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10EC73

Seventh Semester B.E. Degree Examination, Feb./Mar. 2022
Power Electronics

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO full questions from each part.***

PART – A

1 a. Draw the control characteristics, circuit diagram and waveform of the following devices and explain it: i) SCR ii) GTO iii) MCT. **(08 Marks)**

b. What are the different types of power electronic converter circuits and explain it. Also indicate the applications in each case. **(08 Marks)**

c. Write a short note on peripheral effects associated with power converter. **(04 Marks)**

2 a. For the transistor circuit shown in Fig.Q.2(a). Find:

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

ii) The β_{forced}

iii) Power loss in the transistor. Given $R_C = 11\Omega$, $V_{CC} = 200V$, $V_B = 10V$, $V_{BE(sat)} = 1.5V$, $V_{CE(sat)} = 1V$ and $\beta_{(mn)} = 8$. **(08 Marks)**

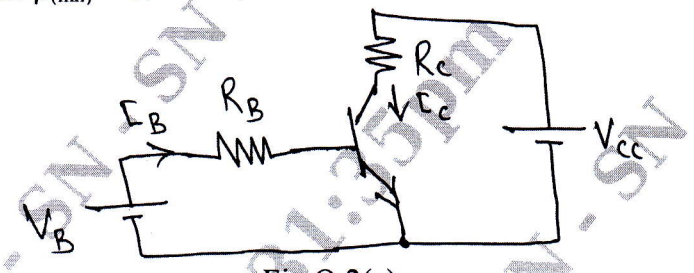

Fig.Q.2(a)

b. With necessary waveforms, explain the switching characteristics of MOSFET. **(06 Marks)**

c. What is base drive control? Discuss the different techniques for optimizing the base drive of a transistor. **(06 Marks)**

3 a. For the circuit shown in Fig.Q.3(a) with $V_S = 200V$, damping ratio is 0.7 and discharging current of the capacitor is 5A, determine:

i) The value of R_S and C_S

ii) The maximum $\frac{dv}{dt}$. **(06 Marks)**

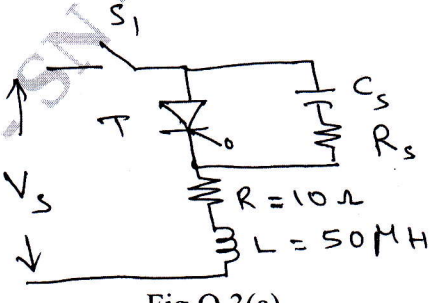

Fig.Q.3(a)

b. Discuss the various methods of turn on the thyristors. **(06 Marks)**

c. With necessary waveforms, explain the working of a UJT triggering circuit. **(08 Marks)**

4 a. With a circuit diagram and waveforms explain the working of a single-phase semi converter with inductive load. **(08 Marks)**

b. A single phase half wave controlled rectifier is used to supply power to 10Ω load from 230V, 50Hz supply at a firing angle of 30° find: i) Average output voltage ii) RMS value of output voltage iii) Average load current. **(06 Marks)**

c. What are the functions of a free wheeling diode in a converter circuit? **(03 Marks)**

d. What are the advantages of circulating current mode of a dual converters? **(03 Marks)**

PART – B

5 a. Derive the expression of

$$t_{off} = \sqrt{L_1 C}\ \tan^{-1}\frac{V_S}{I_O}\sqrt{\frac{C}{L_1}}$$ of a impulse commutation with accelerated recharging. **(08 Marks)**

b. With a circuit diagram and waveforms explain the operation of a complementary commutation. **(08 Marks)**

c. For the circuit shown in Fig.Q.5(c), find the peak value of resonant current and conduction time of a Thyristor. Assume $V_0 = 200V$ **(04 Marks)**

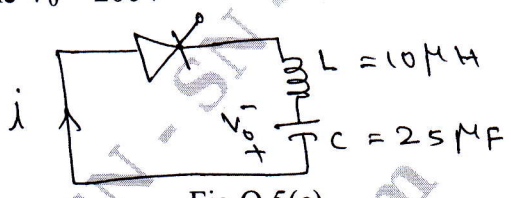

Fig.Q.5(c)

6 a. Explain the operation of a 1-ϕ controllers with inductive loads. **(08 Marks)**

b. A 1-ϕ ac voltage controller shown in Fig.Q.6(b) has a resistive load of 10Ω and the input voltage $V_S = 120V$, 60Hz. The delay angle of thyristor is π/2. Determine:

i) rms value of output voltage
ii) Output power factor
iii) Average output voltage
iv) Average input current.

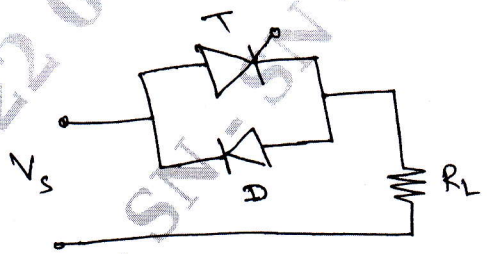

Fig.Q.6(b)

(08 Marks)

c. In an ON-OFF control circuit using 1-ϕ, 230V, 50Hz supply, the ON time is 10 cycles, and OFF time is 4 cycles. Calculate the RMS value of the output voltage. **(04 Marks)**

7 a. A step down chopper is feeding an RL load with $V_S = 220V$, $R = 5Ω$, $L = 7.5mH$, $f = 1kHz$, $K = 0.5$ and $E = OV$. Calculate: i) Minimum instantaneous load current ii) Peak Instantaneous load current iii) Maximum P-P load current iv) Average value of load current. **(08 Marks)**

b. With circuit diagram and waveforms explain the working of step up chopper. **(08 Marks)**

c. Mention the applications of DC choppers. **(04 Marks)**

8 a. What are the applications of current source inverters? **(04 Marks)**

b. With circuit diagram and waveforms, explain the operation of a 1-ϕ full bridge inverter. **(08 Marks)**

c. A 1-ϕ transistorized bridge inverter has a resistive load of R = 3Ω and the dc input voltage of E_{dc} = 48volts. Determine:

i) Transistor rating
ii) Total harmonic distortion
iii) Distortion factor
iv) Harmonic factor and distortion factor at the lowest order harmonic. **(08 Marks)**

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