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**COURSE: ELECTRICAL MACHINES II ( EEE326)**

**ASSIGNMENT 2**

**QUESTION 1**

Harmonics are currents or voltages with frequencies that are integer multiples of the fundamental power frequency. If the fundamental frequency is 60 Hz, then the 2nd harmonic is 120 Hz, the third is 180 Hz, etc. Harmonics are created by non-linear loads that draw current in abrupt pulses rather than in smooth sinusoidal manner. These pulses cause distorted current wave shapes, which in turn cause harmonic currents to flow back into other parts of the power system.

* Generators and motors are affected by harmonics in the networks to which they are connected. Typical effects including:
* Increased heating due to iron and copper losses at the harmonic frequencies
* Higher audible noise emission as compared with sinusoidal excitation
* Harmonic currents in the rotor

**Others includes:**

* **Skin Effect**

In case of AC Current, Current flows in Periphery or Skin of Transmission Lines due to Self Inductance in Conductors. At higher Frequency Skin Effect increases. Due to Skin Effect, Effective Resistance increases. This increases Loss and increase in Temperature.

* **Increase in Iron Loss in Transformers connected to Generator**

Iron Loss consists of Hysteresis Loss and Eddy Current Loss. Hysteresis Loss ∝ f and Eddy Current Loss ∝ f². Thus Iron Loss increases resulting in Higher Loss in Core of Transformer and Temperature is increased.

* **Retarding Torque in Induction Motor**

5th Harmonic produces flux rotating in opposite direction to Main Flux in Induction Motor. This Flux produces Retarding Torque in Induction Motor.

* **Crawling in Induction Motor**

7th Harmonic creates dip in Torque Speed Curve of Induction Motor at 1/7th the Synchronous Speed. This may result in Induction Motor running at 1/7th the Synchronous Speed. This is called Crawling.

The harmonic currents noted above are caused by harmonics in the stator winding, which will produce harmonic currents in the rotor, e.g., 5th- and 7th-order stator harmonics will produce 6th-order rotor harmonics, while 11th- and 13th-order stator harmonics will produce 12th-order rotor harmonics.

These rotor harmonic currents will result in increased rotor heating and pulsating or reduced torque.

**QUESTION 2**

the stator windings of large generators are star connected as a result of the following;

* The availability of the neutral point which can be grounded and thus provide a path for circulating current in case there is any unbalance in the load end or some fault occurs.
* The armature winding of alternator have a six output terminal, in which three terminal short (make neutral point) and remaining three gives output which are possible only in star connection. So we are connected in star
* In star connection there is a neutral availability if there is any problem. And another one is it reduces the high voltage values.
* The phase voltage is 0.577 times the line voltage which results in lesser voltage stress and hence lesser insulation cost.

**QUESTION 3**

The following are the reasons why armature for large machines is stationary

* As armature winding is stationary, the natural cooling is more effective
* Communication is a problem in rotating armature
* There is less chances of sparking in the stationary arm winding compared to stationary rotor
* It is easier to insulate stationary winding for high voltages for which the alternators are usually designed. It is because they are not subjected to centrifugal forces and also extra space is available due to the stationary arrangement of the armature.
* Only two slip rings are required for d.c. supply to the field winding on the rotor. Since the exciting current is small, the slip rings and brush gear required are of light construction.
* As rotating winding is filed winding which is comparatively light, so chances of wear and tear is less

**QUESTION 4**

The brushless technology does not have a contact zone, which considerably reduces wearing and maintenance.