EEET – 241 EXAM #3

Read the Exam carefully – it should look similar to things you have done before (but not exact). Don't try to do the work on these sheets – make your own sheets and just label the first page with "EEET-241 Exam #2" and your name.

Make sure, for **all** parts of **all** problems, show your work.
For all questions below, be sure to show your work clearly.
Do not just write the answer.
Partial credit, cannot be awarded, without you showing your work.

I would suggest that you do the questions in order – this will help you.

Make sure all of your values have units (ohms, volts, amps, VA, W, VAR, etc.)

#1 A utility provides a three phase voltage source of 240V at 60 Hz.
It is shown in phasor notation as $240\angle 0^{o}$.
Plot the following:

Show the plot of the open circuit voltage versus time on a graph. Be sure to clearly indicate the peak and RMS values and the period of the waveforms. Be sure to show all three phases on the same graph. Show two waveform periods of time on the graph.

Connect the utility to a variable frequency drive (VFD) that controls the speed of a motor with PWM. We need to find the value of the (DC) voltage on the DC bus.

Plot the following:

Show the plot of the rectified voltage versus time on a graph. Show all three phases. Be sure to clearly indicate the peak and RMS values of each and the period of the waveforms. Show two waveform periods of time on the graph.

The three phase voltage provides 20A of (line) current to the motor at full speed. This equates to 20A of current from the utility into the VFD.
If the utility has a problem and loses one of the three phases (continues to run on only two phases), what is the current into the VFD? Prove this.

#2 Define the following:

Slip of a Synchronous Generator
Armature of a generator
Rotating AC Field Generator (compare with the next item)
Stationary AC Field Generator (compare with the previous item)
Permanent Magnet Generator (explain the benefits of this and whether it is a Rotation AC Field Generator or a Stationary AC Field Generator)
Infinite Bus

#3 - For a Single Phase Capacitor Start Motor running at 240V (remember single phase) 60Hz at a speed of 1700 rpm, running a water pump. Calculate the following:

What is the synchronous speed of the motor?
What is the slip of the motor?
How many poles does this motor have?
Draw a circuit that shows this motor and how it works. Make sure you show both (all) the windings.
Explain how the motor starts?

After installing this motor, we find that the rotational direction of the motor is backwards. How do we change this so the pump will always run in the correct rotational direction?

#4 - For a regular DC motor, define the following:

Is this motor like a stationary field motor or a rotational field motor? Explain your answer.
What is a "Split Ring"? (Explain what it is physically) Be sure to explain how a "Split Ring" works and what it does?
What is a "Commutator"?
Is the speed of a DC motor proportional to the applied voltage? Explain why or why not.

#5 - Explain/define:

What does ECM mean?
What is an ECM motor?
How does an ECM motor work?

How is this motor different than a regular DC motor?
What is the “Armature” of an ECM motor?

#6 – A 150 KVA 480VAC Permanent Magnet Generator (powered from a diesel engine) has an impedance (Z) of 5 ohms with a normal reactance (X) of 4 ohms.

The generator has a Subtransient reactance (X’’) of 0.5 ohms (occurs for the first 3 cycles when there is a short circuit). What is the short circuit current available from the generator for the short circuit immediately after the short circuit occurs?

The generator has a Transient reactance (X’) of 1.0 ohms (occurs after the short circuit has occurred and is maintained for a long period of time). What is the current from the generator if the short circuit is maintained?