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)**
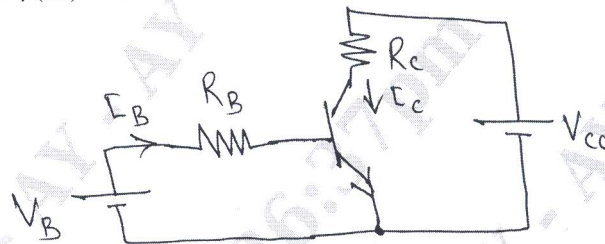

Fig.Q.2(a)

    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 $\dfrac{dv}{dt}$.   **(06 Marks)**
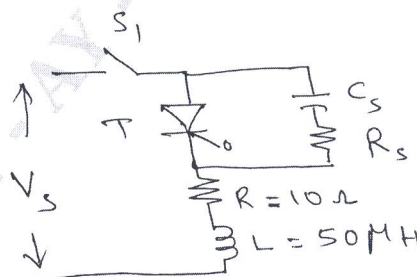

Fig.Q.3(a)

    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)**

1 of 3

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

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

(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)**
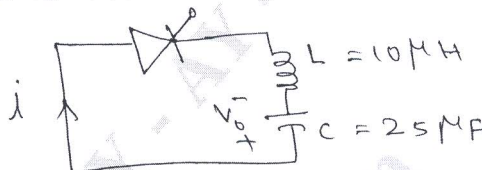

Fig.Q.5(c)

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 $\pi/2$. Determine:
   i)   rms value of output voltage
   ii) Output power factor
   iii) Average output voltage
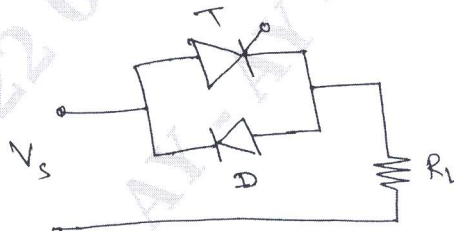   iv) Average input current.

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 $V_S = 220V$, $R = 5\Omega$, $L = 7.5mH$, 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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