

Department of Electrical Engineering

Assignment

Date: 14/04/2020

Course Details

Course Title:	<u>AC Machines</u>	Module:	<u>B-Tech</u>
Instructor:	<u>Eng Rashid Aleem</u>	Total Marks:	<u>30</u>

Student Details

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(Q1) Fill in the blanks?(5 Marks)

(1) Induction motor was invented by In

(2) The Stator of the induction motor is ,in principle ,the same as that of

(3) Greater the no of poles in induction machinethe speed.

(4) The stator winding when supplied with three phase currents,produce a magnetic flux which hasmagnitude.

(5) Motors employing wound rotor are known as Motors.

(Q2) Multiple choice questions?(5 Marks)

(1) Regarding skewing of motor bars in squirrel cage induction motor ,which statement is false?

(a) it prevents cogging (b) it increases starting torque (c) it produces more uniform torque (d) it reduces motor 'hum' during its operation

(2) The principle of operation of a 3-phase induction motor is most similar to that of a

(a) synchronous motor (b) repulsion start induction motor (c) transformer with a shorted secondary (d) capacitor –start ,induction run motors

(3)The magnetizing current drawn by transformers and induction motors is the cause of their power factor

(a)zero (b)unity (c)lagging (d)leading

(4)The effect of increasing the length of air-gap in an induction motor will be to increase the

(a)power factor (b)speed (c)magnetizing current (d)air gap flux

(5)In a three phase induction motor,the relative speed of stator flux with respect to is zero.

(a)stator winding (b)rotor (c)rotor flux (d)space

(Q3)In case of AC generator the input domain is mechanical,identify the potential and kinetic variable for input and output and explain the relationship of input and output?(5 Marks)

(Q4)Is it true that conduction takes place in ac machines.Back your reason with valid facts?Explain the working of synchronous machines and give solid reason why it uses separate dc source?(5 Marks)

(Q5)The stator of a three Phase induction motor has 6 slots per pole per phase.If supply frequency is 60Hz.Calculate the number of stator poles produced and total number of slots on the stator.Calculate the speed of the rotating stator flux?(5 Marks)

(Q6)3-Phase ,50Hz ,8 pole ,induction motor has full load slip of 2%.The rotor resistance and stand still rotor –reactance per phase are 0.001 ohm and 0.005 ohm respectively.Find the ratio of

the maximum to full load torque and the speed at which the maximum torque occurs? (5 Marks)

Q:1 Fill in the blanks. Page: (1)

(i) Induction motor was invented by Nikola Tesla in 1887

(ii) The stator of the induction motor is, in principle, the same as that of synchronous motor or generator

(iii) Greater the no of poles in induction machine less the speed.

(iv) The stator winding when supplied with three phase currents, produce a magnetic flux which has constant magnitude.

(v) Motors employing wound rotor are known as wound motor, slipping motor.

Q:2 Multiple choice questions ::

- (i) Regarding skewing of motor bars in squirrel cage induction motor, which statement is false?
- (a) it prevents cogging (b) it increases starting torque
(c) it produces more uniform torque (d) it reduce motor "hum" during its operation.

(ii) The Principle of operation Page: (2)
of Three 3-phase induction motor is most similar to that of a.

- (a) synchronous motor (b) repulsion start Induction motor (c) Transformer with a shorted Secondary (d) Capacitor-start, Induction run motors.

(iii) The magnetizing current drawn by transformer and Induction motors is the cause of their power factor.

- (a) Zero (b) Unity (c) Lagging (d) Leading

(iv) The effect of increasing the length of air-gap in an induction motor will be to increase the.

~~(a) The effect of increasing the length of air-gap in an~~

- (a) power factor (b) speed (c) magnetizing current (d) air gap flux

(v) In a three phase induction motor, the relative speed of stator flux with respect to is zero.

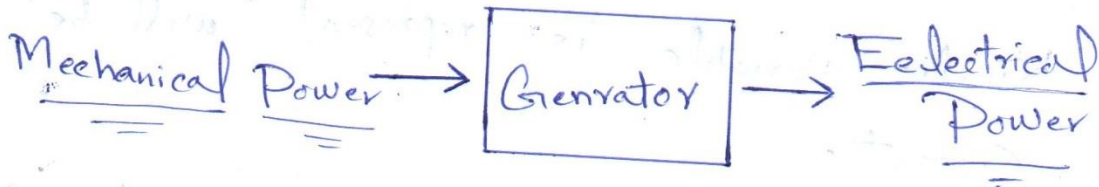
- (A) stator winding
- (B) rotor
- (C) rotor flux
- (D) space

Page ④

Q: 3 In case of AC generator the input domain is mechanical. Identify the potential and kinetic variable for input and output and explain the relationship of input and output.

