M.E. First Semester (Electrical (Electronics & Power) Engg.) (New-CGS)

13314 : Power Electronics Converters : 1 EEPME 2

P. Pages : 4 | AU - 3409

Time : Three Hours | Max. Marks : 80

* 0 3 5 2 *

Notes : 1. Due credit will be given to neatness and adequate dimensions.
2. Assume suitable data wherever necessary.
3. Illustrate your answer necessary with the help of neat sketches.
4. Use of pen Blue/Black ink/refill only for writing the answer book.

SECTION - A

1. a) Explain the on state losses in power BJT with suitable response characteristics. 7

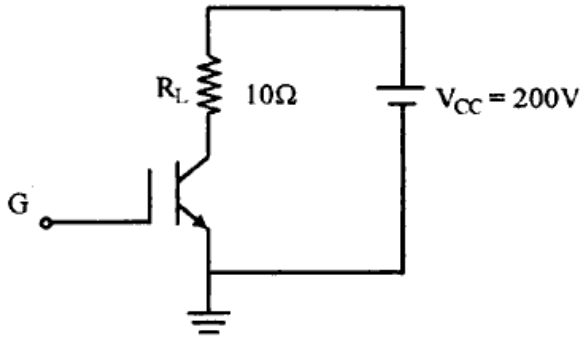
b) For IGBT circuit shown in figure has the following data: 7
$T_{ON} = 3\mu s$, $t_{OFF} = 1.2\mu s$, $V_{CE\,sat} = 2V$, D (duty cycle) = 0.7,
f_s (switching frequency) = 1kHz. Determine:

i) Average load current

ii) Conduction power loss

iii) Switching loss during turn ON

iv) Switching loss during its turn off.



OR

2. a) With the help of switching model and switching characteristics of power MOSFET, explain in detail. 7

b) Derive expression for turn off gain of GTO. Also discuss on the magnitude of negative gate current for reliable turn off of a GTO. 7

3. Design switch mode power supply with the following specifications: 13
$\epsilon_0 = 12V$, $I_0 = 12A$, $f_s = 60kHz$. AC rectified main with LC filter with 230V, 50Hz. A forward converter operating in continuous conduction mode with demagnetising winding is choosen. Assume all components to be ideal except for the presence of transformer magnetization inductance.

Determine:

i) Turn ratio of demagnetizing winding with primary winding at maximum duty cycle of 0.6.

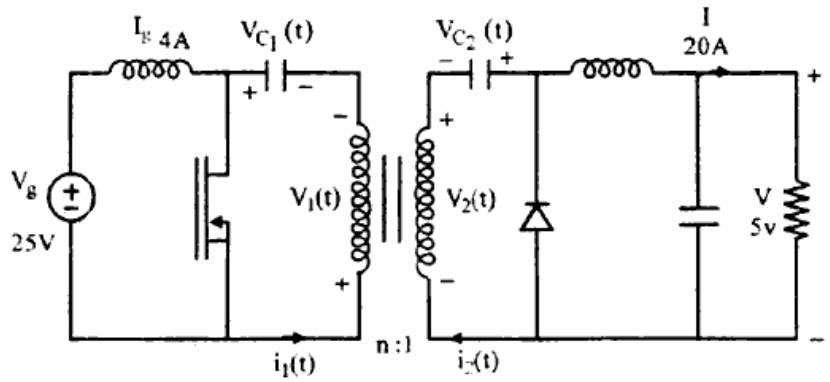
ii) Voltage rating of switch allowing for 50% voltage of input voltage as spike.

iii) DC supply current at full load for input reduced by 20%

OR

4. Explain the operation of full bridge converters with their different operating modes. State its advantages and disadvantages. Also derive the expression for output voltage. **13**

5. **13**



Design two winding transformers for CUK converter shown in figure above. These transformers are to be optimized at the operating point shown, corresponding to D=0.5. The steady state converter solution is $V_c = V_g$, $V_{c_2} = V$. Desired Transformer ratio is $n = n_1/n_2 = 5$. The switching frequency is f_s=200kHz corresponding to $T_s = 5\mu s$. Ferrite pot core consisting of magnatics, P-Material is to be used at 200kHz. This material is described by following parameters. $\beta = 2.6$, $k_{fe} = 24.7\ W/T\beta\ cm^3$. A fill factor of k_u=0.5 is assumed. The power loss of plot = 0.25W. Copper wire, having a resistivity of $\rho = 1.724.10^{-6}\ \Omega - cm$ is to be used.

