ECE 4200/5200 POWER ELECTRONICS TEST II TIPS

There will be 3 questions and you are to answer all. Please, use green/blue books.

Once more, the emphasis is on waveform sketches.

Areas to be covered:

1. DC-AC Inverters
   (a) Single-phase Half-wave
   (b) Single-phase Full-Wave
   (c) Three-phase Full-Wave

2. Single-Phase and Three-Phase Controlled AC-DC Rectifiers With
   (a) R Load
   (b) R - L Load
   (c) R – L – E Load

3. Single-Phase AC-AC Voltage Controllers
   (a) R Load
   (b) R-L Load

4. Three-Phase AC-AC Voltage Controllers
   (a) R Load
   (b) R - L Load

EXAMPLES

1. A single-phase ac voltage full-wave controller with RL load is connected to a 120-V source at 60 Hz with \( R = 18 \, \Omega \) and \( L = 30 \, \text{mH} \), and \( \alpha = 80^\circ \). The extinction angle \( \beta = 211^\circ \).
   (a) Determine the expression for the output current \( i_L(wt) \).
   (b) Estimate the RMS value of the steady-state output current after a long time.
   (c) Sketch the output load voltage and SCR voltage waveforms. Show also the pattern of SCR conduction on your sketches.
2. A six-pulse controlled bridge rectifier shown in Fig. P2.1 is connected to a three-phase 480-V rms line-to-line 60 Hz AC supply. The load resistance \( R = 50 \, \Omega \) and the load inductance \( L = 50 \text{-mH} \). The delay angle is 75°.
   (a) Find the RMS of output current.  
   (b) Find the RMS SCR current.  
   (c) Sketch the waveforms for output voltage \( v_o(t) \) and line current \( i_c(t) \). Show the maximum and minimum values of \( v_o(t) \) and \( i_c(t) \) on the sketches. Show also the pattern of SCR conduction on your sketches.

3. Consider the single-phase controlled rectifier of Fig. P3.1, assuming negligible ripple in the dc current \( i_o \), \( v_S = 220(\sqrt{2})\sin(\omega t) \), \( R = 20\Omega \), and \( \alpha = 45^\circ \).
   (a) Carefully sketch the steady state waveforms \( v_o, i_{ac}, v_{T1} \), and \( i_{T1} \).
   (b) Determine the average value of the dc current \( I_{dc} \).
   (c) Determine the power factor at the ac source.

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4. Problem #6.1 pp. 356  
6. Problem #6.5 pp. 357  
8. Problem #10.13 pp. 548  
10. Problem #10.27 pp. 550  
12. Problem #11.3 pp. 599  

12. Problem #11.10 pp. 600