EP201 - Advanced Power Electronics

P. Pages : 2

Time : Three Hours

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4777

GUG/W/16/3949

Max. Marks : 70

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Notes : 1. All questions carry equal marks.
2. Answer **any five** questions.
3. Assume suitable data wherever necessary.
4. Use of non programmed calculator, Mollier's chart, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted.

1. a) Justify the following statements : **6**
   i) IGBT combines the advantages of MOSFET and IGBT.
   ii) IGBT is preferred as power switch over power BJT and power MOSFET.

b) A IGBT switching circuit as shown in fig has the following parameters **8**
$t_{on} = 2.5\,\mu s$, $t_{off} = 3.5\,\mu s$, $V_{CE(saturation)} = 2.4V$, $R_L = 10\,\Omega$, $f_s = 1.5\,kHz$, $V_{CC} = 250V$

When duty cycle is 50% determine -
   i) average load current   ii) average conduction loss
   iii) turn-on loss and   iv) turn off loss
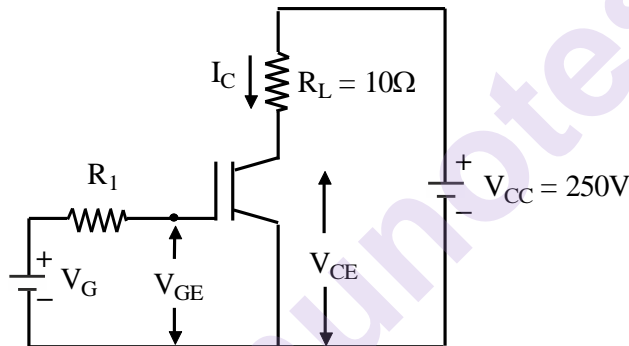
2. a) Why isolation is required in a base drive circuit ? What is the value of duty cycle of transformer isolation base drive circuit ? How can the duty cycle range be improved with transformer isolation between the collector side and the base drive side ? **6**

b) A buck converter has input voltage of 220V and it operates at 500 Hz. The average load current is 50 A. The load resistance is 2Ω. Determine the value of inductance to limit the maximum peak to peak ripple current through inductor to 10%. Find the value of inductance for maximum ripple current. **8**

3. a) Explain in detail continuous conduction operating mode and discontinuous conduction operating mode of BOOST converter. **6**

b) A boost converter has input voltage of 5V and its operates at 20 kHz when the average output voltage $V_o = 10V$, the average load current $I_o = 0.8VA$, $L = 100\,\mu H$ and CI $147\,\mu F$. **8**
   Determine :
   i) duty cycle
   ii) ripple current
   iii) the maximum current flows through inductor I_{max}.
   iv) ripple voltage across capacitor.

4. a) Explain Buck-boost, DC-DC converter using modes of operation & wave form. How the voltage output will be controllable. **7**

b) A buck boost converter has input voltage of 15V. The duty cycle is 0.3 and it operates at 30 kHz. When $L = 30\,\mu H$, $C = 220\,\mu F$ and average load current is 1.5 A. determine **7**
   i) average output voltage
   ii) peak to peak output voltage ripple
   iii) peak to peak ripple current through inductor.

5. a) What are different methods of modulations (PWM) used in inverter. Explain any one in detail. **6**

b) A single phase transistorized half bridge bipolar PWM inverter is operated from a center tap 96V dc input voltage. The fundamental output frequency is 50 Hz and the carrier frequency is 1 kHz and modulation index is 0.75. Determine : **8**
   i) carrier ratio mf
   ii) number of pulses per cycle
   iii) fundamental output voltage
   iv) distortion factor of output voltage waveform.

6. a) Explain with waveforms and circuit diagram "series resonant converter using unidirectional switches". **6**

b) A series resonant RLC inverter using thyristor has the following parameters. $R = 100\,\Omega$, $L_r = 6.0\,mH$, $C_r = 1.2\,\mu F$ and $t_{off} = 0.20\,ms$. **8**
   i) Find the value of output frequency.
   ii) If the load resistance varies from $40\,\Omega$ to $140\,\Omega$. Determine the range of output frequency for non overlap operation of the series resonant inverter.

7. a) Explain 3 phase DC link inverter to obtain variable voltage & frequency output for driving 3 ph load with 180° mode operation. **7**

b) Explain in detail modelling of converters using state averaging techniques. **7**

8. Write short notes on **any three.** **14**

a) UPS

b) Quasi resonant inverters.

c) Isolated converters.

d) DC link inverter.

e) Ferrite core transformer.

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