that there are four different ways in which three single-phase transformer may be connected together between their primary and secondary three phase circuits.
These four standard configuration are given as

(i) Delta - Delta (Dd)
(ii) Star - Star (Yy)
(iii) Star - Delta (Yd)
(iv) Delta - Star (Dy)

Question NO 7

Sol

Transformer ratio $K = \frac{11,000}{\sqrt{3} \times 33,000} = \frac{1}{3\sqrt{3}}$

Per phase $R_{O_2} = 0.876 + \left(\frac{1}{3\sqrt{3}}\right)^2 \times 35 = 2.172\,\Omega$

Secondary phase Current $= \frac{500,000}{\sqrt{3} \times 33,000} = \frac{500}{11\sqrt{3}}$ A

Full Load Condition

Full Load total Cu Loss =

$= 3 \times \left(\frac{11}{\sqrt{3}}\right)^2 \times 2.172 = 4,490$ W; Iron Loss = 3,050 W

Total Full Load

= 4,490 + 3,050 = 7,540 W; output at unity p.f

= 500 kW

F.L Efficiency = 500,000/507.540

= 0.982 or 98.54 % output at 0.8pf

= 400 kw

efficiency = 400,000/407.540

= 0.982 or 98.2 %

Half load Condition

output at Unity p.f = 250 kw

Cu loss = $(1/2)^2 \times 4,490$

= 1,222 W

Total loss

= 3,050 + 1,122 = 4,172 W

N = 250,000/254,172 = 0.9835 = 98.35 %

output at 0.8 p.f = 200 kw

n = 200,000/204,172 = 98 %

Question No 8

General System Requirments of Alternator

The Requirments of Alternator For the generation of emf, there Should be two basic System.

(ii) Armature System which houses the Conductors on which the emf is to be induced.

Q:2

Generally in alternators, the armature is stationary and the Field rotates. Small low-voltage alternators often have a rotating armature and

Stationary Field winding.
But in Large alternators rotating armature Field type is used.

Q:3
(i) Advantages of Stationary Armature:

(1) Current Collection is easy
(ii) Emf is Produced in Armature
(iii) Insulation is easy
(iv) only two Slip rings are required
(v) Sparking at Brushes is avoided.

(ii) Advantages of rotating Armature

(i) The generation level of a.c voltage may be higher as 11 kv to 33 kv
(ii) It is always better to Protect high voltage winding from the

(16) Centrifugal forces caused due to the rotation.

Q: (4)

The Advantages of three phase over a Sing phase System are: The amount of Conductor material required is less for three phase System.
Domestic power and industrial (Commercial Power Can be Provided From the Same Source For three Phase system.
voltage regulation of a three phase System is Detter.

Q: 5 Turbo-alternators

There are basically hydrogen Cooled cylindrical rotor alternators used to generate stations. They have only

2 poles and are run by a 300 rpm turbine for 50 Hz machine and 3600 rpm for 60 Hz machine.

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End