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**DEPT: MECHANICAL**

**MATRIC NO: 17/ENG06/087**

**ASSIGNMENT 2**

**Question 1:** Discuss the effects of harmonics on synchronous machines.

**Ans:**

It has following effects:

**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.

**Question 2:** Justify technically why the stator windings of large generators are star Connected

**Ans:**

The armature winding of the alternator is generally connected in star because of two main reasons:

1. Lesser stress on insulation and Copper saving: Voltage per phase is 0.577 times less for a given line voltage which reduces insulation requirement and this also reduces the number of turns hence copper is also saved.
2. Easy protection: Neutral grounding is necessary to allow zero sequence currents to flow to the ground in case of a fault.
3. Elimination of harmonics: Star connection facilitates a neutral connection which is instrumental in eliminating triple harmonics.
4. No circulating currents: In star connection we don't have circulating parasitic currents like in delta which lead to heating losses.

**Question 3:** Why is it that the armature for large machines is stationary?

**Ans:**

1. 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.
2. The stationary 3-phase armature can be directly connected to load without going through large, unreliable slip rings and brushes.
3. 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.
4. Due to the simple and robust construction of the rotor, the higher speed of rotating DC field is possible. This increases the output obtainable from a machine of given dimensions.

**Question 4:** Why do brushless generators undergo less maintenance?

**Ans:**

The proposed brushless system have benefits of reduced regular maintenance due to elimination of brushes and reduced unscheduled maintenance due to redundancy; causing a reduced cost-of-energy.