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Question 1

There are two types of harmonics and they are odd harmonics and even harmonics. Odd numbers such as 3, 5, 7, etc, are the odd harmonics while even numbers such as 2, 4, 6, etc, are the even harmonics. But harmonic number 1 is used as the fundamental frequency component of the periodic wave while harmonic number 0 is used for either representing the constant or the DC component of the waveform.

EFFECTS OF HARMONICS ON MOTORS AND GENERATORS

Generators and motors are adversely affected by harmonics in the networks to which they are connected. Typical effects are:

1. Increased heating due to iron and copper losses at the harmonic frequencies
2. Higher audible noise emission as compared with sinusoidal excitation
3. Harmonic currents in the rotor

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.**

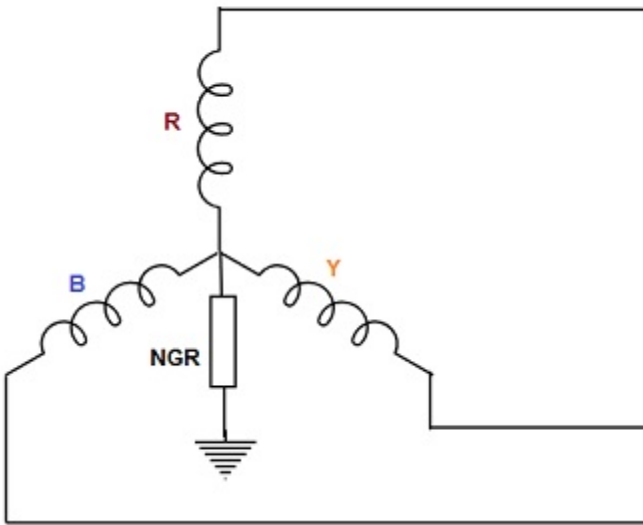
Question 2

Alternator or generator armature winding is always connected in STAR not in DELTA. We know that rotating magnetic field in the air gap can only be created if the phase winding and phase currents are 120° displaced from each other in the space and time respectively. This can be achieved either in star connection or delta connection armature winding in the alternator. But star connection is always preferred over the delta connection due to its advantages.

Advantage of STAR Connection of Generator Armature Winding:

Generator Armature Winding is connected in STAR to achieve technical and economical advantages. Following are some of the advantages:

1) STAR connection provides a neutral point. This neutral point is very important from the stability point of view of generator. Generally, the neutral point is grounded through NGR (Neutral Grounding Resistor). Neutral grounding provides a path for the flow of circulating current during the unbalanced loading condition of generator. In addition to this, it also provides a path for the flow of zero sequence current during the single line to ground fault / double line to ground fault. Furthermore, grounding of neutral point maintains the voltage of healthy phase to the normal phase voltage.



If there were no neutral, the voltage of the healthy phases would have been increased during the ground fault, which may eventually lead to insulation failure of the healthy phases. Thus a single line to ground fault may result in three phase fault due to insulation failure.

Also, the grounding of neutral through NGR limits the value of fault current and hence damage to the stator armature winding.

2) The insulation requirement in STAR connection is less. Since phase voltage is $1/\sqrt{3}$ times i.e. 57.7% ($100 / \sqrt{3} = 57.7\%$) of the line voltage, therefore the insulation requirement of phase winding reduces. This is a great advantage from economic point of view.

Since the generated emf in phase winding,

$$E_f = \sqrt{2}\pi f N \Phi$$

where N = Number of turns

3) In STAR connection Phase voltage = Line Voltage / $\sqrt{3}$, whereas phase voltage = line voltage in DELTA connection. Therefore for generating the same line voltage, the requirement of number of turns in [STAR connection](#) of armature winding will be less as compared to DELTA connection.

4) STAR connection eliminates the triplen harmonics in the generated terminal voltage of generator armature winding.

Question 3

The armature winding is stationary in **ALTERNATORS (LARGE)** because

If we've armature on rotor , rotor with high inertia requires a high initial torque as well as running torque.

We need 3 to 4 brushes(3 phase 3 wire system or 3 phase 4 wire system,etc) on shaft in order to collect high power. It may leads to sparking as well as frictional losses

Because armature is more bulky for high power generation.

Advantage of having field winding on rotor

- ✓ Only two brushes are required on shaft(for DC excitation)
- ✓ low inertia comparatively.

Advantages of having armature winding on stator

- ✓ Power collection is simple from stationary armature
- ✓ Less loss at power collection.

Question 4

Brushless Alternators

Brushless alternators are better suited for more long-term, constant usage because there are no brushes to replace or fix, and have fewer internal parts that can be damaged. You may be asking yourself, "How do they move the electrical current then?" A brushless alternator has two sets of rotors that spin together to generate and transfer the electrical current. But how does it accomplish moving the current without brushes? A brushless alternator has a second, smaller generator on the end of the equipment instead of brushes, which it uses to transfer any electrical current. This is an immediate advantage over a brushed alternator because there are no brushes to replace or repair, saving you long term money and time. A disadvantage of a brushless alternator, however, is the much higher initial

cost, as opposed to a brushed alternator. This is mostly because of the higher amount of materials used in a brushless alternator. Brushless alternators, however, are also more suited to be your primary alternator/generator and are more capable of long-term use. In the long run, you will save money by buying a brushless alternator, but keep in mind that it's an investment because of the higher cost when compared to a brushed alternator.

Whether you're looking for a quick and cheap short-term brushed alternator, or a more advanced and expensive long-term solution brushless alternator, always keep in mind how much power you need to generate as well as your budget. You shouldn't feel pressured into spending more money just for a long-term alternator, but the worst-case scenario is underestimating just how much power your job requires