brain block...

QUESTION 5 *(Courtesy: Rob Melaia, Marthinusen & Coutts (a division of ACTOM (Pty) Ltd*

Does only direct current (dc) flow in a dc motor or generator?

Answer

No, and in fact the fundamental operation of a dc motor relies on alternating current (ac) in the armature.

The field winding (normally situated on the stationary part of the machine) has dc in its windings, but the armature only has ac – created by the commutator.

The commutator is effectively a mechanical switch that reverses the current direction continuously so that it alternates polarity at regular intervals (fractions of a second).

So the current in the armature windings of a dc machine is approximately a square/ rectangular wave ac wave - more correctly a trapezoidal ac wave.

So in effect, the dc motor does not function at all without the ac in its armature - with no dc at all flowing in the armature.

QUESTION 4 *(Courtesy: Rob Melaia, Marthinusen & Coutts (a division of ACTOM (Pty) Ltd*

What are the preferred types of rotating electrical machines for Battery Electric Vehicles (BEVs) and why are they specifically termed 'electrical machines' and not 'motors'?

Answer

Squirrel Cage Induction Machines (SCIMs), Permanent Magnet Synchronous Machines (PMSMs), and Wound (Field) Rotor Synchronous Machines (WRSMs or WFSMs)

- *Tesla Motors, and others, use Squirrel Cage Induction Machines for their simplicity, ruggedness, high-speed capabilty, and low cost*
- *Chevy Bolt, Nissan Leaf, and many others use Permanent Magnet Synchronous Machines for their high torque, high power to mass ratio, high power density - despite their higher cost and inability to control the rotor field excitation. It is worth emphasising here that so-called 'Brushless dc machines' are not dc machines at all; they are Permanent Magnet Synchronous Machines with built-in power electronics that allows them to behave like dc machines as far as their ultimate connection terminals are concerned*
- *Renault uniquely uses Wound Rotor Field Synchronous Machines for their controllable rotor field excitation, the flexibility that comes with variable field excitation, and their generally lower cost than PMSMs - despite the additional maintenance implications of sliprings and brushes*
- *Peugeot-Citroen have used a brushed traditional dc machine for their Berlingo BEV, but use of traditional brushed dc machines is very rare - almost certainly due to their relative high cost and maintenance requirement because of brushes and commutators*
- *Synchronous Reluctance Machines are also very rare, with Holden making use of these in some of their BEVs. These units are termed 'machines' because they function equally as motors and generators in BEV's - in order to regenerate braking energy. Calling them only motors is therefore incorrect. Worth mentioning related to BEV motors are Axial Flux Permanent Magnet Machines: These machines are very expensive but have high power densities. Not yet used in BEVs, they have however been applied in prototype form to aircraft, with Siemens proving a 260 kW 2 400 r/min prototype motor weighing just over 50 kgs. Imagine that in a BEV!*

QUESTION 3 *(Courtesy: Glyn Craig, Techlyn)*

An audio amplifier in an office block drives the audio reticulation system signal at 70,7 V. Each loud-speaker is connected via a transformer.1 Why are the loudspeakers simply not connected in parallel?2 The 70,7 V seems a strange value. Can you offer an explanation?

Answer

***A.** Each loudspeaker will offer an impedance to the drive signal of 4 to 15 Ohms. Several speakers in par-allel, will present an intolerably mall load which will overload the current amplifier's current drive ability. In addition, reasonably sized cable will have a resistance which will result in large voltage loss to the speakers furthest from the amplifier.*

***B.** A 70,7 Vac signal will have a peak voltage of:*
70,7 X 1,414 (the square root of 2 which is 100 V
This means that an amplifier with +100 V and -100 V supply can function without a transformer

QUESTION 2 *(Courtesy Rob Melaia, Marthinusen & Coutts (a division of ACTOM (Pty) Ltd)*

What do the abbreviations 'kW', 'kWe' and 'kWm' mean and relate to, in terms of power in generators, and why do we use these terms?

Answer

Everyone should know that 'kW' is the abbreviation for 'kilowatt' which is one thousand watts of power, where 'W' is the abbreviation for 'Watt'.

'kWe' and 'kWm' are less well known - even to the more experienced people in this field.
In generators - one needs to discriminate between the electrical power produced by the generator and the mechanical power produced by the prime mover (diesel drive engine or turbine etc.) .

The term 'kWe' is used to specifically refer to electrical power produced by the electrical generator.
The term 'kWm' is used to specifically refer to the mechanical power produced by the prime mover or transferred into the diesel generator so that it can convert most of this (there are some losses) into electrical power (kWe).

The terms can of course be extended to 'We', 'MWe', 'Wm', and 'MWm'; in the same way as we use 'W', 'MW' etc. - not just 'kW'.

Although not commonly done - these terms can be extended to motors to discriminate between the electrical input power to a motor - which would be defined by 'kWe' - and mechanical shaft power delivered by the motor to the mechanical load (such as a pump, fan, mill etc.) - which would be defined by 'kWm'. This may seem either superfluous or obvious to many, but so often even specialists confuse motor power terminology between electrical input power or mechanical output power. The simple addition of an 'e' or 'm' to the power abbreviation will prevent any ambiguity without having to use the full terminology every time. For example - a motor power is rated at 10 kWm and 10,7 kWe - meaning that (at full load) it produces 10 kW of mechanical power using 10,7 kW of electrical input power. One automatically knows the efficiency from these two figures? 10/10,7 = 93,45%.

QUESTION 1 *(Courtesy: Glyn Craig of Techlyn)*

In a practical examination a student is presented with an unknown voltage source and an oscilloscope. The student is asked to estimate the RMS (Root Mean Square) voltage and the frequency. A sine wave of 30 Volts peak-to-peak and a period of 16,6 milliseconds is measured.

What are the correct conclusions?

Answer

The peak-to-peak voltage of an ac (alternative current) signal is twice the peak value. (Half the sine wave is positive and the other half is negative).

The RMS value for a sine wave is the peak voltage divided by the square root of 2. (1,414)
The answer is therefore:

V_{rms} = Vp_{pk} /2 X 1,414
= 30/(2 X 1,414)
= 10,6 V (approximately a third of V_{pk-pk})

The frequency is:

f = 1/t Where f is in Hertz (Hz)
t is in seconds
f = 1/16. X 10-3
= 60,2 Hz