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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 $V_{BE(sat)} = 1.5V$, 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.

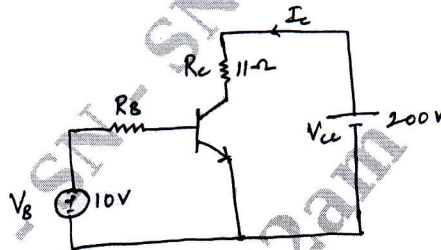


Fig Q2(a)

(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 $f_s = 10\text{ KHz}$. The dc voltage of the chopper is $V_s = 220\text{ V}$ and the load current is $I_L = 100\text{ A}$. The switching times are $t_d = 0$, $t_r = 3\mu\text{s}$ and $t_f = 1.2\mu\text{s}$.
 Determine:
 - i) The values of L_s , C_s and R_s for critically damped conditions.
 - ii) R_s , if the discharge time is limited to $1/3^{\text{rd}}$ of the switching period.
 - iii) R_s , 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 $V_{CE(sat)} = \phi\text{ V}$ (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 $I_{GT} = 250\mu\text{A}$. The silicon diode is used and input voltage is $V = 100 \sin \omega t$. Find firing angle α if $R_1 = 10\text{ k}\Omega$ and $R_2 = 220\text{ k}\Omega$. (08 Marks)
- b. Explain uJT relaxation oscillator and design uJT firing circuit using an uJT having the parameters $\eta = 0.72$, $I_p = 60\mu\text{A}$, valley voltage $V_V = 2.5\text{ V}$, $I_V = 4\text{ mA}$, $V_{BB} = 15\text{ V}$ and $R_{BB} = 5\text{ k}\Omega$. The leakage current with emitter open is 3 mA . The triggering frequency is 1 kHz and $V_{g(\text{min})} = 0.3\text{ V}$. Also calculate the minimum and maximum values of triggering frequency. Assume $C = 0.05\mu\text{F}$. (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 $R = 10\Omega$, and the delay angle is $\alpha = 60^\circ$, 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 :
- Average output voltage
 - RMS output voltage
 - Power output
 - Power factor (pf)
 - 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 $\alpha = 0.4$. Find
- Average output voltage
 - rms output voltage
 - 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 $R = 500\Omega$ 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 :
- The duty cycle, K
 - The filter inductance, L
 - The filter capacitor, C
 - The critical values of L and C.

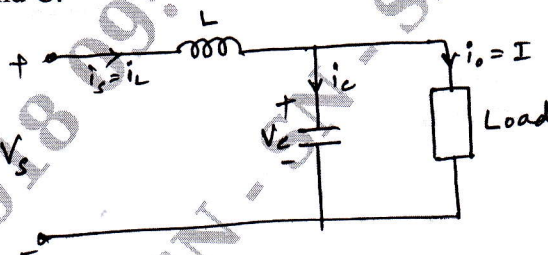


Fig Q8(b)

(08 Marks)

Module-5

- 9 a. What do you mean by inverters? Explain the operation of single phase full bridge 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)
