國立臺北科技大學

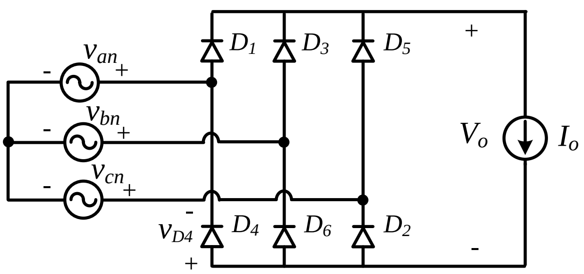
103 學年第一學期電機系博士班資格考試

電力電子學試題

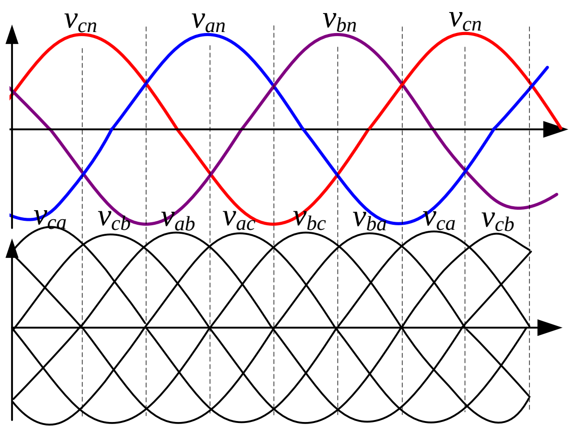
注意事項：

1. 本試題共六題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在試卷答案欄內，否則不予計分。
4. 考試時間:二小時。
5. 可使用計算器。

1. *(15%)* Figure 1(a) shows an ideal three-phase AC-DC rectifier, load current I_o is constant. Sketch voltage of the diode *D4* (at least one period), give your reasoning for the result. The three-phase voltage and line voltages are shown in Fig. 1(b) for your reference.



(a)



(b)

Fig. 1

2. *(15%)* Figure 2 shows the voltage and current waveform of a power supply, find its power factor?

(Hint: Fourier series expression of $i(t) = \frac{4I}{\pi}\sin(\omega t) + \frac{4I}{3\pi}\sin(3\omega t) + \frac{4I}{5\pi}\sin(5\omega t) + \ldots$)

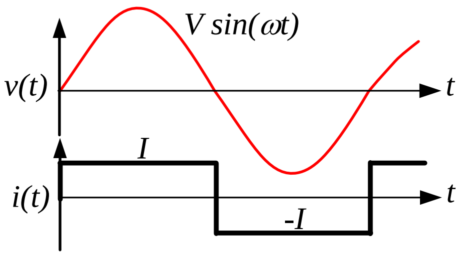


Fig. 2

3. *(15%)* Figure 3 shows a buck converter, V_s is input, V_o is output, T is the switching period, D is the duty, C is very large so V_o can be assumed to be a constant. All the components are ideal. If the circuit is running at steady state and at the boundary between continuous and discontinuous conduction mode, find I_o and express it in terms of V_s, L, D, and T ?

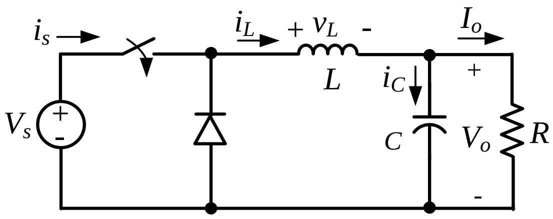


Fig. 3

4. (*15%*) Figure 4 shows a three-phase DC-AC Inverter, input power source is V_i, n is the neutral point. If switches S1, S2, and S6 are closed (turn on), what is the motor phase voltage V_{An}, V_{Bn}, V_{Cn} = ?

