國 立 臺 北 科 技 大 學

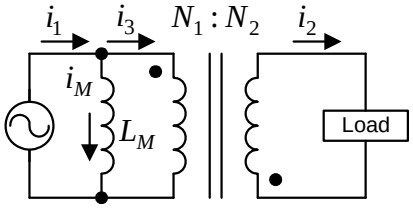
九十八學年第一學期電機系博士班資格考試

電力電子元件試題

注意事項：

1. 本試題共【7】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. As shown in the following figure, if the load is purely resistive, then plot the relationship between i_1, i_3 and i_M based on the phasor diagram, along with a clear explanation. (10%)



2. Prove the power-transferring capability of the transformer in terms of the core area product, the maximum flux density and the switching frequency, under the condition that the input power is equal to the output power. (15%)

3. (a) Please plot the main power stage of the traditional forward converter containing the reset winding. (5%)
   (b) If the reset winding is replaced by one 10V zener and one diode at the primary, then does this converter operate normally? Please explain it as clearly as possible. It is noted that this converter operates in the continuous conduction mode (CCM) with the input voltage of 100V, the output voltage of 5V, the turns ratio of 100:10, and the switching frequency of 100kHz. (5%)
   (c) If the reset winding is replaced by one 10V zener and one diode at the secondary, then

does this converter operate normally? Please explain it as clearly as possible. The required specifications are the same as those in (b). (5%)

4. Find and prove the energy released for one cycle for the flyback converter operating in the boundary conduction mode (BCM), under the condition that the input power is equal to the output power. (15%)

5. If the peak inductor current is 5A, the middle core length is 10cm, the turn number is 10 and the relative permeability is 60, then how about the maximum flux density? (10%)

6. (a) Plot the DC-AC inverter based on the push-pull converter topology, with MOSFETs used as switches. (5%)
   (b) If the load is purely resistive, then how about the magnetizing current flow during the blocking time? Please explain it as clearly as possible. (5%)
   (c) If the load is inductive, then how about the magnetizing current flow during the blocking time? Please explain it as clearly as possible. (5%)

7. (a) For the transformer used in the DC-AC inverter with the duty cycle of 50% to be considered, if the input voltage is 160V, the switching frequency is 40kHz, the core flux-flowing area is $2cm^2$, the primary turn number is 10, then please find the maximum flux density. (5%)
   (b) Based on (a), if the relative permeability is 3000, the middle core length is 10cm, then how about the peak value of the magnetizing current? (5%)
   (c) If an airgap of 0.02cm is inserted, then how about the peak value of the magnetizing current? (5%)
   (d) What may happen in (c)? (5%)