國立台灣科技大學九十七學年度碩士班招生試題

系所組別： 電機工程系碩士班乙組

科　　目： 電力電子學

「總分 100 分」

1. The voltage v across a load and the current i into the positive-polarity terminal are as follows:

$$v(t) = 240\sqrt{2}\cos(\omega t) + 80\sqrt{2}\cos(3\omega t) \text{ V} \quad \text{and}$$

$$i(t) = 60\sqrt{2}\cos(\omega t - 30°) + 20\sqrt{2}\cos(3\omega t + 30°) + 12\sqrt{2}\cos(5\omega t - 60°) + 9\sqrt{2}\cos(7\omega t) \text{ A},$$

where $\omega = 377$ rad/sec. Calculate

(a) the rms value of $v(t)$, (4%)

(b) the total harmonic distortion in the current $i(t)$, (4%)

(c) the average power into the load, (4%)

(d) the load power factor. (4%)

2. In the simplified rectifier of Fig. P2, the balanced three-phase voltage sources are pure sinusoidal with 220 V(rms) line-to-line voltage and frequency at 60Hz. If $I_d = 10$ A, please answer the following questions.

(a) Calculate the average value of the dc-side output voltage v_d. (4%)

(b) Calculate the rms value of the line current i_a. (4%)

(c) Calculate the power factor at which this rectifier is operating. (5%)

(d) What is the maximum instantaneous voltage across each diode? (5%)

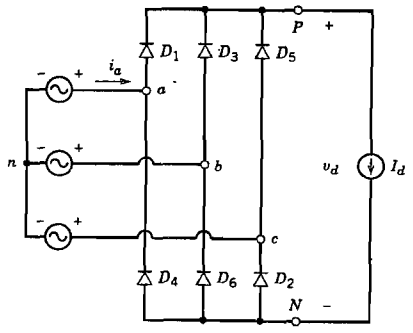

Fig. P2

3. Figure P3 shows a single-phase, phase-controlled rectifier connected to a 60Hz ac source with ac-side inductance L_s. Let $v_s = 110\sqrt{2}\sin\omega t$ V, L_s=1.5 mH, I_d =20 A and the delay angle $\alpha = 30°$.

(a) Calculate the commutation interval u. (4%)

(b) Calculate the average value of the dc-side output voltage v_d. (4%)

(c) Draw v_s, i_s and v_d waveforms. (8%)

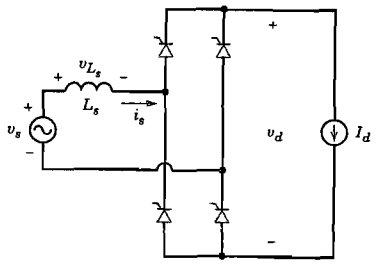

Fig. P3

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4. For the step up converter shown in Fig. P4, the duty ratio is adjusted to regulate the output voltage V_o as 48 V. The input voltage varies in a wide range from 12 V to 36 V. The maximum power output is 240 W. The switching frequency is 100 kHz. Assuming ideal components and C as very large, calculate the maximum value of L that can be used to keep the converter always operating in a discontinuous conduction mode (20 %)

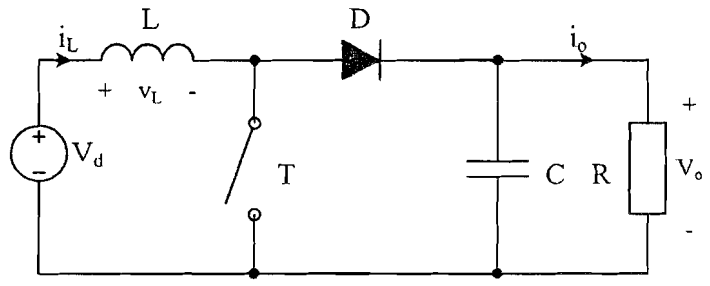

Fig. P4

5. For the CUK converter shown in Fig. P5. Assuming C_1 to be sufficiently large and the converter operates in a continuous conduction mode.
   (a) Draw the waveforms of v_{L1} and v_{L2}. (10 %)
   (b) Derive the voltage gain $\frac{V_o}{V_d}$ of this converter. (10 %)

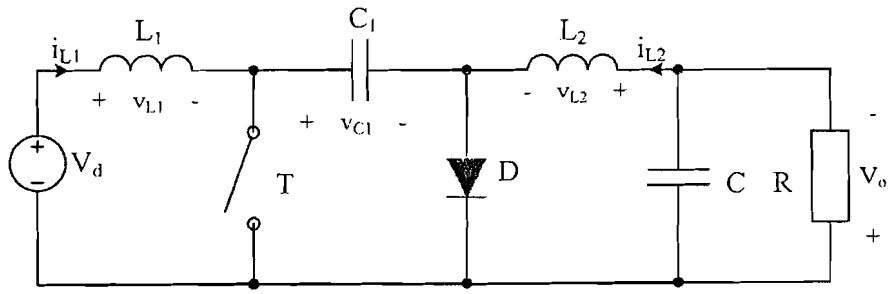

Fig. P5

6. Briefly explain the following terms.
   (a) Sinusoidal pulse-width modulation (5 %)
   (b) Blanking time (5 %)