OR

6. An inductance of 750μH is needed for a power electronic converter operating at 100kHz. A sinusoidal current of 5A RMS maximum flows through the inductor. The only core available is a double E-core having a dimension a = 1.5cm and made from 3F3 ferrite material. The maximum surface temperature $T_s \le 125\,°C$ and the ambient $T_a \le 35°C$. A core database is shown below. Litz wire is used for winding **13**

A (cm)	$A_w\ (cm^2)$	A core (cm^2)	$V_w\ (cm^3)$	$V_{core}\ (cm^3)$	R_{Qsa} (°C/w)
1.5	3.15	3.38	34.1	45.6	3.4

i) Determine the maximum inductance L_{max} that can be wound on the core.

ii) Determine required air gap length Σg that will result in the maximum core flux density when the current in the inductor is maximum (5 arms). Assume 4 distributed gaps.

SECTION - B

7. a) Explain the effect of harmonics present in inverter system. Enlist various method in inverter for reduction of harmonics. Explain any one of them in detail. **8**

   b) Explain the pulse width modulation techniques for control of AC output voltage. **6**

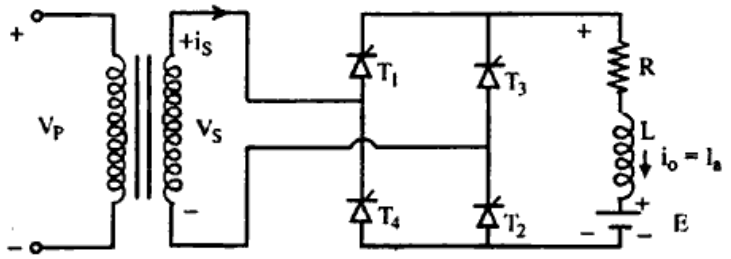
OR

8. a) Explain the three phase 120° mode VSI. Also determine for 120° mode: (i) rms value of load current : (ii) rms value of thyristor current: (iii) load power if the three phase bridge inverter delivers power to a resistive load from a 450V dc source. Load is of 10Ω per phase and star connected. **9**

   b) What is significance of over modulation. **5**

9. a) With the help of general block diagram of thyristor gate drive circuit, explain operation of each component in detail. **6**

   b) The holding current of thyristors in the single phase full converter of following fig is $I_H = 500mA$ and delay time is $t_d = 1.5\mu S$. The converter is supplied from a 120V-60Hz supply and a load of L=10mH and $R = 10\Omega$. The converter is operated with a delay angle of $\alpha = 30°$. Determine the minimum value of gate pulse width I_G. **7**

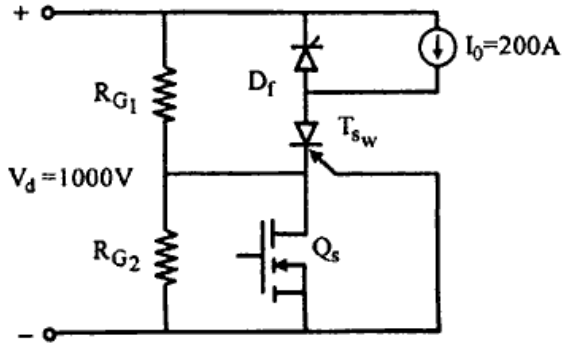


OR

10. The step down converter of figure shown below employs an FCT with a blocking gain μ of 40. The load current $I_0 = 200A$ and the dc input voltage $V_d = 1000V$. **13**

   a) What should be values of R_{G_1} and R_{G_2} in order to ensure proper operation of FCT? Assume R_{G_1} and $R_{G_2} = 1M\Omega$ and include 25% factor of safety in the blocking voltage capability of the circuit.

   b) Describe the characteristic the MOSFET in this circuit should have, including breakdown voltage and max. average current capability.



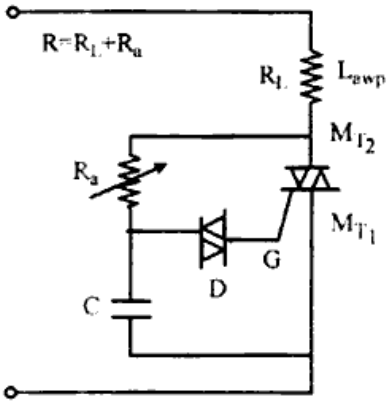
11. a) Explain working operation of three phase to single phase cycloconverter with neat circuit diagram and waveforms. Give comparison between non-circulating and circulating current operation of cycloconverter. **7**

b) Why is the power factor of semi converter better than that of full converter. **6**

OR

12. a) Explain with circuit diagram and waveforms the two types of control used for power transfer. Derive the average value of output voltage. **7**

b) The triac light dimmer circuit of fig shown is used to adjust the intensity of a 120V, 100W incandescent filament lamp working from 120V, 60Hz mains $C = 0.33\mu f$ and $R = 3.33k\Omega$ (5 $k\Omega$ potentiometer is set at $3.33k\Omega$). The breakover voltage of the diac is 40V. Determine the firing delay angle α under these conditions. **6**



Triac Light Dimmer Circuit

****