Abu Dhabi University

EEN 340 - Energy Conversion

Final Exam
OB Revision Sheet

Author:
Muhammad Obaidullah 1030313

Section 1
Version 0.5 Beta

May 26, 2013

Contents

1 AC Machinery Fundamentals

1. Q — **How a revolving magnetic field is created in AC Machines ?**

   A. — In a 3-phase AC motor, each of the coil is connected to a single phase supply. Each coil is energized and de-energized automatically in a particular sequence because of AC current. This causes the magnetic field to appear circulating around the stator.
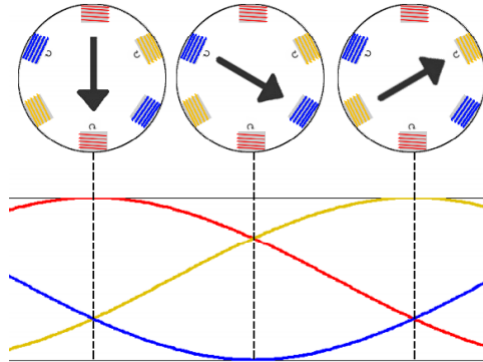

Figure 1: 3-phase set of currents are there, each of equal magnitude and with a phase difference of 120, to flow in a 3-phase winding. In this situation, a constant magnitude rotating field will be generated.

2. Q — **How can we increase the speed of the AC Machine ?**

   A. — We can increase the speed of the AC machine by increasing the frequency of supply voltage. Increasing the frequency will increase the revolutions per second of the rotating magnetic field, thus increasing the speed of rotation.

$$\text{Speed in rpm} = n_m = \frac{120 f_e}{P} \tag{1}$$

3. Q — **How can we increase the torque of the AC Machine ?**

   A. — We can increase the torque of the AC machine by increasing the magnetic field excitation of machine. Increasing the field magnetic field makes the rotor attract more strongly to the rotating magnetic field.

$$\text{Torque Induced} = \tau_{ind} = k B_R X B_S \tag{2}$$

2 Synchronous Machines

4. Q — **What is Voltage Regulation ?**

A. —— Voltage Regulation is mostly used for generators to measure how they maintain the terminal voltages for various loads.

$$VR = \frac{V_{nl} - V_{fl}}{V_{fl}}.100\% \tag{3}$$

5. Q —— **What is Speed Regulation ?**

A. —— Speed Regulation is mostly used for generators to measure how they maintain the rotor speed for various loads.

$$SR = \frac{n_{nl} - n_{fl}}{n_{fl}}.100\% \tag{4}$$

6. Q —— **What happens when we change the excitation and mechanical power of Synchronous Machine ?**

A. —— When we increase the excitation of magnetic field, more voltage is induced into the output. Additionally, if we increase the mechanical power provided to the synchronous generator, the output voltage will increase.

$$\text{Power converted} = P_{conv} = \tau_{ind}.\omega_m = 3E_A I_A cos(\gamma) \tag{5}$$

7. Q —— **What is the effect of increase of load in Synchronous Machines ?**

A. ——

- For lagging (inductive) loads, the phase (and terminal) voltage decreases significantly.

- For unity power factor (purely resistive) loads, the phase (and terminal) voltage decreases slightly.

- For leading (capacitive) loads, the phase (and terminal) voltage rises.
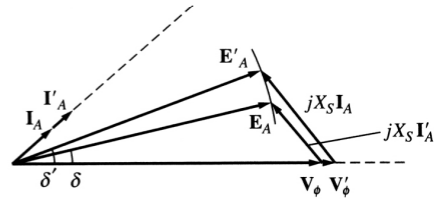
$$E_A = V_\theta + jX_S I_A \tag{6}$$

here only $jX_S I_A$ changes and moves parallel to its original position. As a result changing E_A
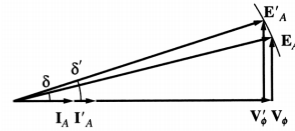
Increase load effect on generators with
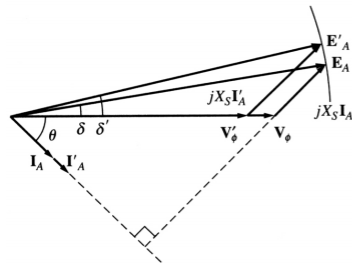
Lagging PF

Leading PF

Unity PF

3   Single Phase Motors

8. Q — **What is a stepper motor and how does it operate ?**

A. — A stepper motor (or step motor) is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any feedback sensor. `http://en.wikipedia.org/wiki/File:StepperMotor.gif`

$$\text{Resolution} = \frac{Number\,of\,steps}{Number\,of\,reolutions\,of\,rotor} \tag{7}$$

$$\text{Stepping Angle} = \alpha = \frac{360}{No.of\,Phases\,X\,No.of\,Poles} \tag{8}$$