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15EC73

Seventh Semester B.E. Degree Examination, Dec.2018/Jan.2019
Power Electronics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Mention and explain the different types of power electronic converter systems. Draw their output/input characteristics. **(08 Marks)**

b. With neat waveforms and switching model, explain the switching characteristics of power MOSFET. **(08 Marks)**

OR

2 a. The bi-polar transistor in below figure – 2(a) is specified to have β_F in the range of 8 to 40. The load resistance is $R_c = 11\Omega$. The dc supply voltage is $V_{cc} = 200V$ and the input voltage to the base circuit is $V_B = 10V$. If $V_{CE(sat)} = 1V$ and $V_{BE(sat)} = 1.5$ V, find

i) The value of R_B that results in saturation with an ODF of 5

ii) β_{forced} iii) Power loss P_T in transistor.

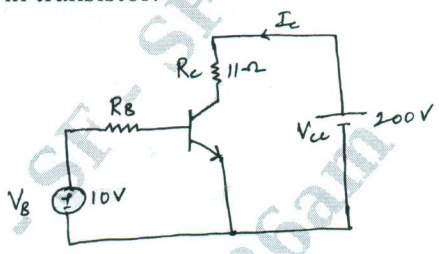

Fig Q2(a) **(08 Marks)**

b. Explain di/dt and dv/dt limitation in power converters.

A BJT is operated as a chopper switch at a frequency of $f_s = 10$ KHz. The dc voltage of the chopper is $V_s = 220$ V and the load current is $I_L = 100A$. The switching times are $t_d = 0$, $t_r = 3\mu s$ and $t_f = 1.2\ \mu s$.

Determine: i) The values of L_s, C_s and R_s for critically damped conditions.

ii) Rs, if the discharge time is limited to $1/3^{rd}$ of the switching period.

iii) Rs, if the peak discharge current is limited to 10% of the load current

iv) Power loss due to R-C snubber P_s neglecting the effect of inductor L_s on the voltage of snubber capacitor C_s. Also assume that $V_{CE(sat)} = \phi$ V **(08 Marks)**

Module-2

3 a. In detail explain the two transistor model of a thyristor. **(08 Marks)**

b. Mention and explain different thyristor turn-on methods. Mention the advantages of gate triggering. **(08 Marks)**

OR

4 a. Explain dynamic turn – off characteristics of SCR.

For R – triggering circuit, the gate voltage required to trigger the SCR is $V_{GT} = 0.6V$ and corresponding $I_{GT} = 250\mu A$. The silicon diode is used and input voltage is V = 100 sin wt. Find firing angle α if $R_1 = 10k\Omega$ and $R_2 = 220k\Omega$. **(08 Marks)**

b. Explain uJT relaxation oscillator and design uJT firing circuit using an uJT having the parameters $\eta = 0.72$, $I_P = 60\mu A$, valley voltage $V_V = 2.5$ V, $I_V = 4mA$, $V_{BB} = 15V$ and $R_{BB} = 5k\Omega$. The leakage current with emitter open is 3mA. The triggering frequency is 1kHz and $V_{g(min)} = 0.3V$. Also calculate the minimum and maximum values of triggering frequency. Assume $C = 0.05\mu F$. **(08 Marks)**

Module-3

5 a. With the help of neat circuit diagram describe the operation of a single phase full converter with R.L load. Draw the associated waveforms. Derive expressions for rms and average output voltages. **(08 Marks)**

b. A single phase half wave converter is operated from 120V, 60Hz supply. If the load is resistive with R = 10Ω, and the delay angle is α = 60°, calculate efficiency, FF, TUF. Also derive the equations for rms and average output voltages. **(08 Marks)**

OR

6 a. With neat circuit diagram and waveforms, explain the principle of phase angle control in AC voltage controller. Derive the equations for rms and average output voltages. **(08 Marks)**

b. A single phase half wave ac voltage controller has an input voltage of 150V and a load resistance of 8Ω. The firing angle of thyristor is 60° in each positive half cycle. Find :

i) Average output voltage ii) RMS output voltage iii) Power output

iv) Power factor (pf) v) Average input current over one cycle. **(08 Marks)**

Module-4

7 a. Classify the choppers and explain the different types and chopper circuits. **(08 Marks)**

b. Obtain an expression for the output voltage for a step-up chopper. A dc chopper has an input voltage of 200V and a load of 8Ω resistance. The voltage drop across thyristor is 2V and the chopper frequency is 800Hz. The duty cycle α = 0.4. Find

i) Average output voltage ii) rms output voltage iii) Chopper efficiency. **(08 Marks)**

OR

8 a. In detail explain buck regulator. **(08 Marks)**

b. The buck regulator shown in figure Q8 (b) has an input voltage of V_s = 12V. The required average output voltage is V_a = 5V at R = 500Ω and peak – to – peak output ripple voltage is 20mV. The switching frequency is 25kHZ. The peak – to – peak ripple current of inductor is limited to 0.8A, determine :

i) The duty cycle, K ii) The filter inductance, L iii) The filter capacitor, C

iv) The critical values of L and C.

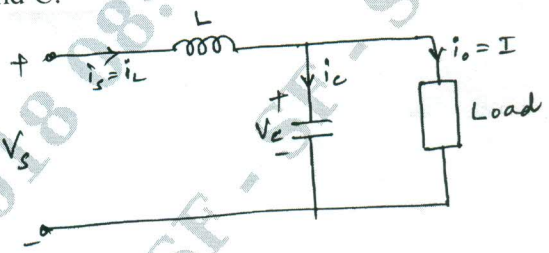

Fig Q8(b) **(08 Marks)**

Module-5

9 a. What do you mean by inverters? Explain the operation of single phase full bride inverter. Draw the load current waveforms for R, RL and RLC loads. **(08 Marks)**

b. Mention the applications of current source inverters. Explain any one type of single phase current source inverter. **(08 Marks)**

OR

10 a. Explain solid state relays. **(08 Marks)**

b. Explain microelectronic relays. **(08 Marks)**

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