Ans

In case of AC generator, we know that generator convert mechanical energy into electrical energy or power.



The output of generator is Electrical Power or Alternating cycle Electrical Power.

Generator

When the input ~~and~~ domain is mechanical in case of generator.

So Therefore the potential variable and Kinetic variable are Torque (T) & (W)

\Rightarrow $\begin{matrix} T \\ W \end{matrix}$

Let us \Rightarrow we know that the generator output domain is AC Electrical Power.

which will Potential variable is

E (Induced emf) and the Second

Kinetic variable is represent will be

Current.

Potential variable is E (Induced Emf)

Kinetic variable is i (Current)

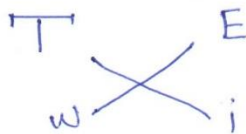
Relationship of input and output.

$$T = \text{Torque}$$

$$E = \text{Induced Emf}$$

$$i = \text{Current}$$

Let Suppose



In this case the relationship b/w

Torque \propto Current and Emf and w .

Q:is

It is true that conduction takes place in ac machines. Back your reason with valid facts? Explain the working of synchronous machines and give solid reason why it uses separate dc source?

~~Ans~~ NO, It is false that conduction takes place in AC machine.

The main reason of ac machine that

Permanent magnet synchronous uses permanent magnet in the steel rotor to create a constant magnetic field. The stator carries winding connected to an ac supply to produce a rotating magnetic field. At synchronous speed the rotor poles lock to the rotating field.

Working Synchronous machines

Synchronous ~~machine~~ ^{motor} depends on the interaction of the magnetic field of the stator with the magnetic field of the rotor. The stator contains 3 phase windings and is supplied with 3-phase power. Thus stator winding produces a 3 phased rotating magnetic field.

and Synchronous generator is electromagnetic induction. If there exists a relative motion between the flux and conductors, then an emf is induced in the conductors. To understand the Synchronous generator working Principle let us consider two oppositemagnetic poles in between them a rectangular coil or turn is placed.

Q: 5

The stator of a Three phase induction motor has 6 slots per pole per phase. If supply frequency is 60 Hz. Calculate the number of stator poles produced and total number of slots on the stator. Calculate the speed of the rotating stator flux?

Solution

given data: No slot per pole = 6
 \Rightarrow Frequency = 60 Hz

Required

- (i) Total NO. of slot on the stator
- (ii) speed of the rotating stator flux

So $P = 2n$

$$\Rightarrow P = 2n$$

$$\Rightarrow P = 2 \times 3 = 6 \text{ poles}$$

(a) Total No. of slots

$$= 6 \text{ slots pole phase} \times 6 \text{ poles} \times 3 \text{ phase}$$

$$= 108$$

$$\text{Total No. of slot} = 108$$

(b) speed of the rotating stator flux.

Let \Rightarrow we know that

$$N_s = \frac{120f}{P} \rightarrow \textcircled{1}$$

putting value in above equation $\textcircled{1}$

$$N_s = \frac{120 \times 60}{6} = 1200 \text{ rpm}$$

Example ② Question NO: 6 Page ⑪

3-phase, 50 Hz, 8 Pole, Induction motor has full load slip of 2%. The rotor resistance and stand still rotor-reactance Per phase are 0.001 ohm and 0.005 ohm-respectively. Find the ratio of the maximum to full load torque and the speed at which the maximum torque occurs?

Solution

First of all we find synchronous speed

So Synchronous speed $N_s = 120 \times 50 / 8 = 750 \text{ rpm}$

\Rightarrow we know that

slip at maximum torque $s_{mt} = \frac{I_2}{X_2}$

Let $a \Rightarrow = \frac{I_2}{X_2} = \frac{0.001}{0.005} = 0.2$

Corresponding speed =

$= (1 - 0.2) \times 750 = 600 \text{ rpm}$

=> Full-load torque

maximum torque

$$= \frac{2s_{MT} s_1^2}{s_{MT}^2 + s_1^2} \therefore \frac{T_1}{T_{max}} = \frac{2 \times 0.2 \times 0.02^2}{0.2^2 + 0.02}$$

$$= \frac{1.6 \times 10^4}{0.0404}$$

$$\frac{T_{max}}{T_1} = 252.5 = 3.96 \times 10^{-3}$$