## WEEK 5: ASSIGNMENT

1. If the half-bridge based voltage source converter is operated using sinusoidal PWM, the carrier frequency is 5kHz, while the fundamental frequency is 50Hz, then which of the following harmonic frequency exists in the output voltage

A. 5100
B. 10150
C. 5050
D. 10100

Answer: A, B

2. For the PFC incorporating following DC-DC converter as shown below, What will be the expression of duty ratio $(d(t))$. Symbols have obvious meanings.

Note: The switches S_1 and S_2 are switched in a complementary manner with S_1 is in conduction during $d(t)T_s$, while S_2 is in conduction for $(1 - d(t))T_s$.
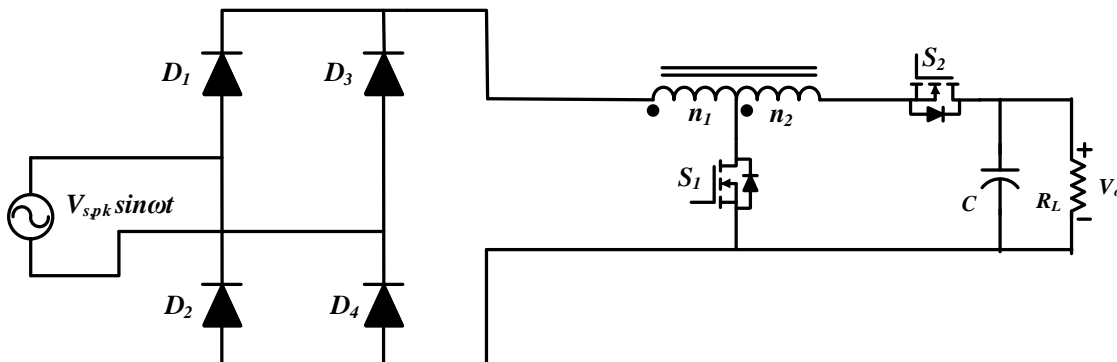
A. $1 - \dfrac{\frac{n_2}{n_1}|v_s(t)|}{V_o}$

B. $\dfrac{V_o - |v_s(t)|}{V_o + \frac{n_2}{n_1}|v_s(t)|}$

C. $\dfrac{V_o + |v_s(t)|}{V_o - \frac{n_2}{n_1}|v_s(t)|}$

D. $\dfrac{1}{1 + \frac{\frac{n_2}{n_1}|v_s(t)|}{V_o}}$

Answer: B

3. A 10kW, 3-phase, AC-DC converter fed from 400V, 50Hz mains. It is operated to generate 750V DC output voltage. If the designer kept the modulation index of 0.875. Then calculate the per phase inductance (in mH) needed to be kept. (Note: The answer should be rounded up to 3 decimal places and use $\pi = 3.14$). Assume converter is loss less.

4. A half-bridge voltage source converter operates under PWM with 100V DC link. The sampled value of modulating signal in one of the carrier cycle has a value equal to 2V and triangular carrier is being used, which varies between 5V to -5V with a frequency of 10kHz. What is the average output voltage (V_{AO}), if the gate pulses are generated by comparing the carrier and modulating signal with a condition that when modulating wave > carrier wave, Top switch (S1) is ON. (Note: The answer should be rounded up to 2 decimal places). Symbol have obvious meaning

5. A 5kW, 3-phase, AC-DC converter fed from 400V, 50Hz mains. It is operated to generate 700V DC output voltage. If the per phase inductance used is 10 mH. Then calculate the modulation index needed to be kept. (Note: The answer should be rounded up to 3 decimal places and use $\pi = 3.14$). Assume converter is loss less.

6. A 10kW, 3-phase, AC-DC converter fed from 415V, 50Hz mains. It is operated to generate 800V DC output voltage with unity power factor operation. Further, the peak of the fundamental component of the output of the half bridges (V_{AO}) has value equal to 360. Calculate the RMS value of current going to the capacitor bank. (Note: The answer should be rounded up to 3 decimal places and use $\pi = 3.14$). Assume converter is lossless, symbols have obvious meaning

7. If a three-phase AC-DC converter operating with unity power factor, then which of the following statement/statement is/are true about the current flowing through the output capacitor voltage

A. It does not have 2nd line harmonic component
B. It has 2nd line harmonic component
C. It does not have switching frequency component
D. It has switching frequency component

8. If a three-phase AC-DC converter operating with unity power factor, then which of the following statement/statement is/are true

A. To obtain the power flow from AC to DC, the phasor obtained from the converter must lead the source voltage phasor

B. To obtain the power flow from AC to DC, the phasor obtained from the converter must lag the source voltage phasor

C. To obtain the power flow from DC to AC, the phasor obtained from the converter must lead the source voltage phasor

D. To obtain the power flow from DC to AC, the phasor obtained from the converter must lag the source voltage phasor
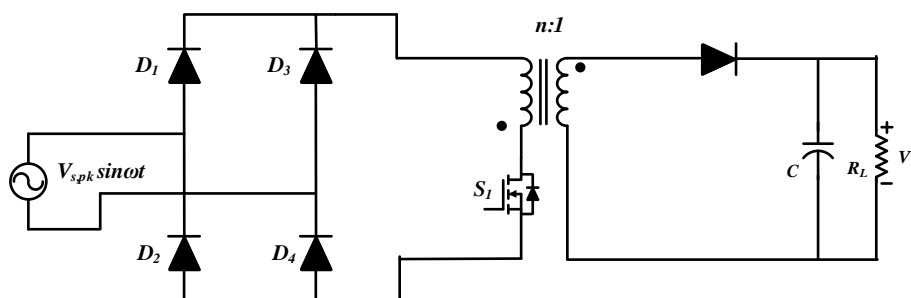
<mark>Answer: B, C</mark>

9. A half-bridge voltage source converter outputs a sine PWM signal with V_{dc} DC link. What will be RMS value of the component of fundamental component in the output phase voltage for modulation index m.

A. mV_{dc}

B. $\dfrac{mV_{dc}}{2}$

C. $\dfrac{mV_{dc}}{\sqrt{2}}$

D. $\dfrac{mV_{dc}}{2\sqrt{2}}$

<mark>Answer: D</mark>

10. For the PFC incorporating Flyback DC-DC converter as shown below is fed from 240V, 50Hz AC voltage. What will be the duty ratio at the positive peak of the input AC voltage, when the output DC link voltage is kept at 400V and $n = 2$.

Assume the switches are ideal and the converter is lossless. The answer should be rounded up to 2 decimal places.

<mark>Answer: 0.64 to 0.67</mark>

Answer Keys:

1. A, B	2. B	3. 4.9 to 5.0	4. 20	5. 0.92 to 0.95
6. 8.5 to 9.0	7. A, D	8. B, C	9. D	10. 0.64 to 0.67