國 立 臺 北 科 技 大 學

一百零三學年第一學期電機系博士班資格考試

切換式電源設計 試題

注意事項：

1. 本試題共【4】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。

1. (a) As shown in Fig. 1, please find and prove the relationship between turns N_4 and N_5 if two output inductors L_1 and L_2 are coupled together and operated in the continuous conduction mode (CCM). (10%)

   (b) Based on (a), if $V_{DC}=15\text{V}$, $V_1=5\text{V}$, $V_2=3\text{V}$, $D=0.5$, then $N_1:N_2:N_3=1:a:b$, and find *a* and *b*. (5%)

   (c) Based on (a) and (b), if $N_1:N_R=1:\frac{2}{3}$, then $D_{max}=?$ (5%)

   (d) Based on (a) and (b), if $N_1:N_R=1:\frac{2}{3}$, then how about the voltage stress on the switch S_1? (5%)

   (e) Based on (a), (b) and (c), if $V_{DC}=15\text{V}$, and $f_s=100\text{kHz}$, then how about the resetting time required for the transformer. (5%)

Forward converter

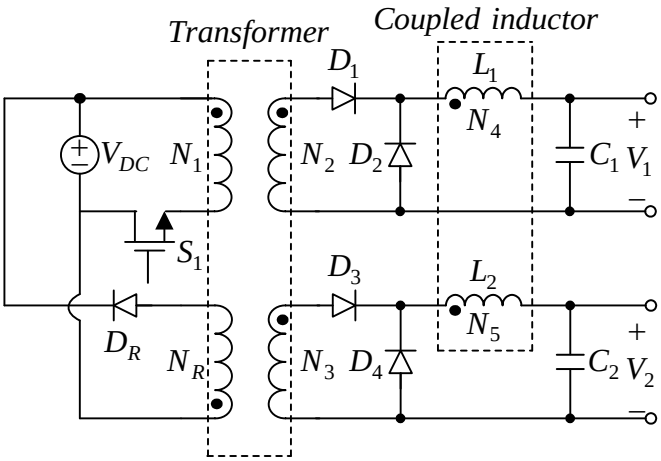
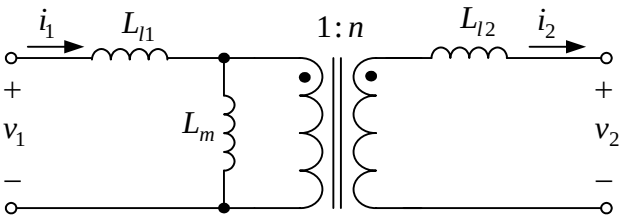


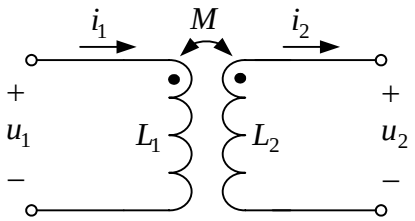
Fig. 1.

2. (a) Please find magnetizing inductance L_m, primary leakage inductance L_{l1}, secondary leakage inductance L_{l2} in terms of primary self-inductance L_1, secondary self-inductance L_2, mutual inductance M and turns ratio n in Fig. 2, where the circuits shown in Fig. 2(a) and Fig. 2(b) are equivalent. (10%)

   (b) How to obtain L_1, L_2 and M by experiments? (10%)



(a)



(b)

Fig. 2.

3. It is assumed that all the components used in the buck-boost converter are ideal. And, the associated specifications are given in the following: (i) the input voltage range is form 8V to 40V; (ii) the output voltage is 15V; (iii) switching frequency is 20kHz; (iv) the value of the output capacitor is $470\mu\text{F}$; and (v) the minimum output power is 2W. Based on the mentioned above, find the minimum value of the inductance so as to make this converter

operated in the continuous conduction mode (CCM) above the minimum output power. (20%)

4. If the AC-DC converter with the power factor equal to one, which is based on the traditional boost converter, then please find and prove the condition that the maximum current ripple occurs. Also, please find the expression of this current ripple. (20%)

5. Please find and prove the relationship between duty cycle, input voltage, output voltage and load current, on condition that the traditional buck-boost converter operates in the discontinuous conduction mode (DCM). (10%)