

Department of Electrical Engineering

Assignment

Date: 14/04/2020

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Course Details

Course Title: AC Machines Module: B-Tech  
Instructor: Engr.Rashid Aleem Total Marks: 30

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Student Details

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

(1) Induction motor was invented by ...**Nikola Tesla**..... In .....**1887**.....

(2) The stator of the induction motor is, in principle, the same as that of ... as that of  
....**Synchronous motor or Generator**...

(3) Greater the no of poles in induction machine ...**Lesser**.....the speed.

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

(5) Motors employing wound rotor are known as .....**Slip Ring**..... 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)

## Answer Sheet

**(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)**

**Ans:**

In case of ac generator. It will convert mechanical power into Ac electrical power.

Ac electrical power or Alternating Cycle electrical power.

AC means Alternating Cycle.

**Ac Electrical power**  **Motor**  **Mechanical power**

In ac motors it will convert Ac electrical power into mechanical power.

In case of Generator:

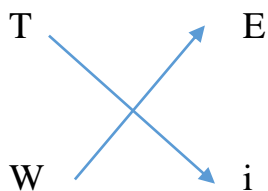
The input domain is mechanical domain, so therefore the potential and kinetic variables are torque and  $w$ .

Output domain which is Ac electrical power. Which will have potential variable  $E$  (induced emf) and kinetic variable will be current.

$E =$  (induced emf) =Potential variable

$i =$  (Current) =Kinetic variable

**Relationship of input and output:**



We have a relation between torque and current. Emf and  $w$ .

**(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)**

**Ans:**

No it is not true due to conductor it transfer from one molecule to another but here in ac machine we will use induction because it produce emf permanent-magnet synchronous motor (PMSM) uses permanent magnets embedded in the steel rotor to create a constant magnetic field. The stator carries windings connected to an AC supply to produce a rotating magnetic field. At synchronous speed the rotor poles lock to the rotating magnetic field.

**Synchronous Generator Working Principle:**

The principle of operation of 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 opposite magnetic poles in between them a rectangular coil or turn is placed.

**(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)**

**Solution:**

(i)  $P = 2n$

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

Total no. of slots

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

$$= 108$$

(ii) We know that

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

Now putting values we get

$$= \frac{120 \times 60}{6} = 1200 \text{ r.p.m}$$

**(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)**

**Solution:**

$$\text{Synchronous speed } N_s = 120 \times 50 / 8 = 750 \text{ r.p.m}$$

$$\text{Slip at maximum torque. } s_{mt} = r_2 / x_2$$

$$= \frac{r_2}{x_2} = \frac{0.001}{0.005} = 0.2$$

$$\text{Corresponding speed} = (1-0.2) \times 750 = 600 \text{ r.p.m}$$

$$\begin{aligned} \frac{\text{full load torque}}{\text{maximum torque}} &= \frac{2s_{mt} \pi}{s^2 m^t + s^2 \pi} = \frac{2 \times 0.2 \times 0.2^2}{0.2^2 + 0.2^2} \\ &= \frac{1.6 \times 10^{-4}}{0.0404} \end{aligned}$$

$$\frac{T_{t_{max}}}{T_f} = 252.5$$

$$= 3.96 \times 10^{-3} \text{N-m}$$