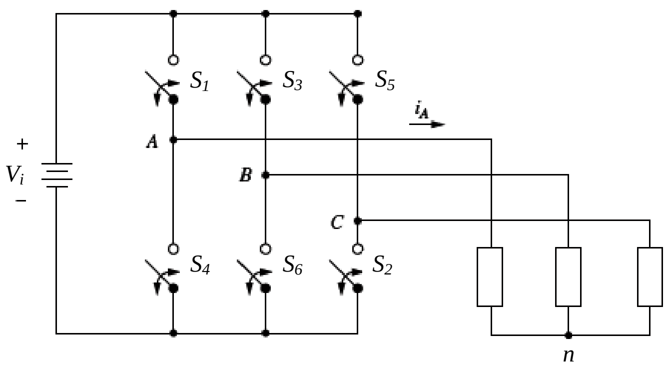
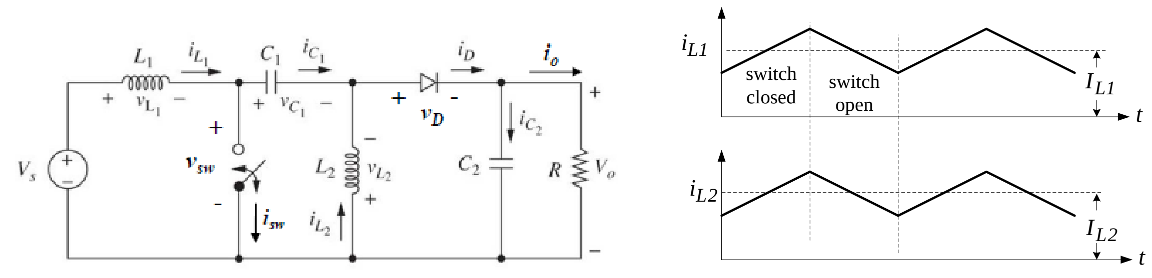


Fig. 4

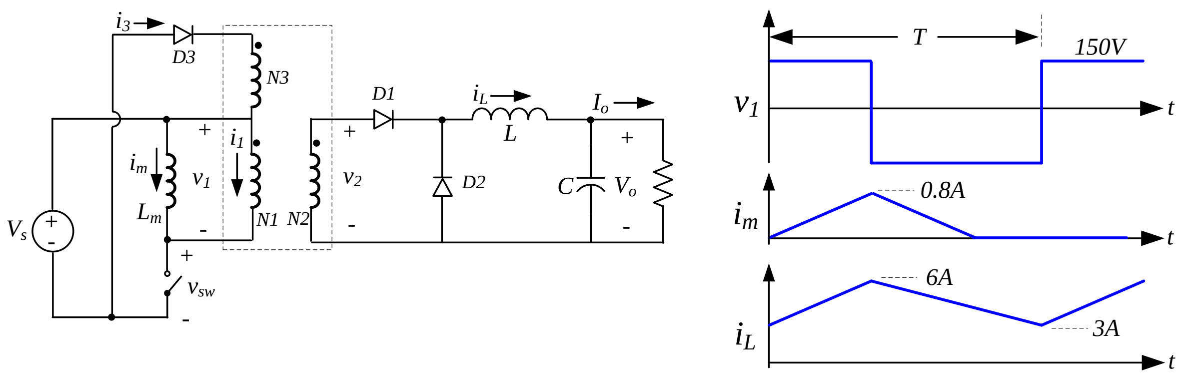
5. *(20%)* Figure 5(a) shows a SEPIC Converter. All the components are ideal, and the circuit is running at steady state and continuous conduction mode. *C1* is very large so v_{C1} can be assumed to be a constant. Derive V_o/V_s = ? If the i_{L1} and i_{L2} wave forms are shown in Fig 5(b), sketch the corresponding i_{C1}, i_{sw} and i_D waveforms?



(a)　　　(b)

Fig. 5

6. *(15%)* Figure 6(a) shows a DC-DC Converter, transformer is already expressed in equivalent circuit, L_m is the excitation inductance, core is completely de-magnetized at the end of each period. V_s=150V, output voltage is V_o, output current is I_o, *T* is the switching period, and *N1*:*N2*=10:1, *N1*:*N3*=1:1. If v_1、i_m and i_L waveforms are shown in Fig. 6(b), find and sketch i_1 and v_{sw} waveforms?



(a)　　　(b)

Fig. 6