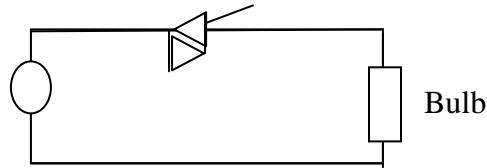


EE432/537 Power Electronics Test

Open Book/Notes. All work must be your own.

So certified _____
Signature

1. Consider the light dimmer circuit below using a Triac. Assume a 100 W Light bulb and a standard 120V outlet
 - a. Show me the output voltage waveform for a firing angle of 45 degrees.
 - b. Draw a graph showing the relationship between firing angle and output power (ignore change in filament resistance with temperature)
 - c. Find a suitable Triac from a manufacturer of your choice
 - d. Show me a schematic for the simplest circuit to control the firing angle
 - e. Calculate the total power loss and specify the thermal resistance of a heat, sink if needed, to restrict device temperature to 60 degrees over ambient

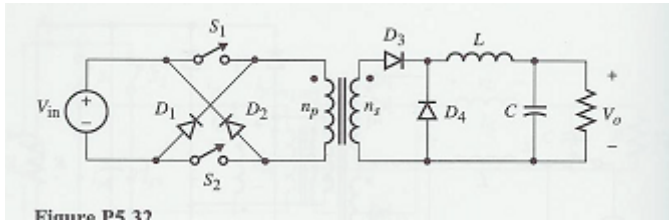


2. Consider a dc motor running off a 48 V battery. During regeneration the Kinetic Energy in the motor is fed back to recharge the battery. Design a buck-boost converter for this purpose. Assume the motor voltage will be between 48 and 10 V while the battery voltage is between 48 and 44 V. The current in the battery needs to be continuous. Assume that battery resistance and inductor resistance amounts to 0.1 ohm each.

Provide

- a. A circuit Schematic
- b. Choice of switching frequency, L and C
- c. Choice of IGBT and Diode from International Rectifier (www.IRF.com)
- d. Worst case losses in the IGBT

3. What in the world is this converter below? Assume S_1 and S_2 are PWM and are switched on and off at the same time. What is the gain? Will it work (why or why not) ?Explain with waveforms



4. Two full bridge, line commutated converters are connected to 230 kV three phase power systems on the ac side and through a dc transmission line on the dc side. Assume the dc side inductances are large and that commutation can be ignored. Dc line resistance is 40 ohms.
- Determine the firing angles required to transmit 70 MW from one power system to the other
 - Show the output voltage waveform and input current waveform (for one of the bridges)
 - For the above condition determine the reactive power drawn by each converter
5. Explain the basic operation of a single phase ac inverter using sinusoidal pulse width modulation. Show the circuit, explain SPWM (with pictures), and tell me what the spectral properties are.

Graduate Students only

It is very common these days to use electronic ballasts on fluorescent lamps. Do a reasonable literature search (~ 2hours) to determine the *state of the art* in this area. Then summarize for me the considerations in electronic ballasts and typical circuits(4-5 pages).

OR

In three phase inverters an alternative to Sinusoidal PWM is the method of Space Vector Modulation. Explain how this method works (4-5 pages)